DEPARTMENT OF ECONOMICS
OxCarre (Oxford Centre for the Analysis of Resource Rich Economies)

Manor Road Building, Manor Road, Oxford OX1 3UQ
Tel: +44(0)1865 281281 Fax: +44(0)1865 281163
reception@economics.ox.ac.uk www.economics.ox.ac.uk

OxCarre Research Paper 221

Structural Transformation, Extractive Industries and Gender Equality

Anja Benshaul-Tolonen

&

Sarah Baum

***OxCarre External Associate**

Direct tel: +44(0) 1865 614997 E-mail: melis.boya@economics.ox.ac.uk

Structural Transformation, Extractive Industries and Gender Equality

Anja Benshaul-Tolonen* and Sarah Baum

September 30, 2019

Abstract

Does structural transformation matter for gender equality? This paper reviews the gender impacts of the highest value export industry in low and middle income countries—the extractive industries (oil, gas and mining). First, we analyze cross-country relationships between natural resource dependence and gender welfare indicators. Countries that are dependent on natural resource rents have greater gender inequality, lower education levels and more patriarchal norms, even after taking GDP per capita levels into account. Second, we conduct a comprehensive review of the empirical literature on the impact of extractive industries on women and gender relations, covering topics such as labor force participation, marriage markets, health, and security. The review points to extractive industries as a mixed blessing for women, showing heterogeneity across genders, sectors, and contexts. We propose new directions for research to ensure that extractive industries generate inclusive growth.

*Corresponding author. atolonen@barnard.edu, Department of Economics, Barnard College, Columbia University; 3009 Broadway, NY 10027, New York; (212) 854-3454; Fax: (212) 854-8947. We are thankful for comments and support from Rick van der Ploeg, Michael Ross and Rajiv Sethi, and from seminar participants at Natural Resource Governance Institute, including Carlos Monge, Katarina Kuai, Claudia Viale, and Lorena de la Puente. We are thankful for research assistance from Dani Stoilova.

1 Introduction

A central concern in the literature on economic development is the linkage between economic growth and inequality, including gender inequality. Correlational analysis reveals that low and middle income countries are less gender equal on average (Jayachandran, 2015), and this observation raises the question of whether economic development leads to gender equality, or whether gender equality spurs economic development. Causal evidence on the directionality and magnitude of these effects is scant: while the literature on gender inequality in the wake of the randomized control trial revolution has produced important and novel insights, it has failed to address general equilibrium and aggregate effects.

Extractive industries—mining, oil and gas—generate quasi-natural experiments to explore the effects of structural transformation on gender inequality. Two reasons make them relevant for the study of this question. First, natural resource industries are largely determined by random geological endowments (Eggert, 2002) making them arguably exogenous to local labor markets—in contrast to endogenously determined industries, such as manufacturing, that are dependent on local labor conditions. Second, extractive industries provide important opportunities for economic development in low and middle income countries. Among the top 40 countries where minerals constitute the highest-value export sector, 35 percent are low or lower-middle income economies (Dietsche et al., 2013). About 80 percent of countries with economies dependent on natural resources have per capita income below the global average (Cameron and Stanley, 2017). At the same time such countries struggle, on average, more with gender inequality.

The question of the gender effects of extractive industries is timely. The field of economics has placed great interest in the welfare effects of natural resource extraction focusing on topics such as the natural resource curse (e.g. Sachs and Warner, 2001; van der Ploeg, 2011) and a large literature on district and local level effects (summarized in Cust and Poelhekke, 2015). The recent review paper by Cust and Poelhekke (2015) on local economic impacts of natural resource extraction mentioned the keyword "gender" once, and referred only to one study that explores effects on "women"[1]. The majority of research papers, including the natural resource curse literature, have implicitly assumed that the industry is gender neutral, or that the gendered impacts are negligible or of second-order importance. In contrast, this review highlights a large number of papers that analyze gender effects across historic and contemporary contexts, as well as in developing and developed countries. We find strong evidence for gender differential impacts of extractive industries at both the macro and micro level.

The discussion of how extractive industries affect gender equality is of interest to the policy world. While the academic research has generally taken a "gender blind" approach, the policy world has long been interested in the gender differential impacts of these industries. However, the policy documents largely exhibit a tendency toward dystopian predictions for women (African Mining Vision, 2011; Eftimie et al., 2009), such as the exclusion from labor markets, decreased household bargaining power and larger environmental burden. Synthesizing the empirical analysis on the topic could significantly balance the ongoing

[1]In contrast, a qualitative review paper, focused on case studies, identified the differential impacts of extractive industries on women (Gamu, Le Billon, Spiegel, 2015)

policy discussion, and potentially shape future policies on extractive industries across the developing world.

First, we analyze cross-country correlational relationships between natural resource dependence and indicators on gender equality. Countries in which natural resource rents (the sum of rents from oil, natural gas, coal, mineral and forests) constitute a larger share of GDP tend to exhibit higher levels of gender inequality, lower levels of absolute female welfare and more conservative attitudes towards women. For example, populations in such countries are more likely to agree that men make better political leaders.

Next, we explore the empirical literature on the welfare effects of extractive industries. The literature review draws from 30 empirical studies covering a time period of more than 250 years. To aid the reader's understanding of pathways, we outline a conceptual framework in the Appendix. While the results from the review are at times both comparable and contrasting, it stands out that extractive industries are a "mixed blessing" for women. Natural resources can provide many opportunities for women to engage in the labor market, with impacts on female political engagement, marriage markets, health and safety. Again, the directionality of these effects is often dictated by mitigating or reinforcing factors such as culture, level of development and population demographics. We synthesize these outcomes from the literature in Figure 1, and provide a more detailed explanation of each paper in Table A3.

The rest of the paper is structured as follows. Section 2 presents correlational results; Section 3 makes a comprehensive literature review of labor markets, inequality and demographic changes; Section 4 discusses women's and infant health; Section 5 gender-based violence, and Section 6 women's political participation. We synthesize in section 7.

2 Analysis

2.1 Gender Inequality

Countries where natural resource rents (from oil, natural gas, coal, mineral and forest) compose a greater share of GDP[2] have higher levels of gender inequality and lower levels of absolute female welfare (Figure 2, Map B, Table A1). Such dependent countries are concentrated in Africa and the Middle East (Figure 2, Map A).

Sub-Saharan Africa (SSA) accounts for 62 percent of countries most dependent on resource rents; a pattern which tracks higher levels of gender inequality, as measured by UNDP's Gender Inequality Index (GII) (Figure 2, Map B). The correlation is partly driven by level of economic development as such countries experience less economic diversification and smaller economies (see Appendix Table A4, and confirmed in Ross (2019)). Our regressions will control for GDP per capita given the its strong relationship to human capital and gender equality, and continent fixed effects to address geographic clustering of natural resource richness.

Figure 3 A shows that countries with higher GDP per capita (indicated by the size of the observation) have lower resource rents and lower scores on GII. A higher share of resource rents as a share of GDP is associated with lower GDI (Table 1 column 1) and a higher

[2]See Appendix Table A4 for an overview by quintile of dependence.

GII (column 4), and also negatively associated with the human development index for men (column 3). Controlling for GDP in Panel B in Table 1, effects are comparable to those in Panel A. Controlling for region fixed effect in Panel C in both tables, reduces some of this effect.

2.2 Female Empowerment: Economic, political and human rights

SSA and the Middle East and North Africa (MENA) contain countries with high resource dependence, but have vastly different economic and cultural contexts leading to differences in rates of FLFP (female labor force participation) (Figure 3 B). To explore regional differences, we use Wave 6 (2010-2014) of the World Values Survey (WVS) data to explore attitudes towards female political participation[3] to explore the correlation between natural resource rents and gender attitudes, we find that agreement with the statement "On the whole, men make better political leaders than women do" increases with resource rent dependence (Figure 4, C). Agreement is highest in the MENA (77 percent) followed by SSA (62 percent). The Americas have the lowest level of agreement (23 percent).

2.3 Education, health and violence

Next we explore education and health. Natural resource dependence is negatively correlated with secondary education for both men and women. Most of SSA countries have the lowest share of women with post-secondary education (Figure 3 C), the highest maternal mortality ratios (Figure 3 D) and are among those with the lowest GDP per capita.

Natural resource rents (share of GDP) is positively correlated with maternal mortality, and negatively correlated with education for men and women (Table A2), and controlling for GDP per capita (Panel B). The magnitude and significance is lower when controlling for region fixed effects (Panel C), illustrating that regional and cultural factors, including gender norms, may be important determinants.

Next, we pull IPUMS-DHS data, which are nationally representative surveys of women aged 15 to 49, to gather attitudes towards domestic violence. We explore all situations (if wife burns food, if she argues or goes out without telling her husband, if she refuses sex and if she neglects the children) and find that violence is more likely justified in countries with higher levels of resource rents (Table A2 column 4). However, interpretation of the correlation should be cautious given the small sample size of 24 low-and middle-income countries primarily located in SSA.

While the analysis performed here serves as a descriptive overview, it has shed light on a larger question of how natural resource dependence correlates with gender equality and women's human development. The analysis highlights that natural resource dependent countries, in general, struggle with more gender inequality even after taking economic development levels into account.

[3]Also used in Simmons (2018).

2.4 Empirical strategies

Next, we explore the mostly empirical literature of the welfare effects of extractive industries. This review draws from 30 empirical studies, covering a time period from 1850 to today, and with data from all continents (see Table A3). The industries analyzed span oil (5 papers), large-scale (LS) and artisanal-small scale mining (ASM) (20 papers) and natural gas (4 papers). The literature covers four distinct topics: female labor force participation (11 papers), health (13 papers), gender-based violence (5 papers) and female political participation (3 papers). The overview of papers can be seen in Table A3.

11 papers covering over 70 countries employ spatial difference-in-difference. To assess the impact of LS and ASM mining, authors spatially match district, household or individual level data to mine location to determine the effect of opening or closing of mines, or proximity to mines. These studies share a fundamental parametric assumption—that the variable of interest would have followed the same trend in treatment and control areas in absence of changes in mining. In addition, it is assumed that mineral endowments are random geological events, uncorrelated with local conditions. Other studies instrument for production levels with variation in international commodity price shocks.

3 Extractive industries and labor markets

3.1 The macroeconomy

Structural transformation refers to the re-allocation of economic activity across different sectors in the economy. Macroeconomic models often consider extractive-induced structural changes to be gender neutral (or simply lack a discussion on its gender implications), despite well-known gender segregation in labor markets[4]. Where men and women occupy different roles in the economy, structural changes and increased specialization to certain sectors and crowding-out of others are likely to affect men and women differently.

Economies experiencing new wealth created from extractive resource booms often show signs of "Dutch Disease": (i) the real exchange rate appreciates, and (ii) the economy shifts away from the traded towards the non-traded sector. The presence of occupational segregation in the labor market and household production mediates how resource induced-structural transformation and Dutch Disease symptoms affect men and women differently (Frederiksen, 2007).

With the extractive-induced shift of the economy from the traded sector to the non-traded sector, FLFP responds differently than male labor force participation. Frederiksen (2007) models how three economies facing occupational segregation—two where the labor market is completely segmented by sex, and one where labor is mobile—respond to increased demand for non-traded and household goods due to a resource boom. In the segmented labor markets, men ineleastically supply all labor to one sector, whereas women face a trade-off between

[4]Occupational segregation by genders is rooted in three interconnected theories (Anker, 1997). First, systematic gender differences in human capital lead to differential productivity and wage. Second, segmentation of the labor market create barriers to switching between primary and secondary sectors. Lastly, social norms and cultural restrictions provide non-economic explanations for the occupational segregation observed as well as the differential accumulation of human capital seen in the more neo-classical approaches.

allocating labor to the formal sector and the household sector, where only they can work. Her model points to the role of gender norms in determining labor market outcomes in the wake of natural resource shocks.

