Published in final edited form as:
Stud Fam Plann. 2013 December ; 44(4): 411–430. doi:10.1111/j.1728-4465.2013.00367.x.

Managing the double burden: Effects of pregnancy on labor-intensive time use in rural China, Mexico and Tanzania

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Abstract

Labor-intensive work is often a way of life for women in rural areas of developing countries. However, physical exertion may result in poor health outcomes for mother and infant if continued through pregnancy. Using longitudinal data from China, Mexico and Tanzania, we examine the relationship between pregnancy and four time use outcomes, measured as hours spent in the last week on: 1) housework, 2) care giving, 3) agricultural work, and 4) self-employed or non-agricultural work outside the home. An individual fixed effects approach is adopted to overcome potential time invariant woman-level endogeneity of pregnancy status. With a few exceptions, we do not find significantly different time use patterns between pregnant and non-pregnant women. The assumption that women decrease labor intensive work in developing countries during pregnancy needs revisiting, and may have implications for both women's livelihood programming and assistance during childbearing periods.

Keywords

time allocation; pregnancy; China; Mexico; Tanzania

1. Introduction

Women residing in rural areas of developing countries often rely on agriculture or other labor-intensive work, which requires physical exertion, for subsistence and livelihoods. This is particularly true for women who have received minimal education or are asset poor and therefore have fewer income-producing alternatives. At the same time, women of prime working age are also likely to be in the childbearing stage of the lifecycle. Total fertility rates (TFRs) are still over 4.2 children per women in least developed countries, and over 4.9

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in sub-Saharan Africa (United Nations 2008). These TFRs mask large variations among and within countries by socio-economic status, religion and by cultural or geographical factors. For example, among the developing countries studied in this paper, TFRs ranged from 1.5 in China to 2.3 in Mexico, to 5.4 in Tanzania in 2012 (Population Reference Bureau (PRB) 2012). Consequently, in these and other countries, a significant amount of time during rural women's prime years is spent on childbearing and care-related activities. Simple arithmetic calculations of pregnancy duration alone in the aforementioned Tanzanian data show that women spend an average of approximately 48.6 months, or just over 4 years pregnant during their prime working age years.

While attempts to quantify the changes in women's time allocation over pregnancy have been conducted, the number of studies, as well as their scope and methodological approaches are dated. Conventional wisdom would suggest pregnancy and higher fertility in general decreases women's opportunities for productive work, due to restrictions in mobility, decreased capacity for physical exertion and through increasing time constraints. Most previous studies find exactly this relationship. Bivariate analysis of 186 households in rural Kenya, finds women who are pregnant or lactating reduce time spent on labor activities in order to increase the time allocated to child care, particularly in the third trimester (Baksh et al. 1994). A study using 24-hour recall in rural Southern India finds pregnant women spend almost two fewer hours working in fields when compared to non-pregnant and non-lactating women, however the study is primarily descriptive and among 115 women (McNeill and Payne 1985). Reduced-form time allocation among urban households also in India indicates that women with younger children aged zero to six had increased home production nearly six times the magnitude of women with older children, implying the reallocation of activities to incorporate childcare (Malathy 1994).

Although these studies confirm seemingly obvious relationships suggesting that women who are pregnant simply have less time, energy or desire to devote time to labor intensive activities, they do not address the confounding relationship between the opportunity costs of women's time, labor force participation and fertility. For example, women may on one hand limit or delay pregnancy and childbearing to increase earning potential, however, as family size increases, women may be forced to increase their work hours to provide for their families (Adair et al. 2002). Furthermore, change in employment opportunities or wage rates may influence reproductive decisions, as women may choose to substitute childbearing periods with additional work. These dynamics may be different for rural women working in the informal sector who may make fewer changes to their time use allocation because they face lower opportunity costs than those in the formal sector, where productive and reproductive roles are less compatible (Adair et al. 2002). In addition, women in rural areas of developing countries may have limited access to contraceptives or ability to make autonomous decisions about their fertility, further complicating the relationship between pregnancy and time use. Although development economists have modeled relationships between fertility and labor force participation accounting for the endogeneity of fertility decisions, primarily using instrumental variable techniques, there has been virtually no analysis of this type examining linkages between more general time use across diverse activities and pregnancy status.

From a research perspective, the relationship between time use and pregnancy is of importance because of potential negative health impacts. Labor intensive work during later stages of pregnancy may result in poor maternal and child health outcomes, such as preterm delivery or low birth weight, exposure to pesticides, and increased propensity for chronic diseases later in life (Adair and Prentice 2004; Barker 1998; Lima et al. 1999; Rao et al. 2003). A number of studies from developing countries suggest that women and children are at risk for poor health due to the double burden of productive and reproductive activities. Prentice and colleagues (1981) follow the energy intake of 143 pregnant and lactating Gambian women for a year and find that breast milk output quality and early infant growth are significantly worse during the wet season, when heavy agricultural duties are performed (Prentice et al. 1981). Using data from five countries in West Africa, Kim (2010) shows that rainfall shocks have adverse effects on the survival of young children born in the rainy season when agricultural time burden placed on mothers is the greatest (Kim 2010). A similar analysis in Senegal finds that highest child survival rates are found in the dry months after the harvest, when the opportunity cost to investing time in childcare (rather than agriculture) is the lowest (Pitt and Sigle 1997). Even in developed countries where access to high quality health care is higher for expectant and recent mothers, labor activities have also been linked to negative birth outcomes including risk of increased and spontaneous abortion (Whelan et al. 2007). However, it should be noted that studies conducted in developed countries often have different foci; such studies tend to look at predictors of change in leisure activity in women during pregnancy (Pereira et al. 2007), changes in energy expenditure (Lof and Forsum 2006), and lifestyle choices (Devine, Bove and Olson 2000). This difference in foci is likely a result of the wider availability of employment avenues to women in developed countries, as well as varying expectations in maternity leave and childcare options. Without a clear understanding of how physically intensive activities affect maternal and child health, it becomes difficult to tailor types and timing of programs to alleviate the dual burden of reproduction and labor.

