The United States Fertility Decline: Lessons from Slavery and Slave Emancipation

Wanamaker, Marianne

The University of Tennessee

July 2009

The United States Fertility Decline: Lessons from Slavery and Slave Emancipation

Marianne H. Wanamaker[†]
Department of Economics
The University of Tennessee, College of Business Administration

February 2012

Abstract

Economic theories of fertility decline often center on the rising net price of children. But empirical tests of such theories are hampered both by the inability to adequately measure this price and by endogeneity bias. I develop a model of household production in the 19th century United States with own children and slave labor as inputs and use the model to show how the price of own children would have changed with changes in the household's slaveholdings. I propose that slave children born to mothers owned by Southern households imparted plausibly exogenous shocks to the net price of the slaveowning household's *own* children. Using a panel dataset of white Southern households between 1850 and 1870, I measure the fertility response of families to this changing price and show a strong, negative correlation between the predicted price of children and household fertility rates. To further corroborate these results, I measure the fertility response of households to another shock to the price of their own children: slave emancipation. Again, I find a strong, negative correlation between predicted prices and fertility rates. The results are consistent with theories of the demographic transition centered on the rising price of children.

[*] Many thanks to Raquel Bernal, Hoyt Bleakley, Lou Cain, Joseph Ferrie, Mark Guglielmo, Tim Guinnane, Charles Manski, Robert Margo, Joel Mokyr, John Parman, Chris Taber, and Celeste Carruthers for helpful comments and suggestions. Comments from participants at the Northwestern University Economic History Seminar, Northwestern Labor Lunch and the University of Chicago Center for Population Economics Workshop on Economics & Biodemography of Aging and Health Care are gratefully acknowledged. In addition, I thank The Graduate School at Northwestern University for providing funding for this research.
[†] wanamaker@utk.edu

1 Introduction

Fertility rates in most of the developed world are currently at or below replacement rate, the level needed to prevent population decline. In many cases, these low rates are the result of decades, and even centuries, of declining fertility, and economists have put forward a number of theories to explain this demographic transition. Beginning with Becker (1960), many economists have conceptualized fertility as the outcome of a household's utility maximization problem subject to its resource constraints. In Becker's formulation, children enter the household utility function in parallel with other consumption goods and carry a positive market price. This price incorporates the direct costs of bearing and rearing children and can incorporate the shadow price of time invested by the parents as well. If children are producers within the household, rather than simply objects of consumption by their parents, their price also incorporates the positive returns associated with the child's household production. The inverse of this price is the child's value, and, *ceteris paribus*, increases (decreases) in the value of children will result in increases (decreases) in household fertility. This basic idea, which this paper will label the "value hypothesis," has given rise to a host of economic theories of the United States fertility decline highlighting different ways in which the value of children has declined over time.[1,2]

For the United States, replacement-level fertility is the culmination of a demographic transition more than 200 years in the making.[3] A simple use of the value hypothesis to explain U.S. fertility patterns is as follows: Early in the 19th century, the net price of children was low. Children worked as laborers on the family farm until early adulthood before marrying and moving, generally to a nearby location. Once the child left the homestead, they still contributed positive value to parents by serving as old-age security. With the "carrot" of land inheritance, parents could ensure that their children provided for them later in life. This mechanism for providing old-age insurance was especially important in the absence of a mature financial system. Over the course of the 19th and 20th centuries, however, the value of children to their parents began to decline due to both a rise in the costs of children and a decline in their benefits. Higher education costs and rising opportunity costs of female time spent in childrearing increased

[1] In later work, Becker calls models such as this "Economic Theories of Fertility." See Becker & Barro (1988). However, in order to distinguish models like this from others in the broader economics literature, I will refer to this cadre of theories as adherents of the "value hypothesis".

[2] Alternative theories of fertility decline abound. In the economics literature, the quantity/quality (Q-Q) hypothesis suggests that changes in the return to investments in human capital precipitated the fertility decline. See Becker & Lewis (1973). Q-Q theories are also similar in spirit to the fertility conjectures of Unified Growth Theory summarized in Galor (2005). The Princeton Project on European Fertility focused on diffusion hypotheses of decline, positing that the spread of cultural norms or contraceptive technologies could explain fertility patterns. See Coale & Watkins (1986), Cleland & Wilson (1987). Other theories have focused on the changing dynamic within households, in particular the increasing bargaining power of women. See Manser & Brown (1980).

[3] American fertility fell from a high of 7.1 children per female in 1800 to 2.2 children by 2000 as measured by the Total Fertility Rate (TFR): the total number of children a woman would bear if she experienced the current age-specific fertility rate throughout her lifetime. See Haines (2008).

the costs associated with children, and an occupational shift from agriculture to manufacturing and service sectors, more stringent child labor laws, an increasing availability of substitute old-age insurance, and downward pressure on manufacturing wages reduced their benefit. The result was a decline in the economic value of children, an increase in their net price and, thus, a lower fertility rate.

To evaluate the validity of such theories, previous empirical work has stipulated an OLS relationship between a dependent fertility rate and an independent approximation of the net price of children, conditional on other attributes of the population in question. The most common technique in the literature is to capture the price of a child with a proxy for one or more of the cost or benefit components mentioned previously, for instance the labor force participation rate of females, the size of the agricultural labor force, or the stringency of child labor laws. Such a method is limited both by the inability of these variables to serve as adequate proxies and by omitted variable bias. Any unobserved variable that is correlated with these proxy variables will contribute to a bias in the estimated effect of these economic considerations on fertility outcomes. To accurately measure the impact of changes in the price of children on fertility rates, it would be useful to observe a "shock" that changes the price of children for households yet is independent of other characteristics of the household.

This paper contributes to the literature on fertility decline by measuring the response of households to plausibly *exogenous* changes in the net price of children. I propose that Southern slaveowners in the 19th century were subject to exogenous shocks to the net price of their children via the fertility of their owned slaves. I build a model of household production to highlight the potential substitutability between own children and slave children. Under the premise that household fertility falls with the price of own children, the testable implication is that positive shocks to slave fertility would have reduced the benefit owners would have received from their own children and resulted in lower fertility rates for slaveowners. I construct a panel dataset of slaveowners' household characteristics and slaveholdings and use this to measure the fertility response of households to slave births. I find that white slaveowner fertility declined in the two years immediately following the birth of a slave child, and the decline is both economically and statistically significant. I find no evidence that the household compensated for this lost fertility in later years.

One potential concern with this exercise is that the fertility of owned slaves was not always independent of the preferences of the slaveowner or was otherwise correlated with unobservables of the household also impacting household fertility. Slave emancipation in 1865, on the other hand, was unanticipated, unaffected by the preferences of slaveowners and orthogonal to household characteristics. I further test the value hypothesis in the context of this historical episode. Again, the labor shock resulting from emancipation changed the net price of the former slaveowner's own children and, if the value hypothesis is correct, should have affected slaveowner fertility. Using panel data to measure the relationship between pre-emancipation slaveholdings and post-emancipation fertility, I find that those households for whom the model predicts the price of children increased the most after emancipation experienced the lowest subsequent fertility. Those with a predicted decrease in the price of children had the highest fertility rates.[4]

Thus, using both changes in slave fertility and the 1865 emancipation of all Southern slaves, I find that the net price of children and household fertility were negatively correlated in the mid-19th century United States. These findings are consistent with value hypotheses of fertility decline.