Ross (2008) theorizes that oil production reduces women's participation in the labor market. Ross starts with the assumption of gender segregation in the labor market. Oil production shifts the national economy away from female dominated secondary sector (manufacturing) to the primary sector and the non-tradable sector. First, as the female dominated manufacturing sector declines due to exchange rate appreciation, declining demand for female labor reduces the prevailing female wage. Women's supply of labor thus decreases. Simultaneously women's reservation wage increases as total household income is boosted through higher male wages and government transfers from the rising natural resource rents, reducing female supply of labor. As a consequence, the supply and demand of female labor is reduced.

Simmons (2018) confirms some of Ross' findings using data from World Value Surveys and oil wealth. He finds that both gender norms and oil wealth matter for FLFP, where egalitarian norms have a decreasing marginal effect on FLFP when oil wealth increases due to Dutch Disease effects.

3.2 Local labor markets

How restructuring of the labor market affects women and men is also analyzed at the local level. Kotsadam and Tolonen (2016) use household data on more than half a million women surveyed over three decades to understand how women's participation in local labor markets respond to the opening and closing of 874 large-scale mines in SSA. The analysis relies on differences in means: comparing women that live near mines (within 20 km), with those that live further away (20-200 km), before and after the change in mining operations. Large-scale mining causes women to switch from the agriculture to the service sector, or out of the labor force, creating a "mixed blessing". First, the drop in agricultural activity among women is larger than the increase in employment in other sectors. Second, the stimulated sectors that generate welfare benefits to women, such as increased cash and work opportunities less bound by agricultural seasons, suffer once the mines close down production (Kotsadam and Tolonen, 2016).

Aragón, Rud and Toews (2018) reinforce this second point, finding that shifts of female labor into other sectors may be unsustainable in the face of mine closures. A difference-in-difference strategy compares employment in districts close to coal mines (within 30 miles) to districts farther away for over 200 coal mines between the years 1981-2011. Coal mine closures increase the number of male manufacturing workers, but significantly decrease the share of women in manufacturing by 3 percentage points between this period. In accordance with the "mixed blessing", Aragón, Rud and Toews (2018) find that these outcomes are not only unsustainable, but persistent, lasting for more than 20 years after most mine closures.

A final paper turns to the oil sector to show how a sector that can absorb female labor can alleviate and even counteract potential negative side-effects of oil booms on FLFP[5]. The

[5]The role of the service sector in increasing women's work hours and decreasing the gender wage gap

authors employ a difference-in-difference strategy for 774 counties in the Southern United States between 1900 and 1940, comparing oil rich counties, before and after the discovery of oil, with those without major oil deposits. Oil has a zero-net effect on female labor force participation rates. The negative effect among married women who exit the labor force is partly offset by the increased employment of single women in the service sector by 5.3 percent. The more productive the oil sector, the higher the demand is for female labor in the non-traded sector.

3.3 Inequality at the local and household level

Gender composition of the labor market is likely to shape economic inequality across households and across men and women. Analysis from Ghana illustrates that inequality between migrant households and non-migrant households increase in the wake of industrial gold mining (Benshaul-Tolonen et al, 2019). Evidence from different types of mines in Sub-Saharan Africa show that food insecurity rises among women, but not among men (Wegenast and Beck, 2019). Women and migrant households may be more vulnerable as they more likely lack land property rights, land access, community influence, and in the case of women, access to direct mining employment.

Increases in mining employment have been show to be linked to rising income inequality among women in Australia. Reeson, Measham and Hosking (2012) compare 781 Statistical Local Areas (SLAs) with the highest levels of mining employment, and relate the proportion of the workforce employed in mining with the Gini coefficient for personal income for all employed persons. Income inequality follows an inverted-U curve whereby inequality rises with increases in mining activity before decreasing at medium to high levels of employment. When the data is disaggregated for men, such that the percent of the workforce employed in mining is graphed against the Gini coefficient for all employed men, the curve is consistent with what is observed for the total population. However, when disaggregated for women, a linear trajectory suggests that as employment in mining increases so does income inequality for all employed women.

Increased gender wage differential could reduce the household bargaining power of women (e.g. African Mining Vision (AMV), 2011) due to decreased female labor market participation. However, because of the mixed blessing, this effect is a priori ambiguous. In contrast to the hypothesis by the AMV, Benshaul-Tolonen (2018) finds no decrease in intra-household decision-making power reported by women in response to structural shifts induced by large-scale gold mining. The prediction that women's intra-household bargaining power decreases arises from the assumption that male wages increase more than female wages in the wake of a natural resource boom. Using data on wages from Ghana, Benshaul-Tolonen (2018) finds that female wages increase more in percent than male wages, in response to active mining. However, initial reported wage earnings among women are few, and mean earnings lower.

---

because of women's competitive advantage within the sector, is well established (Ngai and Petrongolo, 2017).

3.4 Demographic changes and marriage markets

Changes in the intra-household decision-making as a result of changes in the gender wage differential can also have implications for migration, marriage and fertility decisions. Mining sites are often associated with skewed sex ratios, because of higher migration rates among men to such areas. Two recent studies on fracking and mining in the United States examine the effect of positive economic shocks.

In assessing fracking booms on migration in the Rust Belt of the United States between 1999-2013, Wilson (2016) finds that fracking drives short-term migration. Both in- and out-migration are driven by men, often unmarried, young and less educated than the general population. A similar study in the United States between 1970-2012 on mineral resource extraction shocks produces comparable findings to Wilson (2016) (Ouedraogo, 2016). As the male population grew faster in resource extraction dependent counties, the female population grew slower, on average during both boom and bust periods. The decline of the female population in all age groups is attributed to increased out-migration in dependent counties where employment in the extractives sector was predominantly male-biased and services and retail trade grew slower.

A study by Kearney and Wilson (2018) finds that rising female earnings in response to fracking booms in the United States between 1997-2012 increase fertility among less-educated unmarried women. Fracking booms of the late 2000s serve as an exogenous shock to the wage of less-educated men and thus, the authors can explore how changing labor markets affect the "marriageability" of men. Fertility, not marriage, responds to the positive income effect: both marital and non-marital births increase (an additional one thousand dollars in production leading to increases of 0.8 and 0.2 births per one thousand women, respectively), without a corresponding increase in the likelihood of marriage.

As non-marital births become more common, women are more likely to respond to increased income with increased fertility, but not necessarily with marriage. This contrasts findings that increased earnings from coal booms in the 1970s and 1980s increased marriage rates and marital birth rates, while decreasing the non-marital birth rate (Black et al., 2013). These findings highlight the importance of social norms and institutions in determining the extent to which gender-biased economic shocks entrench or alleviate side effects of the mixed blessing.

Overall, we have found that extractive industries affect women and men's labor market participation differently, and subsequently inequality, marriage formation and fertility. The labor market effects seem to stem from existing gender segregation in the labor market, and the effects on reservation wages due to increasing household income, and these two channels concurrently change the demand for and supply of female labor.

4 Health

Extractive industries can affect the health of the population through several pathways. The consideration of gender within this literature often differs by the population of study, whether that is limited to persons involved in extractive industries, local population or both. In some cases, health effects are disaggregated across genders but authors do not address the

mechanisms behind the disease differences between men and women (e.g. Hurtig and San Sebastián, 2002; Hendryx and Ahern, 2008). In other cases, such as a study of mortality due to silicosis and lung cancer among South African gold miners, gender is implicit under the assumption that miners are predominantly male (Hnizdo and Sluis-Cremer, 1991).

A study that explicitly explores gender discusses the role of masculinity for male migrant miners in South Africa in the 1990s (Campbell, 1997). The working conditions in the mines were characterized as dangerous and stressful, with quotidian fear of falling rocks and accidents, and long-term risks of contracting tuberculosis. Some miners were thought to suffer from post-traumatic stress disorder, leading them to consciously engage in high-risk behavior, such as unprotected sex and multiple sexual partners in an area with high HIV prevalence (Campbell, 1997).

Women involved in extractives, especially in ASM, are likely to face silicosis, and exposure to heavy metal substances (Hinton et al., 2003). Jenkins (2014) provides an in-depth review of the health impacts of ASM on women, relying mostly on qualitative and non-causal literature. Men and women engaging in ASM activities may face similar occupational risks: the gradient in health outcomes may differ by awareness. In Tanzania, it is estimated that around 30-50 percent of artisanal miners are women. Awareness of the health risks from mercury exposure from the ASM mining process was different by gender, with female miners being significantly less knowledgeable (22.5 percent) than males (36.9 percent) (Charles et al., 2013).

The negative health effects related to pollution or exposure to lead, arsenic or mercury may to some extent be mitigated by the impact of increased government spending, provision of social services or individual consumption of health services at the micro-level. However, it is unknown whether spending on the health care sector increases with revenue from the natural resource sector. Cockx and Francken (2014) identifies a potential resource curse in terms of health care spending. Using a panel data set from 1995-2009, the authors find a robust, significant negative relationship between natural resource dependence and public health spending relative to GDP. Caselli and Michaels (2013) show that even when municipal oil revenues are spent on social services, tangible benefits may not always follow.

4.1 Mining and the local health-wealth tradeoff

The causal impact of extractive industries on human health within extractive communities is not easily identified due to the health-wealth tradeoff. On one hand, extractives industries can stimulate local economic development and increase consumption of health goods and services. On the other hand, it may bring negative environmental externalities. The supply and demand of health services can also change with extractive industries, especially through corporate social responsibility programs, local fiscal spending, and inward migration pressure.

The two contrasting mechanisms of income and pollution are apparent in a study by Romero and Saavedra (2016) in Colombia between where health and wealth effects are experienced separately. Newborns of mothers living within 20km of different types of mines—some of them illegal—are healthier (a reduction of 0.51 percentage points in the probability of a child having a low APGAR score, an early test of the newborn's health). Mothers living downstream from a mine, however, have an increased likelihood of having a child with a low APGAR score (0.45 percentage points).

In the Democratic Republic of the Congo, sanctions on "conflict minerals" increased child mortality in mining villages by over 143 percent as mothers experiencing negative shocks to employment and income were unable to care for infant children (Parker et al., 2016). Similarly in Tanzania, community members living near a large-scale gold mine lamented the negative effect that the nearby mine's partial closure and transition of ownership (from a private multinational company to a state-run enterprise) had on access to employment and health services, as services at the local health clinic became more expensive (Rhee et al., 2018).

Using pooled data extracted from Demographic and Health Surveys spanning 44 developing countries from 1986-2012, Von der Goltz and Barnwal (2018) confirm that asset wealth increases locally with large-scale mining, but that the material gains are traded off with a reduction in community health. The evidence reveals that the real economic benefits generated in mining communities (0.11 standard deviation increase in asset wealth within 5km of mines) go hand in hand with increases in the incidence of anemia, a common symptom of lead pollution, by 3 to 10 points in adult women. Rates of stunting increase among children born within 5 km from mines are associated with lead pollution.

The level of economic development is likely to contribute to the strength of observed health-wealth effects. The margins for health improvement from a positive income shock are much larger in a context with high poverty related mortality (i.e. due to malnutrition, diarrheal disease and malaria which are major threats to infant survival) (Black et al., 2003). Benshaul-Tolonen (2019) explores how large-scale gold mining changes the survival rates of infants using data from 9 countries which grappled with very high infant mortality rates, in some subnational districts as high as 15%. She finds that the strong local economic effects generated by the gold mines decrease infant mortality rates by 50 percent and almost instantly. The external validity of this result is unclear given that the large-scale gold mining boom occurred in countries that experienced some of the highest infant mortality rates globally. Large-scale mining could have negative effects on infant health in areas where the margin of improvement from income is lower.

Thus, the net effect of exposure to pollution and potential increases in local earnings likely depends on initial health burden and income levels. In richer countries, there will likely be small or no deteriorations in poor health among infants. In the poorest countries, income effects likely outweigh the effect of pollution exposure because of high marginal utility of income and high poverty-related disease burden, generating short-term increases in infant health. This is consistent with the preferences of poor households that, when facing a health-wealth trade-off, prefer immediate consumption compared to investing in environmental quality (Greenstone and Jack, 2015).

4.2 Oil and natural gas on reproductive and infant health

While much of this literature focuses on mining, a subset explores the effects of oil pollution and fracking on reproductive and infant health. One study of 625 women living close to oil fields in the Ecuadorian Amazon basin were found to have a 2.34 times higher risk of miscarriage when compared to women living further away due to oil pollutants in river water (San Sebastián et al., 2002).