As shown from the studies linking pregnancy and time allocation discussed above, the literature is generally dated and typically involves small sample sizes in geographically restricted areas. Little is done to address endogeneity issues between reproduction and time allocation, therefore potentially biasing what we assume to be conventional relationships. We take a step toward addressing this gap by examining the effects of pregnancy on women's time use in labor-intensive activities using large-scale longitudinal data from China, Mexico and Tanzania collected in the 1990s and 2000s to highlight the differences between pregnant and non-pregnant women within the same context. We restrict our sample to rural women of reproductive age (which we define as 15 to 49 years) to control for labor market heterogeneities between rural and urban areas. While time is also a limited commodity for those living in urban areas, the restrictions faced by pregnant women in rural areas are vastly different. For example, many rural women are engaged in informal labor-intensive work activities, which do not allow for regulated pregnancy leave. In addition, household structure may be different in rural settings, with implications for care giving and labor substitution. We examine both productive and reproductive activities across four main categories measured as hours in the past week engaged in: 1) housework, 2) care giving, 3) agriculture and livestock, and 4) self-employed or non-agricultural work outside the home.

We use multivariate modeling including individual fixed effects regressions to isolate relationships accounting for unobserved time-invariant woman-level heterogeneity and find that with the exception of care giving in China and employment among women in their third trimester in Mexico, there are no statistically different time use patterns by pregnancy status. Further robustness checks indicate that in general these relationships do not vary significantly between wealthy and asset poor women, and are exhibited relatively uniformly across all women. We conclude with policy and programmatic implications as well as next steps and calls for further research.

2. Theoretical model

Conceptually, the framework developed by Kes and Swaminathan can be used to analyze time use (Kes and Swaminathan 2006). In this framework, a woman's time can be distributed between market (or income-generating work, *e.g.*, agriculture) and non-market work (*e.g.*, reproductive activities). Allocation of time will also depend on factors such as the availability of work and the composition of the household. Since time is a limited resource, trade-offs will occur between competing tasks, determined through factors such as social norms, and the financial stability of the household. For example, an increase in working hours subtracts from leisure time, thereby lowering welfare created through leisure. Conversely, working usually increases an individual's purchasing power, which broadens the individual's ability to improve her own health and utility, and possibly that of her children, through the purchase of goods and services. From this framework, it is clear that time poverty may be a result of the many competing burdens.

From an economic perspective, households maximize their utility through the consumption of goods and services, including those produced in the home such as housework and child care, subject to budgetary, time, and technology constraints (Becker 1965; Gronau 1976). Optimal time allocation will depend on preferences for number of children and on gender roles within the family (Beegle 2005). Utilizing this framework, pregnancy can affect a woman's allocation of time towards different activities through a number of paths. First, time is reallocated among activities, and total time available for physically demanding tasks may be reduced as women who are pregnant become unable to perform these tasks. Furthermore, the pregnant woman may require additional care, and thus the time available from other household members may be redirected. Second, the income-earning potential of the woman may be lower. For example, due to other demands on their energy, pregnant women may not be able to exert themselves as much in agricultural work. There may be discrimination against pregnant women as employers may perceive their labor to be of a lower quality and thus less effective. These factors may induce women to spend fewer hours in income generating activities. Third, the distribution of household income could be affected, in that pregnant women may have additional needs requiring financial outlays. Fourth, unobserved woman-level factors such as preferences and skills could drive time allocation, depending on individual-specific endowments. For example, some women may be better able to balance working and reproductive activities simultaneously in any given job, some may choose types of employment that allow them to simultaneously work and raise children, and others who are intrinsically motivated to participate in the labor force may be less likely to become pregnant. Similarly, exogenous household factors such as

cultural attitudes may affect the extent to which pregnant women may engage in work. Regardless of the pathway through which the effects are channeled, the expected outcome is that women who are pregnant will work less because of the binding time constraint on managing childcare and productive activities.

3. Data and Methods

3.1 China: China Health and Nutrition Survey (CHNS)

The CHNS is a longitudinal survey started in 1989 collected by the Carolina Population Center at the University of North Carolina at Chapel Hill in collaboration with the National Institute of Nutrition and Food Safety at the Chinese Center for Disease Control and Prevention (Carolina Population Center 2008). The CHNS was designed to help understand the effects of governmental health, nutrition, and family planning policies and to determine how the health and nutritional status of the Chinese population is being affected by the social and economic changes in China. The CHNS covers nine diverse provinces and includes over 200 communities and approximately 4,400 households drawn from a multi-stage random cluster sample, stratified on income and urban/rural location. Questionnaires covered a range of socio-economic modules such as income, employment and education, as well as detailed nutritional modules. To identify pregnancy status, ever married women who were younger than 52 were asked "*Are you currently pregnant?(yes/no)*." The CHNS includes six rounds in 1989, 1991, 1993, 1997, 2000, 2004 and 2006, and we include both an 'early' panel from 1997 to 2000 and a 'later' panel from 2004 to 2006. The objectives of including both panels are twofold in that we gain an additional comparison across countries, while also allowing a comparison across time in China. For further information on the CHNS including fieldwork details, questionnaires and survey design see (Carolina Population Center 2008).

3.2 Mexico: Mexican Family Life Survey (MxFLS)

The MxFLS is a longitudinal, nationally representative survey initiated to better understand the social, economic, demographic and health transitions occurring in Mexico (Rubalcava and Teruel 2006). Funding and implementing institutions vary by wave and are collaborative efforts between Mexican government agencies and research and academic institutions in both the US and Mexico. Data used in this study come from the publicly available waves I (MxFLS-1), which was collected in 2002, and wave II (MxFLS-2) was collected in 2005 and 2006. The baseline survey is a stratified, multi-stage sample of dwellings in Mexico and includes approximately 8,440 households and over 35,000 individuals. Particular attention is paid to issues surrounding international migration of family members and implications for remaining household members. Pregnancy status was identified with the following question asked of all women ages 14 to 49: "*Are you currently pregnant?* (*yes/no/does not know*)." For those answering affirmatively, the following question was asked, "*In what month are you expecting the birth of the child?*" For further information on the survey design, objectives and implementation see (Rubalcava and Teruel 2006; Rubalcava and Teruel 2008).