2 Empirical Strategy

Consider an antebellum slaveowning household in the American South whose household production inputs consist of family members plus the household's slaves. The price of a slaveowner's own children incorporates the direct and indirect costs the household incurs in bearing and rearing the child, less the benefits the child brings to the household. In the 19th century United States, the benefits of children included the present value of their future contributions to household production and their value in providing old-age insurance for their parents, in addition to any traditional consumption utility for their parents.

Now consider the change in the price of an additional child for this household resulting from an exogenous increase in the number of slave children owned by the household. In the model developed below, slave children and own children are substitutes in a household production function with diminishing marginal returns. An exogenous increase in the number of owned slave children results in a reduction in the benefit coming from the household's own children and an increase in their net price. If the value hypothesis of fertility decision-making is correct, this should induce lower household fertility.

The change in the price of a slaveowner's own children will be larger the stronger the substitutability between slave children and own children in the household production function. The historical record indicates that this substitutability was strongest on smaller farms with few slaves where household members and slaves worked side-by-side while

[4] In addition to substitutability between slave children and own children, the model highlights a complementarity between adult slave females and own children.

larger farmers typically relied solely on slave labor for household production. McCurry (1995) describes the reliance of small Southern farmers on *both* slave and family labor, stating that “even the man who owned nine slaves was still by all account, a ‘self-working farmer,’ whose regular calculus of production on the one hundred-odd acres he would typically have cultivated included his own manual labor and, most likely, that of his sons, daughters, and even, on occasion, his wife.”[5] Other historians have reached similar conclusions about the close interaction between own children and slaves on small farms[6], and several have highlighted the similarity of function performed by each.[7]

Further, inasmuch as owners viewed slave children as security for old age, a slaveowner’s own children and his child slaves were substitutes for each other in this way as well. At this point in American history, the argument goes, security in old age could be purchased on the market, but only in the form of human assets. More traditional financial assets for old-age security required a more developed financial sector, and loyal, attentive care for old age must have been “bred” in the years prior in the form of own children. A slave could substitute for own children as old-age insurance if he or she had lived with the household long enough to develop such a relationship. This would have been easiest for slaves owned since their childhood.[8]

Thus, slave children and own children would have been strong substitutes for each other, especially on small farms. This framework generates two testable implications. First, because the birth of a slave child delivered an exognenous, positive shock to the price of children for the slaveowning household, we should observe reductions in household fertility following births of slave children. Second, the magnitude of a household’s fertility response to the birth of slave children should be negatively correlated with the size of its slaveholdings. Larger slaveholders should have muted own fertility responses to slave fertility events while small slave labor force owners should be more sensitive to these events.

It remains possible, of course, that the birth of a slave child was not independent of the preferences of slaveowners themselves or of other unobservable household characteristics also impacting fertility. Slaveowners influenced the fertility of their slaves in a number of ways, some more coercive than others, and the assumption that slave fertility was exogenous to household fertility decisions is thereby violated. In particular, if slaveowners chose to increase

[5]p.50. The majority of Southern slaveowners were not owners of large cotton plantations. In 1860, 88% of slaveowners held fewer than 20 slaves, and 59% held fewer than five slaves. The median number of slaves owned by slaveowners in the sample in this paper is 5.

[6]Hahn (2006) describes a tight-knit labor force on small farms composed of the farmer, his immediate family, and his owned slaves.

[7]See Steckel (1996).

[8]Just such an argument is used in Carter et al. (2002) where they state that “child default [on providing old-age insurance] seems to have been a less powerful catalyst in the South because slaves to some extent could substitute for children to provide security in old age.” (p.39) They find that the percentage of the local population enslaved is negatively correlated with fertility rates in the antebellum South and use that as evidence to support their hypothesis.

the fertility of their slaves and, simultaneously, to reduce their own fertility, then any observed negative correlation between slave and own fertility is partially spurious. Although this scenario seems unlikely, it remains a point of concern.[9]

As a further test of the value hypothesis that avoids this issue, I utilize slave emancipation as another observable shock to the price of a slaveowner's own children. By 1865, all Southern slaves had been released from bondage and became potential participants in the labor market. This emancipation represented a positive shock to the cost of labor in the postbellum Southern labor market.[10] The direction of the shock to the price of own children, on the other hand, depends on the nature of the relationship between slaves and children in the household production function. If slaves and own children were substitutes, the result was a decrease in the net price of own children. On the other hand, if slaves and own children were complements, the result of emancipation was a net increase in the price of own children.

Substitutability between slaves and own children was weakest on larger farms and for owners of slave adults and strongest on small farms and for owners of slave children. Like their counterparts on small farms, adult and child slaves on large farms would typically have been employed in the fields. But in contrast to the *modus operandi* on small farms, the children of plantation owners were unlikely to be so-employed. This was true before emancipation and remained true afterward. Whereas a small slaveowner's post-war method of farming closely resembled his pre-war method, larger plantation owners resorted to sharecropping to fulfill their labor needs. These former large slaveowners

[9]It seems much more likely that unobserved factors may have caused slaveowners to seek increases in both slave and own fertility simultaneously. In that case, the observed correlation between slave and own fertility is biased upward. Any estimated negative impact of slave fertility on own fertility is estimated with a bias towards zero.

[10]Specifically, emancipation represented a positive shock to the price of an effective unit of labor for Southern households, where an effective unit is the amount of labor required to produce a given amount of output. In other words, the cost of the labor input increased in the postwar period where cost is the price of labor multiplied by the quantity needed to produce a given level of output. The cause of this increase in the price of labor was three-fold. First, the efficiency of labor in the postwar years declined dramatically. Emancipation represented a wholesale change in the method of production on some Southern farms. In particular, the gang labor system so often employed on large plantations was replaced by small plot farming and sharecropping. As a result, the productivity of Southern labor declined by approximately 30-40% between 1860 and 1880. See Moen (1992) and Margo (2004). Fogel & Engerman (1974) reach a similar conclusion, stating "large slave plantations were about 34 percent more efficient than free southern farms." (p.209). If nominal wages declined by an equivalent amount, the price of an effective unit would not have changed. But inasmuch as the postwar decline in wages was smaller than the efficiency decline, the price of an effective unit of labor input would have increased. Second, the labor available for hire in the postwar labor market was negatively selected in terms of efficiency. According to Ransom & Sutch (2001), the most efficient freedmen sorted into sharecropping on former plantations. (p.181) The labor remaining for hire by former slaveowners would have been less efficient than that available in the prewar period when all slaves, even the most efficient, were available for purchase. Again, if wages adjusted to reflect this efficiency decline, the cost of labor as an input would not have changed. But with sticky wages, the price of an effective unit of labor would have increased. Finally, for the first time in their lives, former slaves made their own decisions about whether to engage in market labor, at what price, and at what level of effort. Not surprisingly, former slaves participated in the free market at a lower rate than they had under coercion. As a result, emancipation represented a negative supply shock in the labor market. Standard economic theory would suggest that the nominal price of labor increased accordingly. Indeed, this is the conclusion of Ransom & Sutch (2001). "The high demand for labor and the labor shortage produced by emancipation, coupled with the pressure from the Freedmen's Bureau, resulted in a high level of wages in 1866-1867." (pp.64-65) This view has been challenged by recent work documenting a decrease in labor wages in the postwar South. Margo (2004) finds that wages in the Deep South fell after the Civil War, both nominally and relative to Northern wages, and that wages fell for both male and female laborers. However, changes in the price per labor hour may have simply reflected changes in the efficiency of the postwar labor supply. This is Margo's explanation for the postwar wage decline. He asserts "declining labor productivity in agriculture could account for the fall in relative wages in the 1860s." (p.341) These three conditions combined to generate a positive shock to the price of an effective unit of labor in the postwar South.

would have continued to find limited use for their own children in farm production. As a result, although own children and slaves may still have been substitutes in providing old-age insurance for the large slaveowner, they were much less likely to be substitutes in everyday household production. Consequently, relative to their relationship on small farms, own children and slave children exhibited much weaker substitutability on large farms.