When comparing siblings born to the same mother, oil spills in Nigeria produce significant

detrimental effects to infant mortality and the health of surviving children. Combining geo-referenced data on the location of Nigerian oil spills with DHS survey data, Bruederle and Hodler (2019) analyze 2,744 mothers living less that 10 km away from the closest oil spill between 2005 and 2014. Neonatal mortality increases with 38.3 deaths per 1000 live births, and suggestive evidence point to persistence of these effects. These estimates are likely to be underestimated given incomplete oil spill records and random displacement of DHS clusters. Interestingly, the authors does not find that oil spills during pregnancy increases neonatal mortality.

Dagnelie et al. (2018) find that in utero exposure to shocks increase fetal mortality. The authors exploit exogenous variation in the potential value of mineral resources to predict the distribution and severity of conflict in the Democratic Republic of the Congo. In response to increasing mineral prices, armed groups refocus effort to rent-seeking activities on mining industries, reducing intensity of violence (Parker and Vadheim, 2017). It increases fetal mortality, reducing the number of male live births, while infant mortality (0-12 months) is higher among females. Relatively weak male fetuses are lost during pregnancy, thereby generating a selected male cohort at birth.

Two papers exploring the effects of fracking in the US state of Pennsylvania find that fracking has a similar effect on APGAR scores and birth weight. Hill (2014) analyzes the introduction of 2,459 shale gas wells on the health of infants born to mothers residing within 2.5 km between 2006-2010 compared to infants born close to future gas wells, but that have yet to have a well drilled. The introduction of drilling reduces birth weights and increases APGAR scores significantly by 1.4 percent and 2.51 percentage points, respectively, among mothers living within 2.5 km of a well. She suggests that the main mechanism is air pollution from localized economic activity. Similarly, Currie, Greenstone and Meckel (2017) analyze over 1.1 million births between 2004-2013 and determine that adverse health effects are localized to 3 km of a well site, with mothers living within 1 km of a well experiencing a 25 percent increase in the probability of a low birth weight (less than 2500 grams).

Overall, we have presented the potential direct (i.e. pollution, toxicity or injury) and indirect (i.e. health consumption, changes in population and social environment) impacts of the way in which extractives such as mining, oil and fracking, and the local health-wealth tradeoff they present, can exacerbate or mitigate health outcomes. We have also explored how extractive industries affect women's reproductive health and infant health through a variety of shocks, including income, environmental and conflict.

4.3 Mining and sexual health

Migration is an important factor to consider, most notably seen in literature analyzing the relationship of large-scale mining and sexual health. Much of the research on extractive industries and sexual health is focused around HIV, the prevalence of which has been found to be higher around large-scale mining sites than elsewhere (e.g. Desmond et al., 2005). Migration, a common characteristic of the mining industry, is generally considered a risk factor for HIV, e.g. due to frequent absence from family, low social support, and difficult working and housing conditions (Weine and Kashuba, 2012).

Corno and de Walque (2012) explore how migration of male mine workers affects HIV prevalence in by comparing Swaziland and Lesotho, countries with limited domestic mining,

to Zimbabwe, a country with a large domestic mining industries. Swaziland and Lesotho supply labor to the South African mines, which are relatively labor intensive, compared with other mining sectors in neighboring African countries. Women in Swaziland and Lesotho who are in partnerships with migrant mine laborers are 8 percentage points more likely to be HIV positive, compared with women whose partners are not mine workers. Male migrant mine workers aged 30-44 are 15 percentage points more likely to be HIV positive, than other men (Corno and de Walque, 2012). This is consistent with the theory that being a male migrant worker, away from home and the family, is a risk factor. For Zimbabwe, the authors cannot confirm that miners and miners' partners are at higher risk than the population at large when the mineworker population is domestic.

One study from a mining community in northwestern Tanzania found that female food and recreational facility workers (FRFW) are at particularly high risk of being HIV positive. HIV prevalence among FRFW was 42 percent, compared with 6 percent among male mine workers, and 16-18 percent among community members (Clift et al., 2003). Although all groups had significantly higher prevalence rates than the national average, FRFW were more likely to exhibit risky behavior (e.g. higher number of sexual partners and were more likely to report having received money or gifts for sex to supplement income compared to other women). Men employed in the mines were likely to have a greater understanding of HIV transmission compared to men in the surrounding community, though were no less likely to report safer sexual behavior.

The role of migration on sexual health behavior is complicated. Research from Zambia finds reduced rates of risky sexual behavior in response to the copper mining boom in the early 2000s were strongest among migrant women and young adults living within 10km of a mining town. A one standard deviation increase in boom-era local copper production, led to a significant 0.5 to 1 percentage point reduction in rates of transactional sex and multiple partnerships (Wilson, 2012).

Negative economic shocks also change sexual risk-taking behavior (e.g. Burke et al. (2015); Robinson and Yeh, 2011; Dinkelman et al. 2007). Hypothetically, extractive industries could mitigate negative economic shocks from natural catastrophes, such as droughts, by providing additional employment opportunities. On the other hand, the extractive sector is itself volatile, and could thus be associated with negative economic shocks.

To sum up, mining areas often fare worse than the general population in terms of HIV prevalence due several risk factors, such as migrant populations, higher purchasing power among males relative to the initial population, occupational risks among the mine workers (Campbell, 1997) and changes in social norms around gender relations (Werthmann, 2009). This effect may be reinforced where economic shocks, as well as occupational uncertainty, change sexual risk taking behavior or where social norms around gender relations change. However, some research points toward the role that income generating activities can play in reducing sexual risk-taking behavior (Wilson, 2012). The challenge for policy will be to help vulnerable groups get access to such opportunities, while also targeting populations that may not be visibly affected—such as remaining spouses of migrant mine workers.

5 Gender-based violence

5.1 In-conflict settings

The distinct feature of gender-based violence in in-conflict settings is the analysis of violence perpetrated by a non-partner and a partner. Rustad et al. (2016) explores whether, and how, ASM impacts sexual violence by way of armed conflict in Eastern DRC. They posit two mechanisms by which sexual violence is impacted: (i) perpetrated by armed actors to drive out settled populations to allow for mining and/or (ii) secondary to a violent and masculine mining culture. In addition, they explore whether proximity to a site controlled by an armed actor influences exposure. They use a cross-sectional data set from DHS on 2,134 women aged 15-49 spatially linked with 1,139 ASM sites in Eastern DRC. Women living close to ASM sites in Eastern DRC have a 5 percentage point higher risk of experiencing sexual violence by a non-partner. Living closer to an ASM site with the presence of an armed actor increases exposure to sexual violence by a non-partner from 5.7 to 16.2 percentage points. Additionally, women have a 7 percentage point higher risk for sexual violence by a partner than women living farther away.

A second paper explores whether sanctions imposed through the Dodd-Frank Act, which discouraged the sourcing of 'conflict minerals' from Eastern DRC, brought about desired decreases in sexual violence. Foltz and Sambo (2018) employ a difference-in-difference technique to compare DHS data on over 1,000 woman in affected versus unaffected mining zones before and after the Dodd-Frank legislation. The results suggest that Dodd-Frank had no significant effect on interpersonal or non-partner sexual violence, and that observed decreases from 2007 to 2013 are likely due to migration, levels of conflict or the role of civil society in improving security.

Especially regarding ASM, few qualitative studies underscore the importance of cautioning policymakers against overly simplistic policy responses to sexual violence–which often fail to account for women's involvement in extractives and their inclusion in decision-making. Women in Burkina Faso view ASM communities as providing economic and social independence (Werthmann, 2009). A study from DRC found that two-thirds of female migrants in ASM communities attributed their migration decision to a lack of money and employment (Maclin, 2017). Bashwira (2014) highlights the dominant perspective of policymakers to encourage women's departure from ASM in countries like the DRC as a means to protect them from sexual violence and other forms of oppression. The literature review reveals that while extractives, in particular ASM, can spur violence against women (Rustad et al. 2016), for some, the sector is also providing an opportunity for economic independence and empowerment (e.g. Werthmann, 2009; Wilson, 2012). Failing to account for the agency of women who voluntarily migrate to these communities, especially with policy that attempts to exclude women from these industries (Werthmann, 2009), can adds to their disempowerment.

5.2 In non-conflict settings

Gender-based violence analyzed in non-conflict settings focuses mostly on determinants of intimate partner violence as it relates to women's empowerment and intra-household

bargaining power. This research focuses on exposure to violence in addition to women's and men's acceptance of intimate partner violence.

The literature is largely inconclusive regarding the determinants of violence. While employment may empower women and thus reduce the risk of exposure, the backlash theory predicts that the exposure risk instead increases with income gains (Cools and Kotsadam, 2015). Exposure to and acceptance of domestic violence may change with extractives by (i) increasing with women's dependency on men through rising male wages or outside female employment. For instance, financial dependency of women is hypothesized to be a reason for the significant rise in domestic and dating violence following a 2007 oil boom in the Bakken Region in the United States (Jayasundara et al., 2016).

Benshaul-Tolonen (2018) finds lower acceptance levels of domestic violence among women in active gold mining communities in SSA. Women are asked to state if they agree with a standardized set of questions, such as if a husband has the right to hit his wife if she goes out without his permission, if she neglects the children or if she refuses sex. The author hypothesizes that these cultural changes are partially due to changes in women's earning potential, as many women shift from agriculture to service sector employment. The change in gender norms also coincides with increased access to media, such as newspapers and radio, which discuss women's issues.

Kotsadam, Østby, and Rustad (2017) assess the opposing effects of mine openings on domestic violence in 15 Sub-Saharan African countries between 1999-2013. Using a difference-in-difference strategy, they compare 147 active and inactive mines with data on abuse for 142,749 women from DHS surveys. In particular, they find that mine openings are associated with increased domestic violence in areas with higher general acceptance of abuse.

Overall, a limited number of studies assessing conflict and crime have applied systematic empirical analyses or have explored violence related to other extractive industries besides mining. One study evaluating the response of crime to mineral booms and busts in the United States finds significant increases in sexual assault cases, but does not mention gender nor women (Couttenier, 2017). Similarly, a study from South Africa finds that commodity price shocks spur changes in crime rates in mining areas, but the study does not explore violence against women specifically (Axbard et al, 2019).

6 Women's political participation

6.1 Economic rights as a precursor to political empowerment

Pre-existing gender norms may interact with natural resource abundance, and determine outcomes such as women's political participation. Ross (2008)— the first study that specifically links the natural resource curse and gender—posits that oil wealth reduces women's labor force participation and, by extension, diminishes their political influence. He contends that the workforce acts as a mechanism through which information is exchanged and that the growing role of women in the economy forces the government to take their interests into account (Ross, 2008). A one standard deviation increase in oil rent corresponds to a 2.15 percent decrease in the fraction of parliamentary seats held by women. The significance

of these reductions remains robust after including controls for Middle Eastern or Muslim countries, which traditionally have lower rates of female political participation and higher concentrations of oil wealth.

The conclusions put forward in Ross (2008) have received critique. The degree to which Ross attributes levels of women's political participation to the economic impacts of oil is said to overlook cultural and political considerations. A recent cross-country analysis by Liou and Musgrave (2016) finds that gendered outcomes in oil-rich autocracies are more politically determined, arguing that oil rents fund policies that restrict women's autonomy as a means to sustain autocratic rule.

A study employing a similar approach used in Ross (2008) addresses some of these concerns. Simmons (2016) analyzes the state-level effects of mining in the United States. Mining production is heterogenous across states, but cultural differences are smaller across states than across countries. The author can thus determine which effect, culture or resource wealth, has a stronger influence on female political participation. Using panel data from 1997-2012 on female labor force participation rates, voter turnout rate and share of seats in the state's legislature occupied by women, Simmons (2016) finds that resource wealth has a significant negative effect on women's political participation, even after controlling for state location. A one percent increase in per capita mining production decreases female labor force participations by 0.007 percentage points, and female voter turnout and the number of female legislators by 0.01 percentage points, each. Taken together, Simmons concludes that mining production and inegalitarian gender attitudes work simultaneously to suppress women's economic and political influence.