3.3 Tanzania: Kagera Health and Development Survey (KHDS)

The KHDS was originally part of a joint research project to understand the impacts of adult-age mortality launched by the Population and Human Resources and Africa Technical Department of the World Bank (World Bank-Development Research Group 2004). The KHDS interviewed approximately 832 households in 50 communities in the Kagera region of Tanzania over four passages at seven month intervals between 1991 and 1994 and again in 2004. The household sample was random, stratified on agronomic zones, community adult mortality rates and indicators at the household level that were thought to be predictive of future adult deaths including morbidity. The KHDS questionnaires were modeled after the World Bank's Living Standards Measurement Surveys and collected extensive, detailed information on household income, consumption expenditure, individual economic activities, education and individual health status, including the height and weight of all household members. The analysis will utilize the first four waves of KHDS which started in 1991 and took place approximately every six to seven months afterward until 1994. The sample is limited to women between the ages of 15 and 49, corresponding to the age range of women who were asked the fertility modules. To identify pregnancy status, women were asked "*Are you pregnant now? (yes/no)*" and for women who answered affirmatively, a follow up question was asked: *"How many months?"* For more detailed information on the sampling procedure, survey objectives and fieldwork details see (Beegle 2005; World Bank-Development Research Group 2004).

3.4 Models and measurement of key variables

Descriptive, bivariate and multivariate methods are used to assess the linkages between pregnancy and time allocation outcomes. We focus on four primary time allocation outcomes for women, measured in hours spent in the last week: 1) housework (including purchasing, cooking, cleaning, preparing food, and fetching water and firewood); 2) care giving (including children, elderly and sick); 3) working in agriculture (including fieldwork and kitchen gardens, caring for and processing livestock products, processing crops, fishing); 4) self-employed or small handicraft and non-agricultural work outside the home.[1] Although these categories capture general components of time allocation measurements, there are definitional differences across the surveys which are detailed in Table A1 in the Appendix.

As previously mentioned, the key methodological challenge in exploring linkages between reproductive health and labor intensive activities is the endogeneity of reproductive health indicators, where women who are more likely to be pregnant may also be more likely to have unobserved heterogeneities related to time allocation. For example, women of reproductive age are also in prime labor force participation ages and may be more likely to spend time working in agriculture or other occupations.[2] Likewise, women with high

[1]We also consider an aggregate variable including housework, self-employed and agriculture work, however find no effects between pregnancy and time use in all three countries and thus present only disaggregated results which lead to more nuanced conclusions and implications.

[2]An additional reproductive health factor which may influence time use occurs during post-pregnancy when a woman may be taking care of children or breastfeeding infants. Although we have the ability to identify women who are breastfeeding, we do not choose to model this relationship here because breastfeeding is an endogenous factor and it is determined through different pathways than pregnancy.

fertility may be in lower wealth households and be more likely to spend longer hours carrying water, fetching firewood or completing housework activities. We start by modeling time use (in logged hours per week) among pooled cross-sections using Ordinary Least Squares (OLS) regression, where the illustrative unit of analysis is the individual woman *(i)* in community *(j)* and the model can be written as follows:

$$\boldsymbol{Log\ \ hours\ \ in\ \ activity}\boldsymbol{Y}_{it}=\alpha+\beta_1*\boldsymbol{Pregnant}_{it}+\beta_2*\boldsymbol{X}_{it}+\beta_3*\boldsymbol{V}_{jt}+\beta_4*\boldsymbol{T}_{it}+\varepsilon_{it} \quad (1)$$

Here time allocation in activity ***Y*** of women of reproductive ages is a function of current pregnancy status ***Pregnant***, a vector of individual woman-level characteristics ***X***, a vector of community-level indicators ***V*** and an indicator for time ***T***. Hours of time allocated to a specific activity are logged to account for skewed distributions, and standard errors are adjusted for clustering at the community level in all countries. Individual and household indicators include age and age squared, education levels, marital status, household demographics, wealth proxy; community indicators include population, infrastructure, service availability; and seasonal indicators are also included as control variables. Wealth proxies are indices created though principal component analysis using indicators of economic welfare such as ownership of key assets or provision of water and sanitation services. Controlling for seasonal indicators is especially important as both labor market, time allocation and health indicators have been found to vary significantly according to time of year (Panter-Brick 1993) (see Appendix Table A2 for descriptive statistics of control variables by country).

As previously mentioned, the OLS estimator from the simple pooled cross-sectional model in (1) will be biased and inconsistent because it does not take into account unobserved heterogeneous preferences or fixed traits that could influence individual-level pregnancy status and time allocation, and therefore. An individual-level panel fixed effects model is estimated to difference out unobserved time-invariant characteristics that may influence both pregnancy status and time use using the following specification:

$$\boldsymbol{Log\ \ hours\ \ in\ \ activity}\boldsymbol{Y}_{it}=\alpha_i+\beta_1*\boldsymbol{Pregnant}_{it}+\beta_2*\boldsymbol{X}_{it}+\beta_3*\boldsymbol{V}_{jt}+\beta_4*\boldsymbol{T}_{it}+\varepsilon_{it} \quad (2)$$

where α_i are *N* fixed unknown parameters that capture the effects of those variables which are specific to the *i*-th individual and are constant over time. This approach relies on the assumption that the main source of endogeneity is from time-invariant factors influencing reproductive status and in effect uses the panel data to provide 'internal' instruments for endogenous regressors.[3] The transformations $(x_{it}-\bar{x}_i)$ of the original variables used to compute the estimator β are uncorrelated with both the explanatory variables and the model's error term (Verbeek 2000). Although we present results of both models (1) and (2) to show how results change between empirical specifications, our preferred estimates are from model (2) in which we expect coefficients to decrease in magnitude and significance levels when purged of bias in pooled cross-sectional models. It is to our advantage that our