On the other hand, there was likely a strong complementarity between adult slaves and own children on these larger farms. In the prewar period, large slaveowners had the added luxury of using female slaves as house servants, a job which included tending to the owner's own children.[11] As a result, own children and adult slaves may have been complements in production on large farms as these slaves enabled the production of children. The complementarity would have been particularly strong in the case of adult female slaves, as they were more likely to be employed in childrearing.

The emancipation experiment thereby generates two testable implications for slaveowner fertility behavior under the value hypothesis. The loss of slave children to emancipation should have lowered the price of own children and raised slaveowner fertility, especially on smaller farms. On the other hand, the loss of adults, especially adult females, to emancipation should have increased the price of own children and lowered slaveowner fertility, especially on larger farms.

To test these implications, I use the slaveholdings of southern households in 1860 as reported in the U.S. Census Slave Schedules to retrospectively generate a slave fertility history within the household. I then match the slave schedules to their white owners in both the 1860 and 1870 U.S. Population Census returns. Using the population census returns, I generate an analogous household fertility history for white owners and measure the fertility response of these households to slave fertility events between 1850 and 1860. I then use the emancipation of Southern slaves between 1863 and 1865 to further test the value hypothesis. To measure the impact of emancipation on household fertility, I use the linked 1860-1870 data to compare the postwar fertility rates of slaveowners with varying compositions of prewar slaveholdings (along age, gender, and size dimensions) as measured in 1860. To the extent that slaveowner fertility responded positively to decreases in the price of own children and negatively to increases in their price, I take this as evidence in favor of value hypotheses of fertility decline.

[11] See Olson (1992). On many large plantations, slaves of both genders who were too old to work in the fields were also employed in child care. See Fogel & Engerman (1974).

3 Model of Household Decision Making

The model of household fertility behavior in the Civil War era south presented in this section places fertility choice in a framework that has been tailored to match the historical realities of the time period. The model generates testable implications for household behavior in the face of both slave fertility events and the emancipation of slaves. Those implications are tested in Section 5 using household-level data.

Suppose households make decisions to optimize their expected lifetime utility:

$$MAX\ E_t \sum_{\kappa=t}^{T} \beta^{\kappa-t} U(C_\kappa) \tag{1}$$

where C_t is a composite consumption good including all pecuniary and non-pecuniary consumption by the household in time period t. The contents of C_t include the tangible components of consumption (food, clothing, housing, etc.) as well as the standard intangible benefits associated with children (love, companionship, old-age security, etc.).

Notice that the household's children do not enter the household utility function directly. Instead, children are valued for the goods and services they produce.[12] The household, in addition to being a consumer represented by Equation (1), is also a producer utilizing factors of production including land and other non-human capital ($\bar{K}$) and labor (L_t) in the production of a composite output (Y_t). $\bar{K}$ is assumed to be fixed over the lifetime of the household. These two inputs combine to produce output via a Cobb-Douglas production function:

$$Y_t = \bar{K}^{\alpha} {L_t}^{1-\alpha}.$$

The labor component of the output equation (L_t) is, itself, composed of several factors. An antebellum household could have incorporated adult labor (either from the household itself, the rental labor market, or from adult slaves) (R_t), slave children (S_t), and its own children (N_t) in production. These three factors are incorporated into the model using a Constant Elasticity of Substitution (CES) framework. Nesting occurs first between slave children (S_t) and own children (N_t). H_t is defined as the total amount of child labor available to the household:

$$H_t = [\chi S_t^{-\delta} + (1-\chi) N_t^{-\delta}]^{-1/\delta}$$

[12]This formulation emphasizes the interrelationship between slaves and the household's own children in household production. It contrasts with some household fertility models where children do enter U(.) directly. In this context, however, the two formulations generate equivalent predictions about household behavior.

and L_t as the combination of this child labor component (H_t) and adult labor (R_t):

$$L_t = [\pi R_t^{-\rho} + (1-\pi)H_t^{-\rho}]^{-1/\rho}.$$

The implication of these functional forms is that own children (N_t) and slave children (S_t) are imperfectly substitutable at a rate that depends on δ. When δ approaches -1, the relationship is linear, and the factors are perfectly substitutable. However, as δ approaches ∞, the two factors become perfect complements. A parallel relationship exists between child labor (H_t) and adult labor (R_t). The relationship depends on ρ and, again, as ρ approaches -1 the relationship is linear (perfect substitutes) and becomes Leontief (perfect complements) as ρ approaches ∞.[13]

In each period, the household must choose R_t to maximize its utility subject to a budget constraint. I assume a single-period decision as antebellum households could buy and sell adult slaves on the open market. Thus, even if the household purchased (rather than rented) a slave in period t, the slave could be sold at $t+1$ such that the household's decision was binding in period t only and was analogous to renting labor for period t only.

In contrast, the number of slave children, S_t, evolves as a result of births to adult female slaves.

$$S_{t+1} = S_t + A_t \; where \; A_t \in \{0, 1, 2, \ldots, \bar{A}\}.$$

A_t represents births to female slaves in the household and $\bar{A}$ represents the biological upper limit on slave fertility for the household in each period.[14] A_t is assumed to be outside of the control of the household.

Finally, the number of own children, N_t, evolves according to the following equation:

$$N_{t+1} = N_t + F_t \; where \; F_t \in \{0, 1, 2, \ldots, \bar{F}\}.$$

$\bar{F}$ represents the biological upper limit on fertility for the household in each period. Households choose F_t in each period.

The budget constraint is:

[13] A model of household behavior fully-informed by the historical record would also allow for gender specificity among the factors of production as the complementarity/substitutability of adult labor, slave children, and own children likely depended on the gender of each. I have abstracted from this additional complexity here for simplicity of exposition, but the possibility of such a relationship is explored further in the results presented in Section 5.

[14] Households may also have affected S_t through buying and selling slaves on the market. Fogel & Engerman (1974) argue that the market for slave children was thin and inactive. This view has been challenged by Tadman (1989) and Deyle (2005). A more accurate formulation is $S_{t+1} = S_t + A_t + G_t$ where G_t reflects the net purchases of child slaves on the market. I abstract from this additional complexity.

$$C_t + P_{R_t}R_t + P_{S_t}S_t + P_{N_t}N_t + P_{A_t}A_t + P_{F_t}F_t \leq Y_t + I_t$$

where P_{R_t} is the rental price of adult labor, P_{S_t} is the maintenance price of slave children, and P_{N_t} is the maintenance price of own children. In addition, slave and own children incur additional costs for the household resulting from lost maternal labor effort in the period of their birth. P_{A_t} is the cost resulting from the birth of slave children and P_{F_t} represents the costs of newborn own children.[15] All prices are subscripted by time period t and are in terms of the composite good Y_t. The price of the household's consumption good, C_t, is normalized to 1. I_t is any non-labor income the family receives including the income flow from a wealth endowment.