6.2 Investment in human capital

The nature of extractives has implications for investment in human capital. Gylfason (2001) argues that extractives are low-skill intensive industries, and thus, there is less investment in education relative to national income and expected years of schooling and secondary school enrollment are negatively related to natural capital. Davis (1995) finds human capital accumulation to be higher in mineral than non-mineral countries.

The increasing opportunity cost of investing in human capital in the presence of employment in extractive industries can be observed at the local level. A study explores how a gold boom affects child labor and school attendance in Colombia (Santos, 2018). The author uses changes in international gold prices after 2002 to indicate the gold boom, and instruments for census level gold production using data on water supply as much of the gold mining in Colombia is placer mining. A municipality with a higher water supply in 2000 has a higher probability of producing gold in 2001-2002. The gold boom decreases unemployment by 3.5 percent in the short term. The substitution effect of an increase in gold prices dominates the income effect: the probability that child work increases by 9.3 percent with families taking their kids out of school. While the study does not note any gender specific effects, changes in human capital formation will impact future labor market opportunities of men and women.

6.3 Female political engagement and public spending

Doepke, Tertilt and Voena (2012) find that when women acquire political rights as voters and policymakers, they are more likely to shift government expenditures towards health and children. Aligned with Doepke, Tertilt and Voena (2012), the gender composition of political bodies is likely to influence the distribution of public goods. Female legislators are likely to invest in infrastructure and social policies linked to their gender compared to male counterparts (Chattopadhyay and Duflo, 2004). While this phenomenon has not been empirically assessed at the local level in relation to extractive industries, the differential allocation of benefits based on women's involvement has been noted in several case studies.

Engaging women in decision-making can have critical implications on short-term gains, and long-term gender inequities. Company-community negotiations with the OkTedi mine in Papua New Guinea (PNG) in 2007 is an often referenced case study for involving women in community decision-making (Menzies and Harley, 2012). Through revised Community Mine Continuation Agreements, women secured a legally enforceable agreement giving them 10 percent of all compensation. However, the implementation is characterized by a lack of clarity surrounding benefit streams, absence of tangible benefits, disparity in women's leadership demanded, and mixed progress on requested development initiatives (such as family bank accounts and scholarship schemes). What the OkTedi case underscores is that women's engagement in decision-making platforms does not necessarily guarantee influence or a more equitable distribution of benefits.

7 Discussion

Natural resource dependent countries struggle with higher levels of gender inequality, a correlation that persists when controlling for the level of economic development. A vast literature points to how extractive industries change economies, from the very local to the macroeconomy. Linking this literature to gender, reveals that extractive industries can change the economic opportunities available to men and women. While some studies point to the new economic opportunities generated for women, especially in the tertiary sector, other studies find lower levels of labor force participation among women due to an income effect and the presence of occupational segregation that hinders female mobility across sectors.

There are several limitations to the literature. First, while there is extensive qualitative literature on artisanal and small-scale mining (ASM), only three papers (e.g. Foltz and Sambo, 2018; Parker, Foltz and Elsea, 2016; Rustad et al., 2016) distinctly conduct quantitative analysis of this sector. The quantitative literature is mostly concentrated on industrial scale production, such as large-scale mining and giant oil fields. This method-sector dichotomy impedes productive conversation across fields.

Second, the quantitative literature rarely identifies the mechanisms that spur the effect identified in the data. A mixed methods approach could help improve our understandings of the mechanisms driving the results in the data. Jenkins (2014) recently called for more research on the perspectives of women in extractive industries.

Third, there is limited research connecting existing literature on the effect of extractives on public spending, and the way public spending impacts women, as well as on women's

political participation, especially at the local level.

Whilst the literature on the gender effects of natural resources suffers from some limitations, it indicates that the effects of extractive industries are by no-means gender neutral but provides many opportunities and challenges to inclusive economic growth. In contrast to claims that the benefits of extractives more heavily accrue to men and costs most often heavily burden women, this review provides evidence that extractives are more of a mixed-blessing for women's welfare. While women do face unique risks, the extent to which these are felt vary with country context, pre-existing gender norms and inequalities, type and scale of industry, and group of women considered.

Where policymakers have failed to embrace the complexity of gender and extractives, overly simplistic responses (such as excluding women from ASM operations altogether to prevent sexual violence) fail to account for women's role in extractives. In doing so, policy interventions underestimate women's role in extractive industries and thus, reinforce gender-segregation and disempowerment of women in these industries. Harnessing the desired effect depends on research that can fully capture the mixed-blessing as a means to inform gender sensitive policy.

8 References

African Mining Vision (2011). Exploiting Natural Resources for Financing Infrastructure Development: Policy Options for Africa. In *African Union Commission. Paper presented at the 2nd Ordinary Session of AU Conference of Ministers Responsible for Mineral Resources Development, Addis Ababa, December.*

Aguilar-Gomez, S., & Benshaul-Tolonen, A. (2018). California Gold Rush and Marriage Markets. *Available at SSRN 3284515*

Anker, R. (1997). Theories of occupational segregation by sex: An overview. *Int'l Lab. Rev., 136*, 315.

Aragón, F. M., Rud, J. P., & Toews, G. (2018). Resource shocks, employment, and gender: evidence from the collapse of the UK coal industry. *Labour Economics 52*,54-67.

Armah, F. A., Boamah, S. A., Quansah, R., Obiri, S., & Luginaah, I. (2016). Working conditions of male and female artisanal and small-scale goldminers in Ghana: examining existing disparities. *The Extractive Industries and Society, 3*(2), 464-474.

Axbard, S., Benshaul-Tolonen, A., & Poulsen, J. (2019). Extractive Industries, Price Shocks and Criminality. *CDEP-CGEG Working Paper 30.*

Bashwira, M. R., Cuvelier, J., Hilhorst, D., & van der Haar, G. (2014). Not only a man's world: Women's involvement in artisanal mining in eastern DRC. *Resources policy, 40*, 109-116.

Benshaul-Tolonen, A. (2018). Endogenous gender norms: Evidence from Africa's gold mining industry. *Columbia University Research Paper Series CDEP-CGEG WP No. 62.*

Benshaul-Tolonen, A., (2019) Local Industrial Shocks and Infant Mortality. *The Economic Journal*.

Benshaul-Tolonen, A., Chuhan-Pole, P., Dabalen, A., Kotsadam, A., & Sanoh, A., (2019). The local socioeconomic effects of gold mining: evidence from Ghana. *Forthcoming Extractive Industries and Society*.

Black, R. E., Morris, S. S., & Bryce, J. (2003). Where and why are 10 million children dying every year?. *The Lancet, 361*(9376), 2226-2234.

Bruederle, A., & Hodler, R. (2019). The effect of oil spills on infant mortality: Evidence from Nigeria. Proceedings of the National Academy of Sciences, 116(12), 5467-5471.

Cameron, P. D., & Stanley, M. C. (2017). *Oil, Gas, and Mining: A Sourcebook for Understanding the Extractive Industries*. World Bank Publications.

Campbell, C. (1997). Migration, masculine identities and AIDS: the psychosocial context of HIV transmission on the South African gold mines. *Social science & medicine, 45*(2), 273-281.

Caselli, F., & Michaels, G. (2013). Do oil windfalls improve living standards– Evidence from Brazil. *American Economic Journal: Applied Economics, 5*(1), 208-238.

Charles, E., Thomas, D. S., Dewey, D., Davey, M., Ngallaba, S. E., & Konje, E. (2013). A cross-sectional survey on knowledge and perceptions of health risks associated with arsenic and mercury contamination from artisanal gold mining in Tanzania. *BMC public health, 13*(1), 74.

Chattopadhyay, R., & Duflo, E. (2004). Women as policy makers: Evidence from a randomized policy experiment in India. *Econometrica, 72*(5), 1409-1443.

Clift, S., Anemona, A., D. Watson-Jones, Z. Kanga, L. Ndeki, J. Changalucha, A. Gavyole, & D. A. Ross. (2003). Variations of HIV and STI prevalences within communities neighbouring new goldmines in Tanzania: importance for intervention design. *Sex Transm Infect, 79*(4), 307-312.

Cockx, L., & Francken, N. (2014). Extending the concept of the resource curse: Natural resources and public spending on health. *Ecological Economics, 108*, 136-149.

Cools, S., & Kotsadam, A. (2015). Resources and domestic violence in Sub-Saharan

Africa. *World Development, 95*, 211-230.

Corno, L., & De Walque, D. (2012). Mines, migration and HIV/AIDS in Southern Africa. *Journal of African Economies, 21*(3), 465-498.

Currie, J., Greenstone, M., & Meckel, K. (2017). Hydraulic fracturing and infant health: New evidence from Pennsylvania. *Science advances, 3*(12), e1603021.

Cust, J., & Poelhekke, S. (2015). The local economic impacts of natural resource extraction. *Annu. Rev. Resour. Econ., 7*(1), 251-268.

Dagnelie, O., De Luca, G., & Maystadt, J. F. (2018). Violence, Selection and Infant Mortality in Congo. *Journal of Health Economics, 59*, 153-177.

Davis, G. A. (1995). Learning to love the Dutch disease: Evidence from the mineral economies. *World development, 23*(10), 1765-1779.

Desmond, N., Allen, C. F., Clift, S., Justine, B., Mzugu, J., Plummer, M. L., Watson-Jones, D., & Ross, D. A. (2005). A typology of groups at risk of HIV/STI in a gold mining town in north-western Tanzania. *Social Science & Medicine, 60*(8), 1739-1749.

Dietsche, E., Dodd, S., Haglund, D., Henstridge, M., Jakobsen, M., Sindou, E., & Slaven, C. (2013). Extractive industries, development and the role of donors. *London: Oxford Policy Management*.

Doepke, M., Tertilt, M., & Voena, A. (2012). The economics and politics of women's rights. *Annu. Rev. Econ., 4*(1), 339-372.

Eftimie, A., Heller, K., & Strongman, J. (2009). Gender dimensions of the extractive industries: mining for equity.*Extractive industries and development series*, (8).

Eggert, R. G. (2002). Mining and Economic Sustainability: National Economies and Local Communities. *A Study Prepared for the Mining, Minerals, and Sustainable Development Project, Colorado School of Mines*.

Foltz, J. & Sambo, A. (2018). Analyzing the Impact of Dodd Frank Mining Legislation on Sexual Violence in Eastern Democratic Republic of Congo.

Frederiksen, E. H. (2007). Labor Mobility, Household Production, and the Dutch Disease. *University of Copenhagen*.

Gamu, J., Le Billon, P., & Spiegel, S. (2015). Extractive industries and poverty: A review of recent findings and linkage mechanisms. *The Extractive Industries and Society, 2*(1), 162-176.

Goldin, C. (1995). The U-shaped female labor force function in economic development and economic history. *Investment in women's human capital*, edited by T. P. Schultz. Chicago: The University of Chicago Press.

Greenstone, M., & Jack, B. K. (2015). Envirodevonomics: A research agenda for an emerging field. *Journal of Economic Literature, 53*(1), 5-42.

Grosjean, P., & Khattar, R. (2017). It's raining men! Hallelujah? The long-run consequences of male-biased sex ratios. *The Review of Economic Studies*.

Gylfason, T. (2001). Natural resources, education, and economic development. *European economic review, 45*(4-6), 847-859.

Hendryx, M., & Ahern, M. M. (2008). Relations between health indicators and residential proximity to coal mining in West Virginia. *American journal of public health, 98*(4), 669-671.

Hill, E. L. (2014). Shale gas development and infant health: evidence from Pennsylvania. *Charles H. Dyson School of Applied Economics and Management, Cornell University, Working Paper*.

Hinton, J. J., Veiga, M. M., & Beinhoff, C. (2003, May). Women, mercury and artisanal gold mining: risk communication and mitigation. In *Journal de Physique IV (Proceedings)* (Vol. 107, pp. 617-620). EDP sciences.

Hnizdo, E., & Sluis-Cremer, G. K. (1991). Silica exposure, silicosis, and lung cancer: a mortality study of South African gold miners. *Occupational and Environmental Medicine, 48*(1), 53-60.