[3]Time non-variant indicators are 'differenced out' of fixed effects panel regressions. In China and Mexico this results in the exclusion of regional indicators and in Tanzania community-level economic indicators are dropped.

panel periods are relatively close together (*e.g.*, two to three years) as reproductive status is likely to vary, whereas other factors are likely to remain fixed.[4]

4. Results

4.1 Descriptive statistics

Table 1 presents descriptive statistics of the sample and reproductive health outcomes across countries and years. As previously mentioned, we limit our samples to women residing in rural areas as they face differing labor market policies and institutions, and are more likely to undertake labor intensive, often agricultural, work as compared to their urban counterparts (Fussell and Zenteno 1997). The early CHNS sample includes 1,269 women (2,538 women years), the late CHNS sample includes 1,178 women (2,356 women years), the MxFLS sample includes 1,920 women (3,480 women years), and the KHDS sample includes 903 women (1,806 women years). All samples are restricted to women between the ages of 15 and 49. Approximately eight percent of the Tanzanian, three percent of the Mexican and one percent of the Chinese women included in the samples are currently pregnant. Given the population control policies in China, it is not surprising that the incidence of current pregnancy is low in this population compared to Tanzania and Mexico. In addition to the main indicator of pregnancy status, we present additional contextual indicators to understand the situations of women included in the analysis. For example, in China, the majority of women are married or in unions (88–95 percent) and their age is higher (36–39 years) in contrast to women in Tanzania, who are younger (27 years) and are less likely to be married or in a union (46 percent). The percentage who report breastfeeding at the time of the survey is 15, seven, and zero to two percent, in Tanzania, Mexico and China, respectively. Women in Mexico have higher contraceptive use, approaching 60 percent of the sample, while this is approximately 11 percent in Tanzania. Finally, the average parity of women in our sample range from approximately 1.5 in China to 2.4 and 2.7 in Mexico and Tanzania respectively.

Table 2 shows results of the descriptive and bivariate analysis of time allocation indicators, by pregnancy status. Women in the early China panel report the highest average weekly hours spent working self-employed or outside the home (47.75 hours), followed by agriculture (24.89 hours), housework (16.06 hours) and care giving (5.77 hours). Women in the later China panel spend relatively less time in all labor-intensive activities, but especially in agricultural and housework. In the Mexican sample, housework is the largest reported component (22.43 hours), followed by caring for household members (12.98 hours) and working either self-employed or employed (10.05 hours). Very few women in Mexico report time spent working in agriculture (six percent). This is in contrast to the Tanzanian sample where women spend on average the greatest proportion of their time in home and agricultural work (17.57 and 15.22 hours respectively), and very little time spent working in

[4]Because it is likely that the error terms across time use equations will be correlated, we also run Seemingly Unrelated Regressions (SUR) to account for this potential bias. In the case that the system of equations are indeed related through the "contemporaneous correlation," estimation through SUR will be more efficient as compared to OLS Zellner, Arnold. 1962. "An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias." *Journal of the American statistical Association* 57(298): 348–68. Although in most cases the Breusch-Pagan test indicates that errors are correlated across equations, we do not present the SUR results here because results do not change from simple OLS models.

employment or care giving. There are generally few bivariate differences in time allocation by pregnancy status across all countries. In China, women who are pregnant in the earlier panel spend fewer hours on housework, and pregnant women in both panels spend fewer hours working in agriculture. In Mexico, pregnant women spend more time care giving and less time working self-employed or outside the home. In Tanzania, no significant differences are found.

4.2 Cross-sectional and individual fixed effects regression results

Table 3 presents a summary of coefficients on pregnancy from our main cross-sectional and individual-level fixed effects regression models by country (Panels A1 and A2, China; Panel B, Mexico; Panel C, Tanzania). In both cross-sectional and fixed effects models in both China panels, women spend significantly less time care giving while pregnant. The main difference between the earlier and later panels is that the negative impact of pregnancy on care giving is attenuated in the later panel. In addition, results from the fixed effects model indicate that pregnant women actually increase their time working for pay, and the magnitude of this effect is especially large the later panel. In Mexico, pregnancy is not found to significantly affect time use in the outcomes reported. Finally, in Tanzania, although pregnancy is negatively correlated with time spent performing housework in the cross-sectional model, the effect is not robust to the inclusion of fixed effects.

4.3 Extensions

As an extension to the main models, we replicate our cross-sectional and individual fixed effects models including interaction terms between wealth (bottom 40 percent of wealth quintiles) and pregnancy.[5] Our hypothesis is that women who are poorer will have fewer resources, fewer assets and increased time burdens with which to manage reproduction and productive activities, and thus effects may be found among these women who differ from their relatively wealthier counterparts. A summary of the results are reported in Table 4 which show interaction terms and coefficients on pregnancy and wealth indicators by country for both pooled cross-sectional and individual fixed effects models. Results from the fixed effects model show that all interaction terms are insignificant across time allocation activities, countries and models. In general this suggests that relatively poorer and richer women in rural areas do not differ in their labor-intensive activities based on pregnancy status.