In Equation 1, the uncertainty over future utility comes from the stochastic nature of the price vector and from uncertainty over future values of A_t and I_t. If future prices, slave fertility, and non-labor income were known at time t, the household would maximize a deterministic stream of future utility. But with these quantities unknown, the household must form expectations over the future value of its choices. In particular, as own children cannot be bought or sold, the household must use its expectations over future prices, slave fertility, and non-labor income to make choices about current period fertility, F_t.

The household's decision rules for choosing F_t will be used to predict how the household's behavior might change after a slave fertility event and after emancipation. The household's decision rule for choosing F_t (which in turn determines N_t), involves an asset value. An additional child in the household brings costs in the current period (P_{F_t}) and in each subsequent period in the form of maintenance costs (P_{N_t}). On the other hand, additional fertility brings returns to the family determined by the size of $\frac{\partial Y}{\partial N}$. The net price of an additional child in period t, denoted P_t, is:

$$P_t = \sum_{\kappa=t+1}^{T} \beta^{\kappa-t} E_t U'(C_\kappa)(P_{N_\kappa} - \frac{\partial Y_\kappa}{\partial N_\kappa}) + P_{F_t}U'(C_t). \tag{2}$$

As long as P_t is negative, the household has a motivation to bear more children. But the household is biologically constrained in the number of offspring it can produce such that the household may not be able to generate $P_t = 0$ as would be indicated by utility optimization with no constraints on F. In the empirical work in Section 5, household fertility is estimated as a function of P_t under the "value hypothesis" premise that fertility is decreasing in P_t.[16]

[15]For simplicity, I assume capital is fixed and has no cost.

[16]An alternative model assumes that fertility is not a household choice, but that effort in producing children is. Then fertility is some non-deterministic function of effort in producing children subject to uncertainty. Effort would then be a function of P_t. This has the same implications for household behavior.

3.1 Predictions for Household Fertility

Equation 2 provides predictions for household behavior following a slave fertility event and slave emancipation.

First, an exogenous change in the number of slave children in the household (an increase in A_t which then increases S_t) will affect the price of own children through $\frac{\partial Y}{\partial N}$. The effect depends on the relative rates of substitutability between own children and slave children and between children in general and adult labor. When the rate of substitutability between own children and slave children is higher than that between own children and adult labor, $\delta \prec \rho$, $\frac{\partial Y}{\partial N \partial S} \prec 0$ and $\frac{\partial P}{\partial S} \succ 0$. In this case, the net price of own children is increasing in the number of slave children as slave children and own children are net substitutes while adult labor and own children are net complements (as opposed to gross substitutes and complements, a relationship which is determined purely by the signs of δ and ρ). In addition, the historical record indicates that the substitutability between own children and slave children was strongest on smaller farms. This leads to the first testable implication.

1. *Under the assumption that own children and slave children were net substitutes in the household production function ($\delta \prec \rho$), an increase in the number of slave children in the household resulting from a slave fertility event increased the net price of own children and, in turn, decreased fertility. The fertility response should be more pronounced on smaller farms.*

The changes imparted on Equation 2 by slave emancipation are more complex. First, slave children were no longer available for purchase following emancipation and the former child slaves were not necessarily available for hire in the post-war years. Even when formerly enslaved children *were* available for hire (generally in conjunction with their parents), they could no longer serve as old-age security for former slaveowners as the slaveowner had no ownership rights over these children. In the model, this can be understood as a decrease in S_t.[17] For values of $\delta \prec \rho$, slave children and own children were substitutes such that the result is a net decrease in P_t, the price of own children. Again, because substitutability between own children and slave children was strongest on smaller farms, the predicted response should be more pronounced on smaller farms.

In addition to the reduction in the number of slave children, the market for adult labor was also affected by emancipation. As discussed in Section 2, the price of adult labor (P_{R_t}) increased as freedmen (male and female) chose to commit less time to market labor than they had under coercion and the South experienced a negative shock

[17] Modeling emancipation as an increase in P_S does not change the testable implications derived here.

to labor productivity. The assumption that $\delta \prec \rho$ implies that adult slaves and own children were complements in production such that $\frac{\partial Y}{\partial P_{R_t}} \succ 0$ and an increase in P_{R_t} should reduce household fertility. In addition, because female slaves were more likely to be complements to own children while male slaves were substitutes, I further hypothesize that $\frac{\partial P}{\partial P_{R_{t,male}}} \prec \frac{\partial P}{\partial P_{R_{t,female}}}$ where $P_{R_{t,male}}$ represents the price of male adult labor and $P_{R_{t,female}}$ represents the price of female adult labor. In other words, for an equivalent price shock, owners of adult female slaves would have experienced a sharper increase in the price of their own children than owners of adult male slaves. This would have been especially true on larger farms where the complementarity between adult female slaves and own children would have been strongest. The predicted response of households to an increase in the price of adult slaves following emancipation, therefore, depends on the size and gender of the pre-emancipation slave labor force. Households who owned adult females would have faced a larger increase in the price of their own children and, therefore, a stronger incentive to reduce fertility. In addition, larger households would have felt the impact more acutely.

Thus, emancipation represented unanticipated shocks to the price of factors of production and, consequently, to the net price of own children. Importantly, *neither* of these changes were anticipated in 1860 when slave ownership is measured in the data.[18] Two additional testable implications arise.

2. *Under the same assumption as (1) above, a reduction in the slave child labor force (S) following slave emancipation reduced the net price of own children for former owners of slave children and should have, in turn, increased fertility. The impact should be more pronounced on smaller farms*

3. *Under the same assumption as (1) and (2) above, children and adult labor were net complements in the household production function. As a result, an increase in the price of adult labor resulting from emancipation should have resulted in a decrease in household fertility. The impact should be larger for former owners of female slaves and on larger farms.*[19]

[18]Fogel & Engerman (1976) have reconstructed the appraisal and sale prices of Southern slaves during this period; market prices for slaves did not begin to decline until 1861. Prior to this time, Fogel & Engerman (1974) conclude that Southern households did not anticipate emancipation, at least not on a large scale.

[19]In addition, emancipation represented a shock to wealth for slaveowners represented by a decline in I. $\frac{\partial P}{\partial I}$ depends on $U'(C)$, and when $U(.)$ is concave, $U'(.)$ is decreasing in I. But $U'(.)$ appears as both a cost (in the current period) and a benefit (in all subsequent periods) in Equation 2. Thus, the sign of $\frac{\partial P}{\partial I}$ is ambiguous. All the same, I control for changes in non-labor income (wealth) in the empirics in Section 5.

4 Data

The data for this project come from a linkage of Southern households between manuscripts of the 1860 and 1870 U.S. Census Population Schedules and the 1860 U.S. Slave Schedules. A full description of the data collection process is located in Appendix A.