Hurtig, A. K., & San Sebastián, M. (2002). Geographical differences in cancer incidence in the Amazon basin of Ecuador in relation to residence near oil fields. *International Journal of Epidemiology, 31*(5), 1021-1027.

Jacobsen, G. D., & Parker, D. P. (2016). The economic aftermath of resource booms: evidence from boomtowns in the American West. *The Economic Journal, 126*(593), 1092-1128.

Jayachandran, S. (2015). The roots of gender inequality in developing countries. *Annual Review of Economics, 7*(1), 63-88.

Jayasundara, D., Heitkamp, T., Mayzer, R., Legerski, E., & Evanson, T. (2016). Exploratory research on the impact of the growing oil industry in ND and MT on domestic violence, dating violence, sexual assault, and stalking. *Grand Forks, ND: University of North Dakota*.

Jenkins, K. (2014). Women, mining and development: an emerging research agenda.

The Extractive Industries and Society, 1(2), 329-339.

Kearney, M. S., & Wilson, R. (2018). Male Earnings, Marriageable Men, and Nonmarital Fertility: Evidence from the Fracking Boom. *Review of Economics and Statistics*.

Kotsadam, A., Østby, G., & Rustad, S. A. (2017). Structural change and wife abuse: A disaggregated study of mineral mining and domestic violence in sub-Saharan Africa, 1999-2013. *Political Geography, 56*, 53-65.

Kotsadam, A., & Tolonen, A. (2016). African mining, gender, and local employment. *World Development 83*, 325-339.

Liou, Y. M., & Musgrave, P. (2016). Oil, Autocratic Survival, and the Gendered Resource Curse: When Inefficient Policy Is Politically Expedient. *International Studies Quarterly, 60*(3), 440-456.

Maclin, B. J., Kelly, J. T., Perks, R., Vinck, P., & Pham, P. (2017). Moving to the mines: Motivations of men and women for migration to artisanal and small-scale mining sites in Eastern Democratic Republic of the Congo. *Resources Policy, 51*, 115-122.

Maurer, S. E., & Potlogea, A. V. (2017). Male-biased Demand Shocks and Women's Labor Force Participation: Evidence from Large Oil Field Discoveries.

Menzies, N., & Harley, G. (2012). 'We Want What the Ok Tedi Women Have!' Guidance from Papua New Guinea on Women's Engagement in Mining Deals.

Ouedraogo, A. (2016). Local economic impact of boom and bust in mineral resource extraction in the United States: A spatial econometrics analysis. *Resources Policy, 50*, 292-305.

Parker, D. P., Foltz, J. D., & Elsea, D. (2016). Unintended Consequences of Sanctions for Human Rights: Conflict Minerals and Infant Mortality. *The Journal of Law and Economics, 59*(4), 731-774.

Parker, D. P., & Vadheim, B. (2017). Resource Cursed or Policy Cursed? US Regulation of Conflict Minerals and Violence in the Congo. *Journal of the Association of Environmental and Resource Economists, 4*(1), 1-49.

Reeson, A. F., Measham, T. G., & Hosking, K. (2012). Mining activity, income inequality and gender in regional Australia. *Australian Journal of Agricultural and Resource Economics, 56*(2), 302-313.

Rhee, S., Nyanza, E.C., Condon, M., Fisher, J., Maduka, T., & Benshaul-Tolonen, A. (2018). Understanding environmental, health and economic activity interactions following transition of ownership in gold mining areas in Tanzania: A case of private to

public. *Land Use Policy, 79*, 650-658.

Romero, M., & Saavedra, S. (2016). The Effects of Gold Mining on Newborns' Health.

Ross, M. L. (2008). Oil, Islam, and women. *American Political Science Review, 102*(01), 107-123.

Ross, M. L. (2019). What do we know about export diversification in oil-producing countries?. The Extractive Industries and Society.

Rustad, S. A., Østby, G., & Nordas, R. (2016). Artisanal mining, conflict, and sexual violence in Eastern DRC. *The Extractive Industries and Society, 3*(2), 475-484.

Sachs, J. D., & Warner, A. M. (2001). The curse of natural resources. *European economic review, 45*(4), 827-838.

San Sebastián, M. S., Armstrong, B., & Stephens, C. (2002). Outcomes of pregnancy among women living in the proximity of oil fields in the Amazon basin of Ecuador. *International journal of occupational and environmental health, 8*(4), 312-319.

Santos, R. J. (2018). Blessing and curse. The gold boom and local development in Colombia. *World Development, 106*, 337-355.

Simmons, J. W. (2016). Resource Wealth and Women's Economic and Political Power in the US States. *Comparative Political Studies, 49*(1), 115-152.

Simmons, J. W. (2018). Does oil substitute for patriarchy?. Economics & Politics.

Van der Ploeg, F. (2011). Natural resources: Curse or blessing?. *Journal of Economic Literature, 49*(2), 366-420.

Von der Goltz, J., & Barnwal, P. (2018). Mines: The local welfare effects of mineral mining in developing countries. *Journal of Development Economics*.

Wegenast, T., & Beck, J., (2019). Mining, Rural Livelihoods and Food Security: A Disaggregated Analysis of Sub-Saharan Africa. *Unpublished Manuscript*.

Weine, S. M., & Kashuba, A. B. (2012). Labor migration and HIV risk: a systematic review of the literature. *AIDS and Behavior, 16*(6), 1605-1621.

Werthmann, K. (2009). Working in a boom-town: Female perspectives on gold-mining in Burkina Faso. *Resources policy, 34*(1), 18-23.

Wilson, N. (2012). Economic booms and risky sexual behavior: evidence from Zambian copper mining cities. *Journal of Health Economics, 31*(6), 797-812.

Wilson, R. (2016). Moving to Economic Opportunity: The Migration Response to the Fracking Boom.

9 Tables and Figures

Figure 1: Drivers and impacts of extractives on women

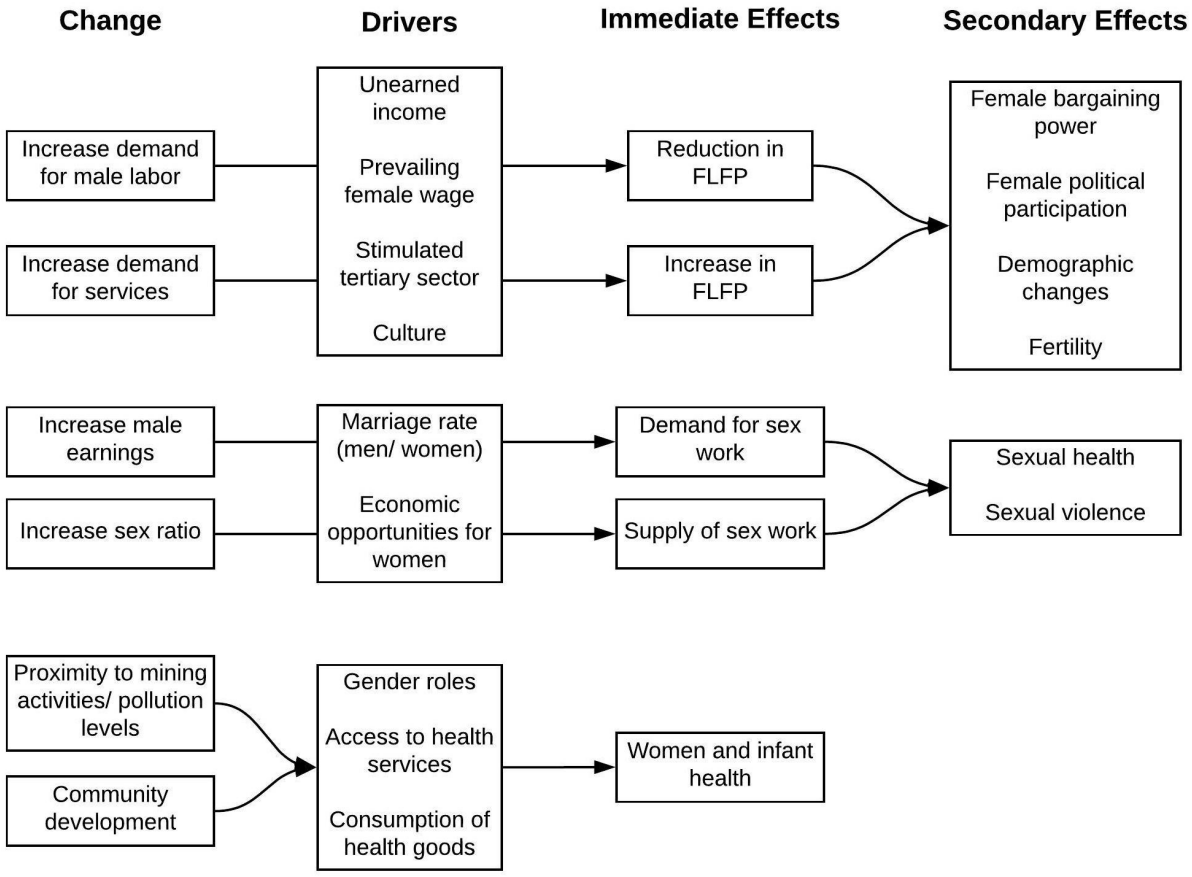
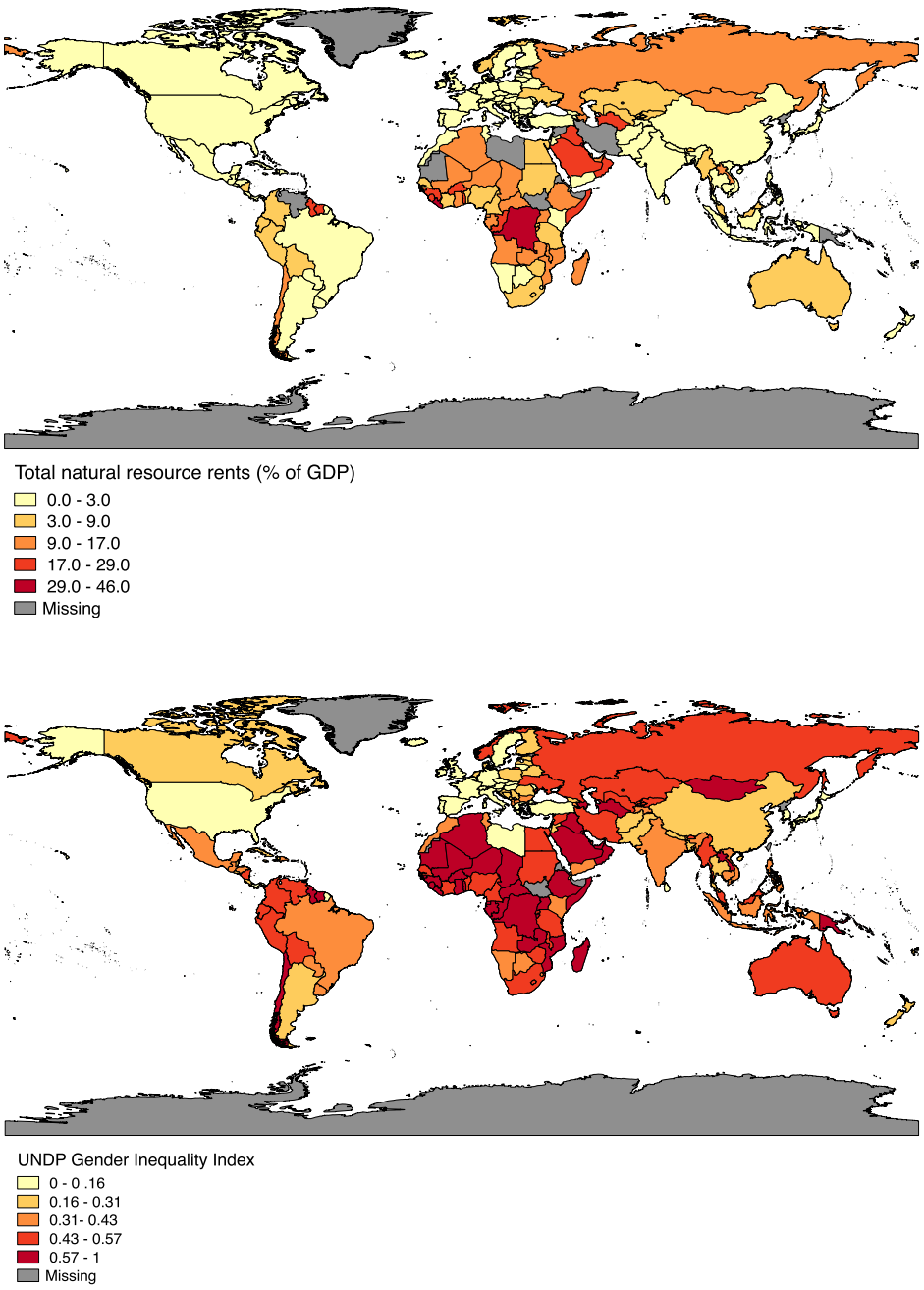
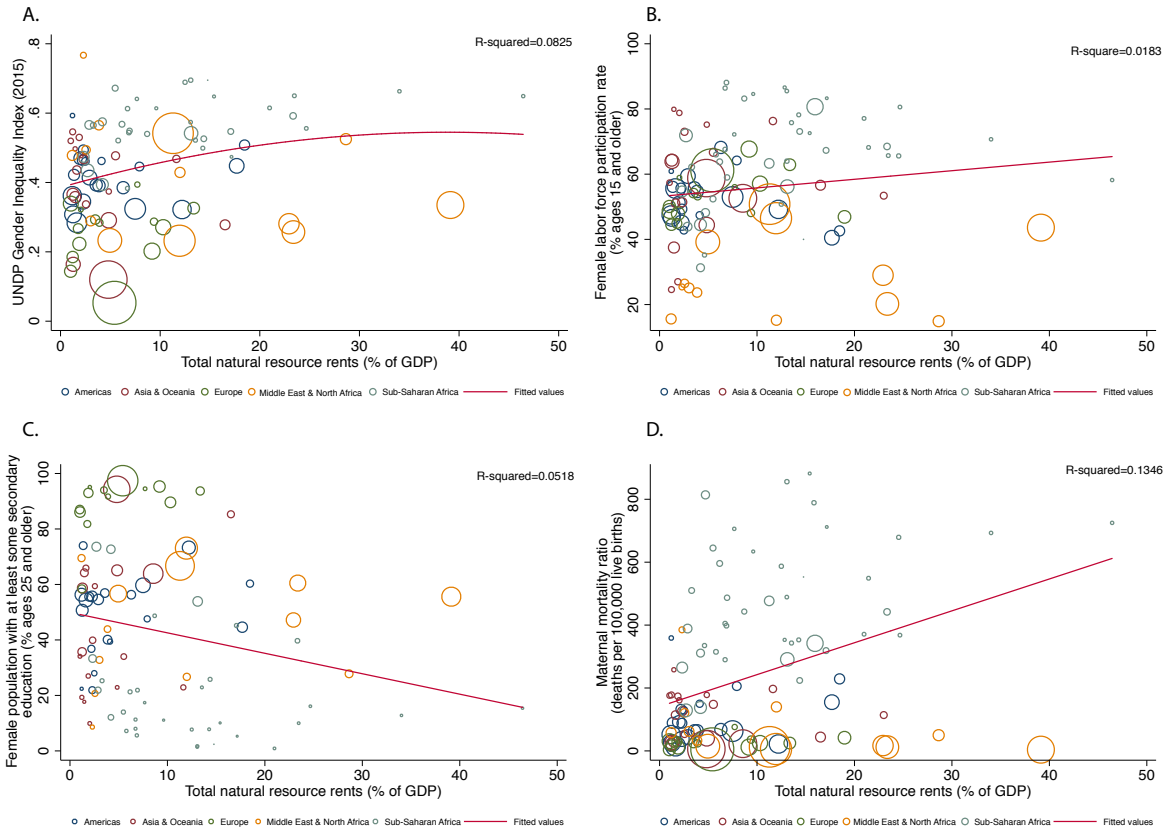