Another potential concern is that thus far, pregnancy has been treated as a uniform state, when in fact, women may modify their behavior along the timeline of their pregnancies. In particular, one may suspect that in the first and second trimesters, women may be able to continue their normal activities, and it is only in the later stages of pregnancy that they need to modify their labor-intensive work. Due to data constraints, we are only able to identify the month of pregnancy in the Tanzanian and Mexican data. We replicate our main models using two variations: 1) first, we include indictors for pregnant in the first/second trimester,

[5]We also considered interactions with education under the hypothesis that higher educated women, who are more likely to be of a higher socioeconomic status, may manage reproduction differently as compared to their less educated peers. However, the samples of those in the highest education brackets who are pregnant are too small to confidently estimate effects and thus we do not present results.

and pregnant in the third trimester separately, 2) second, we include a continuous indictor denoting months pregnant. Note that in the second variation, women who are not pregnant have a value of zero. When we test these two variations, we find that results are unchanged from the main analysis for Tanzania, but we do find differences for Mexico. Namely, in the fixed effects models being in the last trimester of pregnancy is associated with fewer hours spent in employment ($\hat{\beta}=-0.94$, $se=0.39$) as compared to not being pregnant, but there are no significant differences in time use between non-pregnant women and those in the first two trimesters of pregnancy. In the fixed effects model specifying months pregnant as a continuous variable, differences were not significant at the 0.05 level. Future analysis with a larger number of pregnant women is needed to more clearly identify stage of pregnancy in relating status to labor intensive activities.

5. Discussion and conclusions

Interactions between reproduction and time use in both productive and reproductive time use are complex. Development economists have advanced the understanding of gendered effects and program dynamics surrounding labor-intensive agricultural work and time use. Meanwhile, health researchers have increased knowledge around pregnancy and infant health in low-income settings. However, there has been little advancement of what we know about the interaction of these two areas of research. From a policy perspective, these explorations are not straightforward. While there may be some beneficial effects for children's development when women are able to stay home from the field or market based activities, there may be adverse effects on these women's bargaining power (which directly affects children's welfare) within the household when they cease to bring home an independent source of income. From a health perspective, it is preferable if pregnant woman spend less time carrying water, but the tradeoff may be sending a young girl instead, or using water from a nearer unclean source, neither of which is ideal. Despite these complexities, the linkages between reproduction and productive activities are a central concern over the course of women's lives in developing countries, and thus a better understanding of the dynamics surrounding these issues is essential for those engaging in gender and development policy, research and program implementation.

The analysis of longitudinal data from China, Mexico and Tanzania finds little evidence that women significantly modify time spent in physically demanding activities during pregnancy, and that this is true among all women, not limited to those who are asset or resource poor. Although this finding is in contrast to evidence from the public health literature, largely based on cross-sectional analysis among small samples, it is supported by empirical evidence from fertility and labor force participation studies. For example in a study using over 100,000 retrospective fertility histories in Brazil found that differences in fertility across women were only weakly associated with differences in labor supply, most notably among women with multiple children (Lam and Duryea 1999). A plausible suggestion for this unexpected finding is that the time constraint is not binding in developing countries because women can engage in home production and other types of work in the informal sector and other activities simultaneously. In a recent study from Ghana, the authors found that in the Accra Metropolitan Area, women did not lower their labor force participation; while they worked slightly less during pregnancies, the return to the labor market after

giving birth was fairly immediate (Hill et al. 2010). Qualitative work on time use has suggested that, especially in the case of childcare for women, multitasking is more common and that strict demarcation between different activities is hard to identify (Bittman and Wajcman 2000; Floro 1995; Mattingly and Blanchi 2003). Traditional neoclassical household models were often created to be applicable to developed countries where home production activities are relatively straightforward. In contrast, home production in developing countries (particularly in rural regions) is often limited by the failure or complete absence of markets for basic services, which results in the need for activities such as fetching water, and carrying firewood.

The exceptions where we find significant time use difference beyond care giving, are in the later China panel where women increase time spent in self and employment work and in the Mexican sample, where women in the last trimester of pregnancy reduce time spent in employment. In China, these relationships may be a product of relative economic development, for example employer based benefits like maternity leave or ability to use earnings to pay for child care. In Mexico, they may be a function of maternity leave policies and/or employer discrimination, described in more detail below.

As with many studies, there are inherent limitations to both the data and methodology. First, data on time allocation are notoriously hard to collect and analyze (Apps 2004; Floro 1995; Ilahi 2000). Although we utilize questions on weekly time use (primarily because of the lack of reproductive indicators in specialized time-use surveys), time diaries generating 24 hour recall data are generally thought to be more reliable (Juster and Stafford 1991). Because of the lack of detailed time data, we are not able to identify changes in intensity with respect to a given activity, which may capture more subtle differences between non-pregnant and pregnant women's time use, or labor shifting to unmeasured activities. Second, an econometric concern when examining hours worked per week in a given activity is how to model an outcome which has mass points at zero hours and which may have skewed distributions. In particular, women who report any activity or positive hours in a given activity may be somehow systematically different as compared to those who report no activity. Although a potential fix to the selection (distribution) problem, we do not attempt to implement Tobit or selection models, because they do not allow for fixed effects panel modeling. In addition, although we analyze large-scale household surveys, these data were not designed to oversample pregnant women, and thus pregnancy status is still a relatively rare among the women sampled. It is possible that the lack of statistical significance could have been reversed if surveys had sampled different women, or if larger samples were collected which included more pregnant women. Finally, while the fixed effects approach assumes that the source of endogeneity is time invariant, we acknowledge the possibility that time variant bias exists, which may affect both time use and reproductive status.[6] However, since our panels are all relatively short (two to three years), we have confidence that the largest source of bias is time invariant. For example, fertility and family size

[6]The solution for this problem would typically include an instrumental variable approach. We explore this approach using the Tanzanian sample which includes a number of potential instruments including community-level availability of family planning services. In addition, we test potentially exogenous fertility shocks such as the sex ratio of surviving children and the sex of last born child. Unfortunately none of these instruments are strong enough to be considered valid predictors, and thus we do not present the models or instrumented results.

preferences are likely to be fixed over time, whereas in the short term an additional birth can be seen as essentially random.