IPUMS has transcribed a 5% random sample of slaveowners from the 1860 U.S. Census Slave Schedules and their complete slaveholdings.[20] For each slave, his or her age, sex, and race (black or mulatto), in addition to the name and geographic location of their owner, are available. I limited this sample to include only rural slaveowners, those from 6 states of the Deep South (Alabama, Florida, Georgia, South Carolina, Mississippi and Texas), and those who owned their slaves individually, excluding slave-owning corporations or partnerships.

This generated a starting sample of 6,974 slaveowners (representing 89,870 slaves) in 1860. The slave schedules contain no demographic characteristics of slaveowners. Thus, in order to gain detailed household information, each slaveowner was located in the 1860 U.S. Population Census using genealogy website Ancestry.com. The population schedules contain each individual's full name and geographic location. The IPUMS transcription of the slave schedules also records the slaveowner's full name and detailed geographic location. Using these two pieces of information, 92% of slaveowners were successfully matched to their population schedule enumeration.[21] Once linked, the sample was further limited to married couples with female spouses in the fertile age range as marital fertility is the outcome of interest.[22,23]

Of the 6,400 slaveowners who were located in the 1860 Population Schedules, 4,377 were imputed to be married and, of those, 2,491 were in partnerships where the female was ≤ 35 years of age. The cutoff age of 35 was chosen to ensure that the female would remain fertile for at least five years following emancipation (through 1870).[24]

This linking process generated a sample of individuals in 1860 including their household composition and the composition of their slave holdings. In order to measure household fertility over a longer period of time and, specifically,

[20] Ruggles et al (2008).

[21] Within each enumeration district, the population enumeration and slave enumeration were taken in the same geographic order. This additional piece of information made linking households to slave schedules quite straightforward as an individual's neighbors can be used to resolve ambiguities. The added information also serves to ensure a high match quality.

[22] Extra-marital fertility is ignored using this methodology. However, the vast majority of fertility in the U.S. South at this point in history was inside marriage.

[23] Marital relationships were not explicit in the 1860 enumeration but were implied by the position of the individual and other household members on the Population Schedule. Any potential spouse should have been listed immediately following (preceding) the slaveowner if the slaveowner was male (female).

[24] Using data from the 1870 U.S. Census IPUMS sample, there is a steady decline in the fertility rate in these six states after age 40 (age 30 in 1860), and the rate asymptotes to zero after age 45 (35 in 1860). To maximize the sample size, a cutoff of 35 was chosen in 1860, but sensitivity of the results to younger cutoff dates is examined in Section 5.

in the years following emancipation, I used information on the 1860 nuclear family (slaveowner, spouse, and children) to link these 2,491 slaveowning households to the 1870 Census Population Schedules, again utilizing the functionality of Ancestry.com. Match criteria included the name, age, and birth place of the slaveowner, of his/her spouse, and of children in the household.[25] 1,211 of 2,491 slaveowners were located in the 1870 Census; a 50% successful match rate between 1860 and 1870 is reasonable given the carnage of the Civil War in the interim.

A sample of non-slaveowners was also generated as a control group for the analysis in Section 5.2. The non-owning sample contains Southern households who could have been slaveowners according to a minimum wealth criterion, but were not. These non-slaveowners were neighbors of slaveowners in the sample and had enough household wealth to be able to purchase at least one slave. This sample serves as the reference group - households representing general trends in Southern white fertility between 1860 and 1870.[26] The set of non-slaveowners from the 1860 Population Schedules was also matched to the 1870 Population Schedules using the same search criteria as for the slaveowners. The result was 304 non-slaveowners matched to 1870 from a starting set of 561 in 1860. A 54% match rate is approximately equal to that for slaveowners.

One final adjustment to the dataset was required. For the purpose of determining marital fertility rates, it was important to limit the sample to those families with intact marriages between 1860 and 1870. Death of a spouse, divorce and/or separation before 1870 were all criteria on which households were excluded from the dataset. This eliminated 316 observations, leaving a base sample of 1199 households, 975 of which are slave owners.

For each household, the outcome of this linkage process is panel data on slave holdings in 1860, age, location, occupation, wealth, fertility, nativity, and literacy.[27]

To measure the impact of a slave fertility event on household fertility, the complete fertility history of the household and its slave labor force is constructed using the 1860 and 1870 census manuscripts. For slaves, fertility is measured using the 1860 slave schedules.[28] For each household j in year $t \in [1856, 1860]$, F^S_{jt} measures the number of slave children born within the household's slave holdings. For instance, an 8-year-old child observed among the slave labor

[25]I did not use the 1860 geographic location to search for households in 1870 to avoid introducing migrant/non-migrant bias.

[26]See Appendix A for details on the data generation process for non-slaveowners.

[27]Education has repeatedly been shown to be correlated with fertility in the literature. However, a quick glance at the literacy variable recorded in the census enumerations shows that it is extremely unlikely to be useful as a proxy for education of the individuals in my sample. Less than 5% of the individuals report that they cannot read or write. Instead of reported literacy, I use the households' responses to questions of how old they are to construct a variable that I call "numeracy". This variable can be interpreted as a measure of the ability of the male and female heads of the household, on a scale from 0 to 100, to correctly report their age in years in 1870, assuming they correctly reported in 1860. I use numeracy as a rough proxy for education. See Appendix A for the full variable definition.

[28]Slaves are nameless in the 1860 Slave Schedules and cannot be located in 1870 to determine fertility between 1861 and emancipation in 1865.

force in 1860 is coded as an 1852 fertility event. Although slave children *were* bought and sold prior to the age of 14, the practice was relatively rare. The mismeasurement of the slave fertility variable should serve to bias the measured impact of slave fertility on household fertility towards zero. I also undertake sensitivity tests in Section 5 to the age cut-off (e.g., only imputing fertility events for 1856-1860).

The fertility history of the household is constructed in the same way but incorporates 1870 population census data as well to build a full 21-year (1850-1870) fertility history. For each household j in year t, F_{jt}^{HH} measures the number of children born to the household. Like the slave fertility history, the household history will necessarily omit births that ended in the death of a child prior to Census enumeration or births for which the child is no longer living in the household.

5 Results

5.1 Household Fertility Responses to Slave Fertility Events

To test the implications from Section 3, I first measure the impact of a slave fertility event on household fertility for Southern slaveowners between 1850 and 1860. The testable implication of the model is that slave fertility events increased the net price of own children and, in turn, decreased fertility and that the response was more pronounced among smaller slave owners.

I use a linear model with household fertility in year t (F_{jt}^{HH}) as the dependent variable and the number of slave births (F_{jt}^{S}) as the independent variable. The baseline specification incorporates the five-year history of slave fertility events in order to capture lagged impacts on household fertility. The model also includes year and household fixed effects.

$$F_{jt}^{HH} = \sum_{\kappa=0}^{4} \gamma_\kappa F_{j,t-\kappa}^{S} + \theta_j + \lambda_t + \epsilon_{jt} \tag{3}$$

where $t \in [1850, 1860]$ and relevant slave fertility events occurred between 1846 and 1860.[29]

Because households are observed in 1860 and fertility is inferred retrospectively, not all households will have been in existence for the entirety of the 1850-1860 time period. Unfortunately, the 1860 census does not include information on date of marriage. Instead, I assume households are formed and eligible to exhibit positive fertility when females are

[29] Slave fertility is measured from 1846 to 1860 and household fertility over 1850 to 1870, so the estimation, including lagged effects, is restricted to 1850-1860. The model is estimated using linear OLS to facilitate the presentation of marginal effects, although values of F_{jt}^{HH} are discrete. Ordered probit results are similar.