Figure 2: Countries by resource dependence and gender inequality (2015)



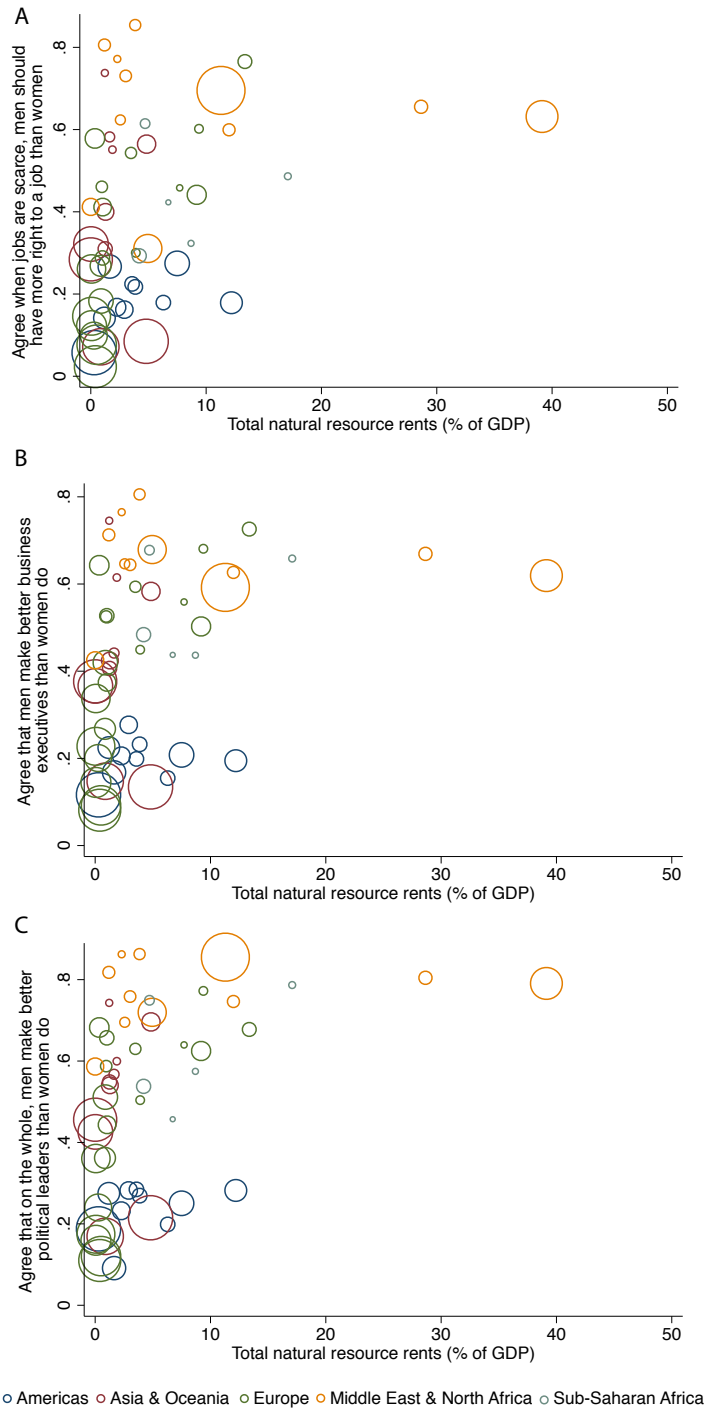
Notes: Total natural resource rent as a share of GDP (2015) (A) and UNDP Gender Inequality Index (2015)(B). Darker color indicates higher share of natural resource rent to GDP (A) or more inequality (B). Grey indicates no available data.

Figure 3: Natural resource dependence and gender inequality, female labor force participation, female education and maternal mortality



Notes: Total natural resource rent as a share of GDP (2015) and against (A) UNDP Gender Inequality Index (2015), (B) FLFP (2015), (C) share of female population with some secondary education (2015), (D) maternal mortality ratio (2014). The color indicate regions, and each observation is scaled to reflect total GDP per capita ($US 2015).

Figure 4: Natural resource dependence and gender inequality and World Value Survey Responses



Notes: Total natural resource rent as a share of GDP greater than 1% of GDP (2015) and response rates from World Value Survey). The color indicate regions, and each observation is scaled to reflect total GDP per capita ($US 2015).

Table 1: Natural resource rents and gender equality measures

VARIABLES	(1) Gender Development Index (GDI)	(2) Female Human Development Index	(3) Male Human Development Index	(4) Gender Inequality Index (GII)	(5) Female Labor Force Participation Rate	(6) Parliament Seats (% held by women)
Panel A						
Total natural resource rents (% of GDP)	-0.003***	-0.010***	-0.009***	0.011***	0.376**	-0.208**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.173)	(0.085)
Observations	154	154	154	153	171	179
R-squared	0.128	0.232	0.230	0.201	0.040	0.021
Panel B						
Total natural resource rents (% of GDP)	-0.003***	-0.009***	-0.008***	0.010***	0.383**	-0.200**
	(0.001)	(0.002)	(0.002)	(0.002)	(0.183)	(0.087)
GDP (current US$)	Yes	Yes	Yes	Yes	Yes	Yes
Observations	153	153	153	152	168	178
R-squared	0.125	0.250	0.252	0.221	0.040	0.020
Panel C						
Total natural resource rents (% of GDP)	-0.000	-0.003**	-0.003***	0.003*	0.263*	-0.223**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.141)	(0.102)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	154	154	154	153	169	179
R-squared	0.394	0.624	0.643	0.607	0.405	0.136

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. GDP (current US$) controls for country-level GDP. Fixed effects for Sub-Saharan Africa, Asia, America, Europe, and Middle East and North Africa.

Appendices

A Conceptual framework

In a natural resource economy, a woman's utility will be defined by several factors that are affected by the industrial specialization of the economy. Most apparently, income and public goods provided will determine her utility:

$$U_w = f(income_w, income_m, public\_goods) \tag{1}$$

where $income_w$ is women's income, and $income_m$ is men's income. The income levels are determined by wage rates and labor force participation. The wage rates for men and women differ because of occupational segregation in the labor markets, which follows from differential productivity across the genders or norms that determine suitable employment (Anker, 1997). Women's utility is thus determined both by her wage rate, and the wage rate of men, which will influence her household income. Lastly, utility depends on public spending on public goods such as health care and education. This utility function is however an over-simplification, and as described below, many other factors will determine women's welfare. To our knowledge, no empirical research has tried to understand and disentangle all the factors determining women's utility that change with extractive industries.

The extensive margin female labor force participation (FLFP) is determined by women's opportunity costs, but also men's wages as it affects household income. An increase in household income can decrease women's labor force participation by increasing her reservation wage (Ross, 2009). Provision of government transfers from the state to the household can also increase women's reservation wage, at the same time, more public services such as a child care, can increase FLFP by reducing the cost of care work (Cavalcanti and Tavares, 2011). Extractive industries may change both household income and government transfers. If men have competitive advantage in the extractive sector, or indirectly stimulated sectors, male wages can rise compared to women's wages. High-value export from the extractive sector could also positively affect government budget. However, natural resource revenues may not necessarily lead to more government transfers where investment in social services is lower (Gylfason, 2001) or corruption is present (Caselli and Michaels, 2013). We hypothesize that FLFP is a function of wages and spending of public goods:

$$FLFP = f(wage_w, wage_m, public\_goods) \tag{2}$$

where the partial derivates of the first two factors are

$$\frac{\delta FLFP}{\delta wage_w} > 0 \tag{3}$$

$$\frac{\delta FLFP}{\delta wage_m} < 0 \tag{4}$$

Simplistically, women's wage rate is determined by local economic and demographic factors:

$$wage_w = f(demand_t, demand_{nt}, sex\_ratio_{m/w}) \tag{5}$$

Ross (2008) finds that oil industries reduce the demand for tradable (denoted $demand_t$) sectors, such as manufacturing, through Dutch Disease effects. This reduces demand for women's labor as women are overrepresented in manufacturing. This effect may be offset by an increasing demand in non-tradable sectors, such as construction and services. The service sector expansion has been important for closing the gender wage gap (Ngai and Petrongolo, 2017). At the local level, Kotsadam and Tolonen (2016) and Benshaul-Tolonen (2018) find that demand for non-tradables ($demand_{nt}$) increases substantially in mining areas in Africa, especially within 20 km from a mine.