The three countries studied here vary widely with respect to socioeconomic status, cultural contexts, health care delivery, and policies addressing maternal well being. In China, there have been a number of recent policy changes aimed at improving maternal well being. These include the expansion of the rural New Co-operative Medical Scheme (NCMS) since 2003 to include a maternal care benefit package, the Central government's Special Provisions on Labor Protection of Female Employees that took effect in May 2012[7], and various local government efforts to provide financial aid for pregnant women.[8] Studies have found that the use of maternal care in rural China may have improved as a result. However, the financial burden relating to the use of prenatal care and facility-based delivery for the rural poor remains high (Long 2012), and population control policies in China likely limit improvements in maternal well-being. For example, studies have shown that women with unauthorized pregnancies and births seek and/or obtain significantly less maternal care (both pre- and post-natal care and facility-based births) (Klemetti et al. 2011; Short and Zhang 2004). It is possible that maternal well being could improve further if China's central government takes on recent recommendations to relax its population control policies.[9]

In Mexico, health care is delivered through a patchwork of social security institutes, governmental services headed by the Ministry of Health, and the private sector. Even within the public sector, the government maintains multiple, parallel health care systems targeted towards different groups (Barraza-Lloréns et al. 2002), and health disparities are evident across socioeconomic groups as well as states (Secretary of Health [Mexico] and Pan American Health Organization (PAHO) 2007). The Constitution protects women from engaging in work that demands "considerable force or endangers their health with respect to the pregnancy" and specifies that they are entitled to one month paid leave prior to delivery and two months post-delivery (Political Constitution of the United Mexican States [Constitución Política de los Estados Unidos Mexicanos]). In addition, lactating mothers are legally entitled to two half-hour breaks per day. However, enforcement and implementation of maternal leave laws are not uniform, particularly for domestic and temporary workers, and one study of Mexican women delivering at three major hospitals found that women without antenatal leave benefits had higher odds of small-for-gestational age babies and preterm deliveries (Guendelman et al. 2009). Even within formal sector employment, these protections may not be adhered to and there may be discrimination against pregnant women, as has been documented in *maquiladoras*, or export factories, where women were often

[7]The Special Provisions on Labor Protection of Female Employees (Central People's Government of the People's Republic of China website (May 7, 2012)) now entitles female employees to 98 days of maternity leave for childbirth (from 90 days) with extensions for cases with delivery complications and multiple births. The provisions also set forth guidelines for compensation during leave and for payment of health-related expenses. Employers must also give one hour of work time each day to lactating female employees for breast-feeding. Importantly, the Special Provisions adjust the scope of jobs that employers cannot assign to female employees in general or during menstrual periods, pregnancy, or lactation, respectively.

[8]For example, 2007 and 2008, Gansu and Shaanxi province each instituted a financial aid for pregnant women that covers prenatal care, child-birth and post-natal care in poverty-stricken rural counties.

[9]The China Development Research Foundation, a Chinese government think tank under the Cabinet, is urging the country's leaders to start phasing out its one-child policy immediately, allowing a two-child policy in some provinces starting 2012, and a nationwide two-child policy by 2015. It proposes all birth limits be dropped by 2020 (Cite: http://www.telegraph.co.uk/news/worldnews/asia/china/9645210/China-should-move-to-two-child-policy.html).

discriminated against for becoming pregnant or are required to take a pre-employment pregnancy test (Williams 2005).

In Tanzania, maternity leave is formally covered under the Employment and Labour Relations Act (2004), whereby women are eligible for 84 days of paid maternity leave and are allowed more in the case of multiple or complicated births. However, these formal regulations do not apply to the majority of the population who reside in rural areas and work in the informal sector. Further, the Act limits benefits to four births per woman per employment contract. Although maternal health services in public and government funded facilities is provided free of charge, high maternal mortality and fertility rates demonstrate the need for improved services (Ministry of Health and Social Welfare [Tanzania] April 2008) and emphasis on community-based interventions for bridge coverage gaps (Gross et al. 2012; Mushi, Mpembeni and Jahn 2010).

Therefore, in general across the three countries, although there have been advancements in formally regulated maternity leave policies, as well as in service provision, particularly in terms of social safety nets to alleviate the financial burden related to pregnancy, there is still little focus on intensive labor force and work considerations during pregnancy. Prenatal leave policies have been introduced around the world varying from one week to eight weeks, however with the exception of the recent policy change in China, none of the countries offer explicit rules for leave during pregnancy or for flexibility in dividing leave between pre- and post-natal periods (International Labour Organization 1999). If the assumption that women reduce physical labor during pregnancy does not hold in developing countries with potential negative health impacts for women and children, what are the program and policy implications resulting from this finding? Broadly, two main promising areas of intervention are formal and informal programs to assist mothers and pregnant women participate in work activities, or alternatively investment in public provision of infrastructure such as water and electricity which may alleviate gender-specific work burdens (Quisumbing, Hallman and Ruel 2007). The need for childcare and maternity services targeted towards women's economic sphere has been previously noted, but rarely emphasized. A study in Ethiopia found nearly 27 percent of women cite childcare as a reason for not applying to public works (typically food-for-work) programs in rural areas in contrast to approximately three percent of men (Quisumbing and Yohannes 2004). In a survey of 50 women working in the sugar beet industry in Egypt, 12 percent reported leaving children alone at home, 70 percent left children with grandmother or brothers, 10 with other relatives or neighbors and eight percent brought children to the fields with them (El-Eshmawiy, El-Shiraif and El-Khafif 2007). There have been some innovative and promising interventions developed to tackle lifecycle issues, which can be used as a starting point for program innovation. For example, in Gambia, the Baby-Friendly Community Initiative (BFCI), coordinated by The Gambia's National Nutrition Agency, runs a demand driven intervention to promote exclusive breastfeeding in rest houses that are built where women can breastfeed while working their fields. In addition, some participatory communities have instituted policies of community assistance for women during the three months before and six months after delivery to mirror traditional government provided maternity leave (Jallow 2005; Jallow 2006). Although increasingly pubic infrastructure in rural areas of rural developing countries is implemented and analyzed with an aim to reduce time burdens for women or investigate intra-household

effects, the potential impact of these types of projects to affect women's time use remains largely unexamined (Chakraborty 2008; Lawson 2007).