20 years of age. For example, I assume a female observed in 1860 at age 24 would have first been eligible to exhibit $F_{jt}^{HH} \succ 0$ in 1856.[30].

The results of estimating Equation 3 under this assumption about household formation are located in Table 2. The γ_κ coefficients represent the change in fertility for households in year $t + \kappa$ following a slave fertility event in year t. Sample averages of fertility variables and other relative metrics are contained in Table 1.

Column 1 of Table 2 incorporates all households in the sample, 895 in total.[31] For each slave born within the household, the results indicate a contemporaneous increase in household fertility of 0.017 children (from an average of 0.259) and no significant lagged effects. However, as predicted by the model in Section 3, owners with smaller slave holdings have stronger reactions to slave fertility events. Column 2 is limited to households owning fewer than 8 slaves (62% of households), and the impact on contemporaneous fertility (γ_0) is insignificantly different from 0. But, as is predicted by the model, households react to slave fertility with fewer children of their own in subsequent years ($\gamma_1 - \gamma_4$). Indeed, households exhibit lower fertility in each of the next four years and the impact is statistically significant in year 1 where the reduction in household fertility reaches 24%. The cumulative impact on household fertility over the next four years is somewhat less substantial; summing over $\gamma_1 - \gamma_4$, the birth of a slave child to a household reduces cumulative fertility over the next four years by 0.15 children, a 14% reduction over these four years.

Limiting the sample to households with the smallest slave labor forces, those who owned fewer than 4 slaves in 1860 (38% of households), Column 3 demonstrates even larger impacts on household fertility. In the year following a slave fertility event, household fertility is reduced by 0.08 children (30%) and in year 2 by a statistically significant 0.12 children (46%). Summing over the first four years following a slave birth event, the cumulative reduction in household fertility for the smallest slave owners was 24%.

A natural question is whether the fertility behavior observed in Columns 2 and 3 is simply a continuation of behavior prior to slave birth events. Perhaps households with smaller slave labor forces are also low-fertility in general. Column 4 measures pre-treatment trends in fertility prior to the birth of a slave child for households owning fewer than 8 slaves in 1860 (analogous to the results in Column 2). Each γ_κ now represents the impact of slave births in years

[30] This is a conservative estimate. In actuality, females aged 24 in 1860 had average fertility in 1854, 1855, and 1856 of 0.17, 0.19, and 0.23 children and household formation was significant prior to the age 20 cutoff. Eliminating this restriction on the data gives more statistical significance to the coefficients in Table 2

[31] Some of the original 975 slave-owning households are excluded from this empirical exercise completely due to the assumption about the age of the female at household formation.

$t + \kappa$ on year t household fertility. No coefficient is significant, and the cumulative "effect" of a slave fertility event in the four years prior is 2%.

In the formulation of Equation 3, the independent variables are the total number of slaves born in year $t - \kappa$ when households may have responded only to whether a slave child was born or not. Converting the slave fertility variable to a binary indicator variable does not substantially change the estimates as exhibited in Column 5 of Table 2.

One notable concern about the results in Table 2 is that the contemporaneous effect of a slave child birth (γ_0) is large and, for the full sample, marginally statistically significant. This result appears to be due entirely to "age-heaping", the tendency of households to report ages of household members and slaves that end in 0 or 5. In particular, there is a substantial mass of both 5-year-old children and 5-year-old slaves in the 1860 census enumerations, especially among owners of larger slave labor forces. This generates a spurious correlation between slave and household fertility events that manifests itself in a positive value for γ_0. It will also lead to a spurious negative correlation between a slave fertility event and household fertility in the year subsequent if age-heaping households report four-year-old own children as five-year-old children to census enumerators. Potential corrections for the age-heaping issue are not perfect, but are explored in more detail in Appendix B. Under the preferred correction, estimates for γ_0 are statistically insignificant and smaller in magnitude while the impacts on fertility in the years following ($\gamma_1 - \gamma_4$) are largely unaffected.

Thus, the results in Table 2 indicate a significant and sustained reduction in household fertility following the birth of a slave child, and the effect is larger for small slave owners than for larger plantation households. Households with fewer than 8 slaves responded to the birth of a child with lower household fertility in the year following the slave birth and the impact dwindled over the subsequent three years. These results do not seem to reflect fixed effects in household fertility as they are not evident in the years preceding a slave birth.[32] These findings are fully consistent with models of fertility behavior predicated on the value hypothesis.

Yet, despite the robustness of the results to a number of alternative specifications, the conclusions must still be qualified by the acknowledgement that slave fertility was in no sense randomly assigned to households. Slave owners had multiple avenues by which to impact slave fertility in the household and may have undertaken behavior that would

[32] A number of robustness checks confirm this conclusion. (Results not shown, but available upon request.) First, there is no observable "catch-up" in household fertility following the five-year window captured in Table 2. Extending the specification to years 6 and 7 shows no significant change in household fertility beyond year 4. Second, it is possible that the observed negative impact of slave fertility on household fertility is entirely spurious and is, instead, the result of younger (or older) households owning younger (child) slaves. Age of the female or male head is absorbed by the household fixed effect in the estimation. However, dividing the sample by age at the median age of the female in 1860 (26) indicates no notable difference in γ_0 or γ_1 coefficients between the two samples. Following year 1, the fertility impact is consistently negative in the older sample, but not in the younger. Finally, to partially correct for the possibility of differential selling/buying behavior, the panel is limited to slave birth events occurring between 1856 and 1860 as the very youngest slaves were unlikely to be sold. There are no remarkable differences in the estimates.

increase the fertility of slaves while reducing household fertility in the years following. Further, to some extent, households selected the age and gender of slaves in their labor force. If low-fertility households were more likely to select high-fertility slaves, the results in Table 2 may partially reflect that selection. Although it seems unlikely that the selection described above would generate the specific pattern of no correlation in year t followed by reduced household fertility in years $t + 1$ and following, these concerns motivate examining another event that would have affected the price of own children for slaveowners. In the next section, identification of fertility responses to price changes comes from a different shock to the price of own children: the emancipation of slaves.

5.2 Household Fertility Responses to Slave Emancipation

The testable implications for household behavior following the emancipation of slaves in 1865 are twofold. First, a reduction in the slave child labor force (S_t) following emancipation served to reduce the net price of own children and, in turn, should have increased fertility for former owners of slave children. The positive fertility response should be larger on smaller Southern farms. Second, the historical record indicates that children and adult labor were likely complements in production such that an increase in the price of the latter following emancipation resulted in an increased net price of the former and should have resulted in reduced fertility among former slaveowners. Former owners of female slaves and larger slaveholdings should have been more responsive to this change in the price of adult labor.