Galor and Weil (1996) find that economic development increases women's relative wages as the economy transitions to be more capital intensive. Increases in women's relative wage are a product of their comparative advantage in these sectors, since men traditionally possess more physical "brawn". Where extractive industries are often associated with low-skill intensive industries, rather than capital intensive industries, women may not be able to reap the rewards of increases in relative female wages.

Economic shocks can affect the sex ratio of the population by inward migration and by consequence, wage rates, marriage formation and fertility decisions. Aguilar-Gomez and Benshaul-Tolonen (2018) find that during the Gold Rush in the U.S, women labor force participation was affected by the sex ratio, corroborating anecdotal evidence that female entrepreneurs could charge very high prices for services normally provided for free within the household, such as cooking and laundry, as most men had little chances of marrying. Thus, we hypothesize that marriage formation is a consequence of the following factors:

$$marriage_w = f(sex\_ratio_{m/w}, wage_w, wage_m) \tag{6}$$

The effect of male wage shocks on marriage rates is however non-conclusive, as some papers see increased marriage rates among women (Aguilar-Gomez and Benshaul-Tolonen, 2018) and other papers no change (Benshaul-Tolonen, 2018; Kearney and Wilson, 2018).

During the Gold Rush in the end of the 19th century, mining led to increased marriage rates among women, in particular where the sex ratio was high. Because of scarcity of women, the marriage rates of men were lower than elsewhere (Aguilar-Gomez and Benshaul-Tolonen, 2018). The Gold Rush created, however, exceptionally high sex ratios. One parallel may be Australia in the 19th century due to the extradition of convicts that were predominantly male (Grosjean and Khattar, 2017).

We hypothesize that fertility is an effect of women's marriage rates, women's opportunity cost and male wages.

$$fertility_w = f(marriage_w, wage_w, wage_m) \tag{7}$$

Kearney and Wilson (2018) do not find an increase in marriage rates in fracking areas in the United States that saw increased wage rates of unskilled male labor. However, fertility rates increased with fracking, both within and outside of marriage. The authors compare the results with the coal boom in the Appalachian in the 1970s and 1980s, which found increased marriage rates and within wedlock fertility. This difference could be due to changes in cultural perceptions of out of wedlock births over time in the US.

A woman's intra-household bargaining power is linked to her economic standing, both in absolute and relative terms. A wide set of theoretical collective bargaining models (e.g. Browning et al., 1994; Basu, 2006) illustrate that women's ability to earn income increases their bargaining power.

$$bargaining\_power_w = f(wage_w, wage_{m/w}) \tag{8}$$

$$\frac{\delta bargaining\_power}{\delta wage_{m/w}} < 0 \tag{9}$$

However, as

$$\frac{\delta bargaining\_power}{\delta wage_w} > 0 \tag{10}$$

an economic shock that deepens wage inequality, but increases women's absolute wage rate may still lead to increased bargaining power of women. Benshaul-Tolonen (2018) finds a zero-effect of bargaining power in mining areas in sub-Saharan Africa.

Next we consider how health may change with extractive industries. We hypothesize that women's and infant health is a product of government spending on public services, household income and exposure to pollution:

$$health_{iw} = f(public\_services, income_h, pollution) \tag{11}$$

As the government revenue changes, government spending may increase health infrastructure and change prices of health services provided. Increases in household income (with subscript h for the household), due to government transfers or through labor market effects, may increase consumption of health goods. Health gains, however, may be offset by exposure to pollution from these industries in the proximity to extractive areas. While the former two factors may change at the national, district or local level, pollution is a local concern. Local environmental factors such as mountains, rivers, geology and whether the location is upstream or downstream will matter for the pollution exposure, as well as the technology used in the extractive industries. The effect can thus vary widely also within smaller geographic areas.

Other factors to consider would be the provision of sexual services and sexual risk taking behavior as a response to economic shocks.

$$sexual\_risk = f(wage_w, wage_m) \tag{12}$$

Edlund and Korn (2002) outline a theory of prostitution whereby the demand for sex work is a function of male marital status, price and male income. While the demand of sex work can increase with rising male wages, if accompanied by rising female wages, the net effect of sexual risk taking can be inconclusive, or even negative as seen in Wilson (2012). Empirical evidence from Kenya (Robinson and Yeh, 2011) and in Cape Town (Dinkelman et al., 2007) underscore the importance of income shocks on the provision of risky, transactional sex. Burke et al. (2015) finds that negative income shocks explain up to 20% of variation in HIV across African countries.

Migration of male laborers is another factor leading to changes in sexually transmitted diseases. Inward migration of laborers can change the epidemiological landscape in the mining community, as migration is often considered a risk factor (Weine and Kashuba, 2012). Return migration can also pose a risk, as high risk migrant laborers return to their home communities and wives with recently acquired infections (Corno and de Walque, 2012).

$$STI = f(male\_migration, sexual\_risk) \tag{13}$$

Lastly, we explore the effects of structural transformation on political influence. Work enables women to develop policy interests, exchange information and form organizations (e.g. Iversen and Rosenbluth, 2008; Ross, 2008). Doepke and Tertilt (2009) emphasize the initial expansion of women's economic rights as a precursor to their political rights, whereby

rising returns to education due to economic development increases male support of expanding women's political rights. Taken together, we hypothesize that female political influence is a product of female labor force participation and human capital.

$$political\_influence_w = f(FLFP, human\_capital) \tag{14}$$

The conceptual framework outlined here illustrates that many factors are determinants of the gender impacts of extractive industries. Because many factors have opposite effects, the net effect of a resource boom on gender inequality remains an empirical question. In the next section, we will discuss the empirical strategies generally employed to measure these outcomes.

10 References

Aguilar-Gomez, S., & Benshaul-Tolonen, A. (2018). California Gold Rush and Marriage Markets. *Available at SSRN 3284515*

Anker, R. (1997). Theories of occupational segregation by sex: An overview. *Int'l Lab. Rev., 136*, 315.

Basu, K. (2006). Gender and say: A model of household behaviour with endogenously determined balance of power. *The Economic Journal, 116*(511), 558-580.

Benshaul-Tolonen, A. (2018). Endogenous gender norms: Evidence from Africa's gold mining industry. *Columbia University Research Paper Series CDEP-CGEG WP No. 62.*

Browning, M., Bourguignon, F., Chiappori, P. A., & Lechene, V. (1994). Income and outcomes: A structural model of intrahousehold allocation. *Journal of political Economy, 102*(6), 1067-1096.

Cavalcanti, T. V., & Tavares, J. (2011). Women prefer larger governments: Growth, structural transformation, and government size. *Economic Inquiry, 49*(1), 155-171.

Caselli, F., & Michaels, G. (2013). Do oil windfalls improve living standards– Evidence from Brazil. *American Economic Journal: Applied Economics, 5*(1), 208-238.

Corno, L., & De Walque, D. (2012). Mines, migration and HIV/AIDS in Southern Africa. *Journal of African Economies, 21*(3), 465-498.

Doepke, M., & Tertilt, M. (2009). Women's Liberation: What's in it for Men?. *The*

Quarterly Journal of Economics, 124(4), 1541-1591.

Dinkelman, T., Lam, D., & Leibbrandt, M. (2007). Household and community income, economic shocks and risky sexual behavior of young adults: evidence from the Cape Area Panel Study 2002 and 2005. *AIDS (London, England)*, 21(Suppl 7), S49.

Galor, O., & Weil, D. N. (1996). The gender gap, fertility, and growth. *The American Economic Review, 86*(3), 374-387.

Gylfason, T. (2001). Natural resources, education, and economic development. *European economic review, 45*(4-6), 847-859.

Grosjean, P., & Khattar, R. (2017). It's raining men! Hallelujah? The long-run consequences of male-biased sex ratios. *The Review of Economic Studies*.

Iversen, T., & Rosenbluth, F. (2008). Work and power: The connection between female labor force participation and female political representation. *Annu. Rev. Polit. Sci., 11*, 479-495.

Kearney, M. S., & Wilson, R. (2018). Male Earnings, Marriageable Men, and Nonmarital Fertility: Evidence from the Fracking Boom. *Review of Economics and Statistics*.

Kotsadam, A., & Tolonen, A. (2016). African mining, gender, and local employment. *World Development 83*, 325-339.

Ngai, R., & Petrongolo, B. (2017). Gender gaps and the rise of the service economy. *American Economic Journal: Macroeconomics, 9*(4), 1-44.

Ross, M. L. (2008). Oil, Islam, and women. *American Political Science Review, 102*(01), 107-123.

Weine, S. M., & Kashuba, A. B. (2012). Labor migration and HIV risk: a systematic review of the literature. *AIDS and Behavior, 16*(6), 1605-1621.

Wilson, N. (2012). Economic booms and risky sexual behavior: evidence from Zambian copper mining cities. *Journal of Health Economics, 31*(6), 797-812.

A Tables

Table A1: Descriptive statistics of natural resource richness and gender equality

Total Natural Resource Rents (% of GDP) by quintile	1		2		3		4		5	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Natural resource dependence										
Total natural resource rents (% of GDP)	0.04	0.04	0.64	0.29	2.05	0.67	6.64	2.35	19.39	7.81
Mineral rents (% of GDP)	0.01	0.02	0.10	0.18	0.75	0.82	1.50	2.05	4.31	5.68
Oil rents (% of GDP)	0.01	0.01	0.10	0.13	0.35	0.57	2.10	2.59	9.28	10.51
GDP per capita (Current $US)	25380	22850	17616	17415	4665	3534	10010	18378	5458	8797
Gender inequality and female empowerment										
UNDP Gender Development Index (2015)	0.96	0.02	0.97	0.07	0.93	0.07	0.94	0.06	0.88	0.07
UNDP Human Development Index (Female)	0.84	0.08	0.79	0.13	0.66	0.10	0.63	0.16	0.54	0.17
UNDP Human Development Index (Male)	0.87	0.07	0.82	0.10	0.70	0.08	0.67	0.14	0.60	0.16
UNDP Gender Inequality Index (2015)	0.19	0.16	0.22	0.16	0.41	0.13	0.42	0.15	0.50	0.14
Female labor force participation	51.91	10.52	48.79	11.14	49.24	15.57	57.26	14.69	58.17	19.90
Male labor force participation	70.54	6.01	68.21	9.01	76.02	7.37	78.53	7.23	78.79	7.82
Secondary education (Female)	75.47	19.32	78.35	24.42	47.32	24.38	46.57	30.36	33.11	27.82
Secondary education (Male)	78.56	18.73	82.68	20.69	54.21	21.31	51.42	28.70	40.47	24.81
Proportion of legislative seats held by women	19.40	11.93	23.66	10.94	20.15	9.76	23.49	14.82	18.27	9.58
Maternal mortality ratio (per 100,000)	28.14	33.84	46.83	82.27	122.28	124.17	234.44	235.22	357.49	280.05
Agree when jobs are scarce, men should have more right to a job than women	0.26	0.11	0.23	0.19	0.49	0.24	0.40	0.21	0.55	0.20
Agree men make better political leaders than women do	0.36	0.17	0.37	0.22	0.55	0.24	0.54	0.23	0.68	0.20
Agree men make better business executives than women do	0.31	0.11	0.31	0.20	0.49	0.21	0.46	0.21	0.58	0.19

Notes: The data on natural resource dependence come from the World Bank (2015). The data on gender equality and female empowerment comes from UNDP, the Inter-Parliamentary Union, UNESCO and International Labour Organisation (2015). The data in the final three rows come from Wave 6 (2010-2014) of the World Value Surveys and reflect responses in 24 countries.