This study has taken a first step at utilizing large-scale data collected for economic analysis to examine the linkages between reproductive health and labor-intensive time use. Although we find no statistically significant differences between pregnant and non-pregnant women, this could be due to a number of limitations, particularly around sample size of pregnant women and inability to account for labor intensity or timing of pregnancy sufficiently in our data. In addition, a more complete analysis should account for labor shifting within the household, potentially in response to a woman's pregnancy. We hope this study will underscore the research gap in examining how to aid poor women in managing double burden of productive and reproductive roles, particularly in the context of livelihood programming and delivering maternal health assistance, and stimulate further rigorous research to contribute to our understanding surrounding these linkages.

Acknowledgments

We thank John Hoddinott, Agnes Quisumbing, participants at the PAA meeting 2010 and two anonymous reviewers for helpful comments on earlier drafts. The findings, interpretations and conclusions expressed in this paper are entirely those of the authors, and do not represent the views of the institutions with which they are affiliated. All errors are our own.

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Appendix materials

Table A1

Definitions of labor intensive time use variables in China, Mexico and Tanzania

Panel A: Reproductive Labor	**Description (*number hours weekly spent…*)**
(1) Housework	
China	Domestic chores (e.g buying/cooking/preparing food, washing clothes)
Mexico	Domestic chores (e.g. cooking/preparing food, washing clothes, cleaning) and fetching water, carrying firewood.
Tanzania	Domestic chores (e.g. preparing meals, cleaning, doing laundry, s hopping for food), fetching water, carrying firewood.
(2) Care giving	
China	Caring for own or other's children.
Mexico	Caring for children, sick individuals, and elderly.
Tanzania	Caring for or visiting sick household members.
Panel B: Productive Labor	
(3) Agriculture and livestock	
China	Working field/garden plots, fishing and lifestock.
Mexico	Working field/garden plots and caring for animals.
Tanzania	Working field/garden/plots (e.g. preparation and planting, weeding, pruning, applying fertilizer), caring for livestock (e.g. feeding, tending, transporting), processing crops or livestock products (e.g. harvesting, transforming, marketing).
(4) Self employed or work for pay	
China	Handicraft, household business or market based employment. Time recorded for up to two self or employed business activities.
Mexico	Work including paid, self-employed, selling handicrafts, and sale of other homemade products.
Tanzania	Working for self or household in an independent activity (e.g. fisherman, lawyer, medical) or working for someone outside the household (e.g. government, firm, private enterprise). Time recorded for up to two self or employed business activities.

Notes: All measures are hours on a weekly basis, definitions are authors interpretations based on survey questions.

Table A2

Control variables in China, Mexico and Tanzania

	China (CHNS)		Mexico (MxFLS)	Tanzania (KHDS)
	(1997–2000)	(2004–2006)	(2002–2005)	(1991 – 1994)
Individual level controls[a]	**Mean**	**Mean**	**Mean**	**Mean**
Age (years)	36.19	38.64	31.28	26.58
Age squared (years squared)	1379.94	1539.43	1067.67	808.09
No schooling	--	--	0.07	0.10
Incomplete primary schooling	0.26	0.13	--	0.34
Some/completed primary schooling	--	--	0.50	
Completed primary schooling	0.6	0.66	--	0.42
Some/completed secondary schooling	--	--	0.29	--
Secondary or above schooling	0.14	0.21	--	0.04
Above secondary schooling	--		0.14	--
Married, union (reference category)	0.88	0.95	0.66	0.46
Never married	0.10	0.04	0.30	0.37
Widowed, separated, divorced	0.02	0.01	0.05	0.17
Household level variables				
Bottom 40 percent of wealth index	0.40	0.39	0.37	0.43
Number of 0–5 year olds in household	0.08	0.07	0.75	1.43
Number of 6–17 year old males in household	0.54	0.29	0.89	1.40
Number of 6–17 year old females in household	0.48	0.25	0.94	1.66
Number of 18–59 year old males in household	1.25	1.02	1.20	1.11
Number of 18–59 year old females in household	1.33	1.19	1.70	1.79
Number of 60+ year olds in household	0.20	0.21	0.31	1.25
Community level variables				
Population (in 1,000s)	2.96	3.88	7.13	3.24
Electricity	--	--	0.92	0.17
Piped water	--	--	0.67	0.12
Bank	--	--	0.43	0.13
Public transportation	--	--	0.37	0.30
Transportation score (0–10) [b]	4.97	5.66	--	--
Communications score (0–10) [b]	6.76	5.97	--	--
Economic score (0–10) [b]	4.65	6.22	--	--
Health facilities score (0–10) [b]	5.89	5.24	--	--
Sanitation infrastructure score (0–10) [b]	5.92	6.84	--	--
Housing infrastructure score (0–10) [b]	4.77	6.36	--	--
Regional indicators[c]				

	China (CHNS)		Mexico (MxFLS)	Tanzania (KHDS)
	(1997–2000)	(2004–2006)	(2002–2005)	(1991 – 1994)
Individual level controls[a]	**Mean**	**Mean**	**Mean**	**Mean**
Northern region	0.26	0.40	--	--
Central region	0.38	0.31	--	--
Southern region	0.36	0.29	--	--
Pacific North region	--	--	0.18	--
North Central Gulf region	--	--	0.21	--
Bajio region	--	--	0.19	--
Central region and Mexico City	--	--	0.28	--

Note: Sample is limited to women ages 15 to 49. Control variables for seasons (months) and for endline (=1) in the case of OLS regressions are included but not reported in all countries. Time non-variant indicators are 'differenced out' of fixed effects panel regressions. In China and Mexico this results in the exclusion of regional indicators and in Tanzania community-level economic indicators are dropped.