The dependent variable of interest is the household's post-emancipation fertility between 1866 and 1870 ($F^{HH}_{i,1866-1870}$) - the number of children in the household in the 1870 Population Census whose reported age was 0-4 years.[33] 1866-1870 is the 5-year span immediately following emancipation and the end of hostilities in the Civil War and was chosen to ensure that the fertility metric does not include a "war effect" that differed by household.[34] As Confederate forces surrendered to Union leaders at Appomattox, VA in April 1865, 1866 was chosen as the beginning of the fertility window.

Equation 4 is estimated for each household in the sample in 1870:

[33]Note that the fertility measure here is really "surviving fertility by 1870" as it excludes children in the household born between 1866 and 1870 who died prior to being enumerated. Clearly this variable measures a combination of fertility and infant/child mortality. There is no way of distinguishing the impact of each separately. Rather, the results should be interpreted as the impact of a change in the value of children on a household's net production of children either through changes in the number of births or changes in the household resources that affect infant mortality (including household effort to reduce mortality).

[34]For instance, it is widely accepted that larger slaveowners were less likely to fight in the Civil War due to the "20-Negro Rule" exempting them from service. As a result, fertility measured between 1863 and 1865 might pick up correlation between the size of the household's 1860 slave labor force and its fertility that results only from the physical location of the male partner during the Civil War. This is not the fertility response of interest.

$$F^{HH}_{i,1866-1870} = \eta P_{i,1866-1870} + \beta X_{i,1866-1870} + \epsilon_{i,1866-1870}. \quad (4)$$

where $P_{i,1866-1870}$ represents the net price of own children and is proxied by a vector of characteristics describing the household's slaveholdings in 1860. Indicators are used for the size of the slave labor force in 1860 (1-3, 4-7, or more than 8 slaves), its age composition (0-2, 3-6, 7-10, 11-15, 16-35, or greater than 35 years of age), gender, and interactions between these categories. Means of $F^{HH}_{i,1866-1870}$ and the variables used to proxy $P_{i,1866-1870}$ are located in Table 3. As with Equation 3, the model is again estimated using linear OLS.

$X_{i,1866-1870}$ includes the ages and squared ages of the male and female household heads, an indicator for whether the male is employed in agriculture, numeracy as a proxy for education, the household's 1870 real estate and personal wealth, and the change in the household's real estate and personal wealth levels between 1860 and 1870.[35] County-level fixed effects are included to absorb effects on fertility resulting from idiosyncratic variation in local labor markets and wages.[36] Fixed effects for the male head's place of birth are included to capture variations in fertility related to cultural and religious norms.[37] Finally, in an attempt to account for any fixed effects in fertility (differing tastes, etc.) and also the possibility that families pursued a "target" family size, the household's fertility rate between 1856 and 1860, $F^{HH}_{i,1856-1860}$ is also included as a component of $X_{i,1870}$.[38] Complete variable definitions are located in Appendix A. Means and variances of the variables included in $X_{i,1870}$ are located in Appendix C, Table 6. Estimates for β are located in Appendix C, Table 7.

η, the coefficient on $P_{i,1866-1870}$, is the result of interest and is reported in Table 4 under a variety of proxies for $P_{i,1866-1870}$ in the estimation of Equation 4. I examine the effect of size and age/gender categories and report the coefficients collectively in Table 4 as a percentage of $F\bar{HH}_{i,1866-1870}$ with indicators for statistical significance and t-statistics in parentheses.[39]

As a first step, $P_{i,1866-1870}$ includes indicators for slaveholding size only. (Non-slaveowners are the omitted

[35] Separate controls for changes in real estate and personal wealth are used to separately account for changes in fertility coming from a pure wealth effect (the coefficient on personal wealth) and from changes in the marginal product of labor in land due to falling crop prices after 1865 (the coefficient on real estate wealth). See Appendix C.

[36] Ideally, I would interact county fixed effects with components of $P_{i,1866-1870}$ to fully account for county-level variation in labor conditions, but the sample size is prohibitive.

[37] For instance, the religious and cultural incentives for childbearing may have differed for immigrants relative to native-born households.

[38] One issue with using the household's fertility between 1856 and 1860 is that there is no way of knowing how long the household has been intact when first observed in 1860. A household may have low fertility in 1860 simply because the heads have not been married for very long. Excluding this variable from the list of controls, however, does not affect the main results of this section.

[39] An all-encompassing, fully-interacted vector of slave ownership variables is the preferable specification, but the sample size is too small for such an exercise.

category.) The coefficients on the size of holdings categories are estimated from an OLS regression including only these three indicators in $P_{i,1866-1870}$. The percentage change in $F^{\bar{H}H}{}_{i,1866-1870}$ implied by $\hat{\eta}$ is reported under the "no interaction" column (Column 8). I then control for age/gender variables only, interacting gender with age for adults aged 16-35.[40] The results are reported in the "no interaction" row. Again, the coefficients on the age and gender categories are estimated from an OLS regression including only indicators for these seven categories ("Ages 0-2" through "Ages 36+") in $P_{i,1866-1870}$.

These initial results indicate there is no statistically significant impact of either the size of a slaveowning household's 1860 slave holdings or its age and gender stratification on the household's 1870 fertility rate. But the testable implications from Section 3 indicate important interactions between these categories. For each age/gender category listed in Table 4, Equation 4 is estimated with an interaction term between that age/gender indicator and the three size indicators, leaving the remaining age/gender indicators without interaction. For example, percentages in Column 1 represent the percentage change in $F^{HH}_{i,1866-1870}$ for a household who owned slaves aged 0-2 *and* owned between 1 and 3 slaves, between 4 and 7 slaves, and 8 or more slaves in 1860, respectively. The other components of $P_{i,1866-1870}$ in this specification include the remaining age and gender categories, uninteracted, and all comparisons are vis-à-vis the non-slaveowning middle class. This exercise is repeated for every age and gender category in Table 4.

Incorporating interaction terms between these two dimensions exposes substantial differences in fertility outcomes across groups. Indeed, fertility behavior is consistent with the implications of the fertility model developed above. For households who owned slaves aged 0-2 in 1860, an interaction between this indicator and the overall size of the slave holdings (1-3, 4-7, or 8+) indicates that the smallest slaveowners exhibited fertility rates a statistically significant 37.2% higher than the non-slaveowning middle-class following slave emancipation while those owning between 4 and 7 slaves exhibited fertility rates 17.4% higher, although this latter result is not statistically significant. The largest slaveowners of young children, on the other hand, exhibit no remarkable fertility difference relative to non-slaveowners. These are precisely the patterns we would expect to see if the loss of slave children to emancipation lowered the net price of children, especially for the smallest slaveowners. For former owners of slaves aged 3-6, the same general pattern holds, although the results are not statistically significant. The smallest owners exhibit higher fertility than the largest owners and the owners of 4 to 7 slaves lie somewhere between. The interaction terms for

[40]There is no statistically significant impact for interactions between gender and the 36+ age category.

owners of slaves aged 7 to 10 and 11 to 15 are unremarkable.