Table A2: Natural resource rents and gender equality measures

VARIABLES	(1) Maternal Mortality Ratio	(2) Female Education	(3) Male Education	(4) Domestic violence justified
Panel A				
Total natural resource rents (% of GDP)	13.469***	-1.562***	-1.336***	0.010*
	(2.644)	(0.287)	(0.276)	(0.006)
Observations	172	154	154	23
R-squared	0.253	0.021	0.165	0.189
Panel B				
Total natural resource rents (% of GDP)	12.967***	-1.461***	-1.233***	0.011
	(2.650)	(0.279)	(0.264)	(0.007)
GDP (current US$)	Yes	Yes	Yes	Yes
Observations	171	153	153	22
R-squared	0.254	0.176	0.160	0.189
Panel C				
Total natural resource rents (% of GDP)	4.608**	-0.256	-0.119	0.0138**
	(1.801)	(0.226)	(0.199)	(0.006)
Region fixed effects	Yes	Yes	Yes	Yes
Observations	172	154	154	23
R-squared	0.679	0.565	0.587	0.263

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Column 4 is an index variable ranging from 0 to 1 if respondent agrees with "that a husband justified to beat his wife if she burns the food/ argues with him/ refuses sex/ goes out without his permission/ neglects the children?". GDP (current US$) controls for country-level GDP. Region fixed effects include include fixed effects for Africa, Asia, Middle East and Northern Africa, Europe, America.

Table A3: Summary of empirical literature on extractive industries and women

Section	Title	Authors	Year	Analysis	Main result
Labor markets	Resource shocks, employment and gender: evidence from the collapse of the UK coal industry	Aragón, Rud and Toews	2018	Spatial difference-in-difference	Mine closures lead to crowding out of women in labor market and persistent declines in the share of women employed in manufacturing.
	Working condition of male and female artisanal and small-scale goldminers in Ghana: Examining existing disparities	Armah, Boamah et al.	2016	Counterfactual decomposition	Only 33 percent of the gap in working conditions between men and women employed in artisanal and small-scale gold mining in Ghana is due to productive characteristics.
	Labor Mobility, Household Production, and the Dutch Disease	Frederiksen	2007	Theoretical	The presence of occupational segregation in the market mediates how resource booms affect female labor force participation rates.
	Male earnings, marriageable men, and nonmarital fertility: Evidence from the fracking boom	Kearney and Wilson	2018	Cross-census area regression analysis	The effect of fracking (1997-2012) on female earnings and culture increases fertility rates, without increases in marriage rates.
	African mining, gender, and local employment	Kotsadam and Tolonen	2016	Quasi-experimental	Mine openings cause women to shift from agricultural to service sector or out of workforce, decreasing overall female work force participation. These shifts are permanent in the face of mine closures, while other welfare benefits (such as earning cash and working annually) are reversed.
	Male-biased demand shocks and women's labor force participation: Evidence from large oil field discoveries	Maurer and Potlogea	2017	Spatial difference-in-difference	Increases in employment of single women in service sector offset declines in female labor force participation due to increased unearned income and marriage rates.
	Local impact of boom and bust in mineral resource extraction in the United States: A spatial econometrics analysis	Ouedraogo	2016	Spatial difference-in-difference	Out-migration of women from mining communities (1970-2012) due to fewer employment prospects, and increased opportunities for education and marriage from non-extractive communities.
	Mining activity, income inequality and gender in regional Australia	Reeson, Measham and Hosking	2012	Cross-regional regression analysis	Income inequality for women in mining regions is linear– as mining activity increase so to does inequality in personal income for all employed women.
	Oil, islam and women	Ross	2008	Cross-country regression analysis	Oil production reduces number of women in labor force and subsequently reduces their political participation.
	Endogenous gender norms: Evidence from Africa's gold mining industry	Benshaul-Tolonen	2018	Quasi-experimental	Women did not report decreases in intra-household decision-making power due to large-scale gold mining. Female wages increase more in percent than male wages, in response to active mining.
	Moving to economic opportunity: The migration response to the fracking boom	Wilson	2016	Instrumental panel analysis	Increased migration of young, single, less-educated males to fracking communities as they face the highest earning potential and lowest moving costs
Gender-based violence	Endogenous gender norms: Evidence from Africa's gold mining industry	Benshaul-Tolonen	2018	Quasi-experimental	Active mining reduces female acceptance of domestic violence and improve access to services which coincides with increased access to media discussing women's issues.
	Analyzing the Impact of Dodd Frank Mining Legislation on Sexual Violence in Eastern Democratic Republic of Congo	Foltz and Sambo	2018	Spatial difference-in-difference	Sanctions on conflict Dodd-Frank did not decrease sexual violence against women in mining communities.
	Exploratory research on the impact of the growing oil industry in ND and MT on domestic violence, dating violence, sexual assault, and stalking	Jayasundara, Heitkamp et al.	2016	Mixed-methods	Increase in dating and domestic violence (2009-2014) following 2007 oil boom.
	Structural change and wife abuse: A disaggregated study of mineral mining and domestic violence in sub-Saharan Africa, 1999-2013	Kotsadam, Østby and Rustad	2017	Spatial difference-in-difference	Effect of mine openings (1999-2013) on domestic violence in 15 Sub-Saharan countries is heterogeneous, though increases in domestic violence in areas with higher general acceptance of abuse.
	Artisanal mining, conflict, and sexual violence in Eastern DRC	Rustad, Østby and Nordas	2016	Spatial regression analysis	Proximity to ASM mine, and ASM with presence of armed actors increases sexual violence by intimate partner and non-partner.

Section	Title	Authors	Year	Analysis	Main result
Political participation	Oil, Islam and Women	Ross	2008	Cross-country regression analysis	Declines in female political participation due to declines in female labor force participation which changes women's exposure to workplace.
	Blessing and curse. The gold boom and local development in Colombia	Santos	2018	Instrumental variable	Families respond to gold boom by withdrawing children from school. Unemployment decreases in short term. There are persistent effects on child human capital accumulation.
	Resource wealth and women's economic and political power in the US states	Simmons	2016	Cross-state regression analysis	Mining production decreases female labor force participation and declines are reinforced by inegalitarian gender attitudes that decrease female political participation.
Health: Women and infant health	The effect of oil spills on infant mortality: Evidence from Nigeria	Bruederle and Hodler	2019	Spatial difference-in-difference	Nearby oil spills prior to conception increase infant mortality.
	Local Industrial Shocks and Infant Mortality	Benshaul-Tolonen	2019	Quasi-experimental	Infant mortality of infants born close to mines, especially for girls, declines by up to 50% due to household economic benefits generated by large-scale gold mines.
	A cross-sectional survey on knowledge and perceptions of health risks associated with arsenic and mercury contamination from artisanal gold mining in Tanzania	Charles et al.	2013	Survey	Female miners were significantly less knowledgeable (22.5 percent) than males (36.9 percent) to be aware of the health risks of mercury.
	Hydraulic fracturing and infant health: New evidence from Pennsylvania	Currie, Greenstone and Meckel	2017	Spatial difference-in-difference	Infants both to mothers living within 3km of well site during pregnancy increases probability of low birth weight and average birth weight, with infants born to mothers living within 1km of well site having a 25 percent increased probability of having a low birth weight.
	Violence, Selection and Infant Mortality in Congo	Dagnelie, De Luca and Maystadt	2018	Instrumental variable	In utero exposure to conflict, particularly during the first two trimesters, increases fetal mortality and that number of male live births.
	Shale gas development and infant health: Evidence from Pennsylvania	Hill	2014	Spatial difference-in-difference	Introduction of well drilling decrease birth weight and APGAR scores of children due to air pollution.
	The effects of gold mining on newborns' health	Romero and Saavedra	2016	Spatial difference-in-difference	The likelihood of higher APGAR scores for infants born close to a mine is higher than infants born downstream, in communities whose do not receive economic benefits.
	Unintended consequences of sanctions for human rights: Conflict minerals and infant mortality	Parker, Foltz, and Elsea	2016	Spatial difference-in-difference	Sanctions on 'conflict minerals' increase child mortality rates in mining villages.
	Outcomes of pregnancy among women living in the proximity of oil fields in the Amazon basin of Ecuador	San Sebastian, Armstrong, and Stephens	2002	Odds Ratio	Risk of spontaneous abortion is 2.34 times higher for women living closer to oil fields compared to women living farther away.
	Mines: The local welfare effects of mineral mining in developing countries	Von der Goltz and Barnwal	2018	Spatial difference-in-difference	Increases in wealth of mining communities coincides with 10 percentage point increases in anemia among adult women and 5 percentage point increases stunting among young children due to lead pollution within 5 km of mine.
Sexual health	Variations of HIV and STI prevalences within communities neighbouring new goldmines in Tanzania: importance for intervention design	Clift et al.	2003	Cross-sectional survey	Female food and and recreational facility workers have an HIV prevalence of 42 percent compared to compared with 6 percent among male mine workers, and 16-18 percent among community members.
	Mines, migration and HIV/AIDS in Southern Africa	Corno and de Walque	2012	Spatial regression analysis	Migrants working in South Africa are likely to be HIV positive, and infect female partners at home in Swaziland and Lesotho, where mining is not intensive.
	Economic booms and risky sexual behavior: Evidence from Zambian copper mining cities	Wilson	2012	Spatial FE and temporal FE regression analysis	Women shift away from high risk behavior when their outside economic opportunities improve decreasing likelihood of transactional sex and multiple partnerships.

Table A4: Total natural resource rents (% of GDP) by country

Quintile 1 (0-0.15%)	**Quintile 2** (0.18-1.03%)	**Quintile 3** (1.18-3.48%)	**Quintile 4** (3.57-11.63%)	**Quntile 5** (11.94-46.44%)
Antigua and Barbuda	Afghanistan	Albania	Angola	Algeria
Austria	Bangladesh	Argentina	Australia	Azerbaijan
Bahamas	Belarus	Armenia	Bahrain	Burkina Faso
Barbados	Belize	Botswana	Benin	Burundi
Belgium	Bosnia and Herzegovina	Brazil	Bhutan	Central African Republic
Cyprus	Cabo Verde	Bulgaria	Bolivia (Plurinational State of)	Chad
Czech Republic	Canada	Cambodia	Brunei Darussalam	Chile
Dominica	Croatia	China	Cameroon	Congo
France	Cuba	Costa Rica	Colombia	Congo (Democratic Republic of the)
Germany	Denmark	Dominican Republic	Comoros	Equatorial Guinea
Greece	Djibouti	Fiji	Cote d'Ivoire	Ethiopia
Grenada	El Salvador	Guatemala	Ecuador	Gabon
Hong Kong, China (SAR)	Estonia	Haiti	Egypt	Ghana
Iceland	Finland	Honduras	Gambia	Guinea
Ireland	Georgia	India	Kazakhstan	Guinea-Bissau
Italy	Hungary	Indonesia	Kyrgyzstan	Guyana
Japan	Israel	Jamaica	Lao People's Democratic Republic	Iraq
Kiribati	Latvia	Jordan	Lesotho	Kuwait
Korea (Republic of)	Lithuania	Kenya	Malawi	Liberia
Lebanon	Moldova (Republic of)	Mexico	Malaysia	Madagascar
Luxembourg	Montenegro	Morocco	Myanmar	Mali
Maldives	Netherlands	Namibia	Nicaragua	Mongolia
Malta	New Zealand	Nepal	Nigeria	Mozambique
Marshall Islands	Panama	Pakistan	Norway	Niger
Mauritius	Poland	Paraguay	Peru	Oman
Micronesia (Federated States of)	Portugal	Philippines	Qatar	Saudi Arabia
Palau	Romania	Sao Tome and Principe	Russian Federation	Sierra Leone
Saint Kitts and Nevis	Samoa	Serbia	Rwanda	Solomon Islands
Saint Lucia	Slovakia	Swaziland	Senegal	Somalia
Saint Vincent and the Grenadines	Slovenia	Tajikistan	South Africa	South Sudan
Seychelles	Sweden	Thailand	Sudan	Suriname
Singapore	Timor-Leste	The former Yugoslav Republic of Macedonia	Tanzania (United Republic of)	Togo
Spain	Turkey	Tunisia	Trinidad and Tobago	Turkmenistan
Sri Lanka	United Kingdom	Uruguay	Ukraine	Uganda
Switzerland	United States	Viet Nam	Uzbekistan	United Arab Emirates
Tonga	Vanuatu	Yemen	Zimbabwe	Zambia