[a] Differences in education categories reflect differences in response categories and relative distributions of educational attainment in each country (e.g. since Chinese women are relatively better educated, it does not makes sense to include a category “no schooling” as in Mexico and Tanzania).

[b] Scores are community-level measures of urbanicity ranging 0 – 10 with 10 being more developed (see Ng et al., 2009 for details on construction and components).

[c] Regional indicators are omitted for Tanzania, as data are entirely from the population living in the Kagera region.

Table 1

Key reproductive health indicators in China, Mexico and Tanzania

	China (CHNS)		Mexico (MxFLS)	Tanzania (KHDS)
	(1997–2000)	(2004–2006)	(2002–2005)	(1991 – 1994)
Key indicators	**Mean**	**Mean**	**Mean**	**Mean**
Currently pregnant	**0.01**	**0.01**	**0.03**	**0.08**
Auxiliary indicators				
Age (years)	36.19	38.64	31.28	26.59
Currently married/partnered	0.88	0.95	0.65	0.46
Ever pregnant	--	--	0.68	0.61
Total fertility (parity)	--	1.45	2.35	2.74
Contraceptive use	--	--	0.58	0.11
Currently breastfeeding	0.02	0	0.07	0.15
Sample Size	2538	2356	3840	1806

Note: Sample is limited to women ages 15 to 49; contraceptive use includes both modern and traditional methods.

Table 2

Descriptive and bivariate analysis on time use outcomes and reproductive health by survey

	China (CHNS) (1997–2000)			China (CHNS) (2004–2006)			Mexico (MxFLS) (2002–2005)			Tanzania (KHDS) (1991–1994)		
Time use (hours last week)	**Any activity (hours>0)**	**Non-pregnant Mean N=2510**	**Pregnant Mean N=28**	**Any activity (hours>0)**	**Non-pregnant Mean N= 2328**	**Pregnant Mean N= 28**	**Any activity (hours>0)**	**Non-pregnant Mean N=3735**	**Pregnant Mean N=105**	**Any activity (hours>0**	**Non-pregnant Mean N=1668**	**pregnant mean N=136**
Housework	0.91	16.12	10.42**	0.95	9.38	7.88	0.94	22.38	23.97	0.91	14.10	14.73
Care giving	0.15	5.76	7.25	0.18	4.42	2.25	0.42	12.85	17.76*	0.21	1.15	1.14
Agriculture	0.69	25.01	14.21*	0.56	17.86	7.89*	0.06	0.57	0.36	0.80	15.33	14.02
Working self or employed	0.87	47.68	54.04	0.76	45.05	38.14	0.27	10.19	5.06**	0.14	2.18	2.82

Note: Mean values are preserved (not log transformed) for descriptive presentation, for details on components of time use see Table A1. Sample is restricted to wome levels reported from t-tests.

* denotes significance at the 5% level.

** at the 1% level.

Table 3

Summary of pregnant coefficients from cross-sectional and individual-level fixed effects regression models in China, Mexico and Tanzania

Time use (logged hours last week)	Cross-sectional Coeff (SE)	Individual FE Coeff (SE)
Panel A1: China CHNS (1997 – 2000; N = 2538)		
Housework	0.02	0.02
Care giving	−1.24**	−2.84**
Agriculture	−0.76	−0.22
Working self or employed	0.33	0.81*
Panel A2: China CHNS (2004 – 2006; N = 2356)		
Housework	−0.02	0.08
Care giving	−0.94**	−1.05*
Agriculture	−0.23	−0.30
Working self or employed	0.09	1.11*
Panel B: Mexico MxFLS (2002 – 2005; N = 3840)		
Housework	−0.02	0.04
Care giving	−0.01	−0.71
Agriculture	−0.04	0.04
Working self or employed	−0.15	−0.41
Panel C: Tanzania KHDS (1991 – 1994; N = 1806)		
Housework	−0.22*	−0.11
Care giving	−0.02	0.00
Agriculture	−0.22	−0.09

Note: Coefficients are from OLS pooled cross-sectional and individual fixed effects models where dependent variables are logged hours per week. For details on construction of outcome indicators see Table A1. Control variables are at the individual, household and community level and are described in Table A2. Standard errors are clustered at the community-level. Sample is restricted to women ages 15 to 49.

* denotes significance at the 5% level

** at the 1 % level.

Table 4

Summary of reproductive health coefficients and interactions with wealth from individual-level fixed effects regression models in China, Mexico and Tanzania

Time use (logged hours last week)	**Pregnant Coeff (SE)**	**Pregnant*Wealth Interaction Coeff (SE)**
Panel A1: China CHNS (1997 – 2000; N = 2538)		
Housework	−0.10	0.27
Care giving	−2.97**	0.31
Agriculture	−0.41	0.44
Working self or employed	0.77	0.09
Panel A2: China CHNS (2004 – 2006; N = 2356)		
Housework	0.23	−1.05
Care giving	−0.78	−1.91
Agriculture	−0.18	−0.90
Working self or employed	1.18*	−0.54
Panel B: Mexico MxFLS (2002 – 2005; N = 3792)		
Housework	0.23	−0.52
Care giving	−0.66	−0.12
Agriculture	0.07	−0.07
Working self or employed	−0.37	−0.10
Panel C: Tanzania KHDS (1991 – 1994; N = 1806)		
Housework	−0.23	0.23
Care giving	−0.02	0.04
Agriculture	−0.33	0.45
Working self or employed	−0.06	0.05

Note: Coefficients are from individual fixed effects models where dependent variables are logged hours per week and interaction terms with bottom 40 percent of wealth index. For details on construction of outcome indicators see Table A1. Control variables are at the individual, hosuehold and community levels and are described in Table A2. Standard errors clustered at the community-level. Sample is restricted to women ages 15 to 49.

* denotes significance at the 5% level,

** at the 1% level.