A second implication of the model developed previously was that the rising price of adult slaves, who may have been complements in household production with own children, should have reduced fertility for owners of these slaves. This was predicted to be especially true among the largest slaveowners who may have used adult female slaves as caretakers for young children. The interactions between an indicator for owning a slave 36 and older and size of holdings indicators (column 7) indicate a uniformly reduced level of fertility relative to the non-slaveowning middle-class, but the results are not statistically significant. But a similar interaction for the 16-35 age category generates significant results. The interaction between an indicator for the 16-35 age category and an indicator for owning 8 or more slaves generates a negative, significant coefficient (not shown). This result is driven entirely by the behavior of owners of female slaves in this category. A comparison of columns 5 and 6 indicates that the largest slaveowners who owned female slaves between the ages of 16 and 35 responded to slave emancipation, and the resulting increase in slave prices, by substantially reducing household fertility. Medium-sized slaveowners with adult females had a more muted, but still negative response, and the smallest owners of adult females showed no remarkable difference in fertility relative to non-slaveowners. A similar gender stratification for the age 36 and higher category does not produce remarkable results.[41]

Thus, households whose price of children should have decreased the most following emancipation (small slave holders who owned very young slaves) exhibited substantially higher fertility rates in the post-war era. At the same time, those households whose net price of children was predicted to rise following emancipation (the largest plantation owners with adult, female slaves) exhibited reduced fertility after 1865. As with the results in Section 5.1, the results in Table 4 corroborate theories of fertility behavior that rely on household responses to changes in the net price of children.

6 Conclusion

The cause of the United States demographic transition during the 19th and 20th centuries is an unanswered historical question. Using a panel dataset of Civil War-era southern households and their slave holdings, I show that changes

[41] As a robustness check, the sample is limited to females aged 30 years and younger in 1860. The impact of emancipation should have been stronger for these individuals as they were more fertility in the 1866-1870 time frame. Indeed, for these women, the interacted age of the youngest slave children (0-2) and size of slaveholdings variables (Column 1 of Table 4) become more significant. For owners of 1-3 slaves, there is an estimated 52.5% increase in fertility (significant at the 2.5% level) and for owners of 4-7 slaves, there is an estimated 22.0% increase in fertility (significant at the 10% level). Similarly, corresponding to Column 5 of Table 4, the youngest women with the largest slaveholdings (8 or more slaves) show a reduction of 36.2% in post-emancipation fertility (significant at the 5% level) compared to 30.7% in the full sample.

in the net prices of own children are negatively correlated with household fertility rates. In the pre-emancipation era, small slave-owning households exhibited reduced household fertility following the birth of slaves within their slave holdings. In the post-emancipation era, small slave-owning households responded to the loss of young slave children with significantly higher household fertility by 1870. Large households responded to the loss of older, female slaves with significantly lower household fertility by 1870. In each case, increases in the predicted price of children resulted in lower household fertility and decreases in the predicted price of children resulted in higher household fertility.

As is characteristic of most natural experiments, the specificity of the data in this paper (consisting only of white, rural slaveowners and yeoman farmers from the Deep South between 1866 and 1870) makes it challenging to draw broad conclusions about general behavior. Similarly, the specificity of the data do not allow me to estimate how much of the overall United States fertility decline can be attributed to a changing net price of children; I reserve that question for future research. But inasmuch as the behavior of the sample in this paper is representative of the American population over the past two centuries, this paper indicates that the value hypothesis cannot be ruled out in explaining the nationwide fertility decline.

References

Becker, G. (1960). An Economic Analysis of Fertility. In Universities-National Bureau Committee for Economic Research (Ed.) *Demographic and Economic Change in Developed Countries*, (pp. 209–231). Princeton, NJ: Princeton University Press.

Becker, G., & Barro, R. (1988). A Reformulation of the Economic Theory of Fertility. *The Quarterly Journal of Economics*, *103*(1), 1–25.

Becker, G., & Lewis, G. (1973). On The Interaction Between the Quantity and Quality of Children. *Journal of Political Economy*, *81*(2), S279–S288.

Carter, S., Ransom, R., & Sutch, R. (2002). Family Matters: The Life-Cycle Transition and the Unparallelled Antebellum American Fertility Decline. In T. Guinnane, W. Sundstrom, & W. Whatley (Eds.) *History Matters: Essays on Economic Growth, Technology, and Demographic Change*. Stanford: Stanford University Press.

Cleland, J., & Wilson, C. (1987). Demand Theories of the Fertility Transition: An Iconoclastic View. *Population Studies*, *41*, 5–30.

Coale, A., & Watkins, S. (1986). *The Decline of Fertility in Europe*. Princeton: Princeton University Press.

Deyle, S. (2005). *Carry Me Back: The Domestic Slave Trade in American Life*. Oxford: Oxford University Press.

Fogel, R., & Engerman, S. (1974). *Time on the Cross*. Boston: Little, Brown.

Fogel, R., & Engerman, S. (1976). *Slave Sales and Appraisals, 1775-1865*. ICPSR Data set No.7421.

Galor, O. (2005). From Stagnation to Growth: Unified Growth Theory. In P. Aghion, & S. Durlauf (Eds.) *Handbook of Economic Growth*, (pp. 171–293). Amsterdam: Elsevier.

Hahn, S. (2006). *The Roots of Southern Populism: Yeoman Farmers and the Transformation of the Georgia Upcountry, 1850-1890*. Oxford: Oxford University Press.

Haines, M. (2008). Fertility and mortality in the united states. Http://eh.net/encyclopedia/article/haines.demography.

Manser, M., & Brown, M. (1980). Marriage and Household Decision-Making: A Bargaining Analysis. *International Economic Review*, *21*(1), 31–44.

Margo, R. (2004). The North-South Wage Gap Before and After the Civil War. In D. Eltis (Ed.) *Slavery in the Development of the Americas*. Cambridge: Cambridge University Press.

McCurry, S. (1995). *Masters of Small Worlds: Yeoman Households, Gender, Relations, and the Political Culture of the Antebellum South Carolina Low Country*. New York: Oxford University Press.

Moen, J. (1992). Changes in the Productivity of Southern Agriculture between 1860 and 1880. In R. Fogel, & S. Engerman (Eds.) *Without Consent or Contract: The Rise and Fall of American Slavery*, vol. 1, (pp. 321–350). New York: W.W. Norton and Company.

Olson, J. (1992). The Occupational Structure of Southern Plantations during the Late Antebellum Era. In R. Fogel, & S. Engerman (Eds.) *Without Consent or Contract: The Rise and Fall of American Slavery*, vol. 1, (pp. 137–169). New York: W.W. Norton and Company.

Ransom, R., & Sutch, R. (2001). *One Kind of Freedom: The Economic Consequences of Emancipation*. Cambridge: Cambridge University Press.

Ruggles, S., Sobek, M., Alexander, T., Fitch, C., Goeken, R., Hall, P., King, M., & Ronnander, C. (2008). *Integrated Public Use Microdata Series: Version 4.0 (Machine-Readable Database)*. Minneapolis, MN: Minnesota Population Center.

Steckel, R. (1996). Women, Work and Health under Plantation Slavery in the United States. In D. Gaspar, & D. Hine (Eds.) *More than Chattel: Black Women and Slavery in America*. Bloomington, IL: Indiana University Press.

Tadman, M. (1989). *Speculators and Slaves: Masters, Traders, and Slaves in the Old South*. Madison: University of Wisconsin Press.

Zelnik, M. (1961). Age Heaping in the United States Census: 1880-1950. *The Milbank Memorial Fund Quarterly*, *39*(3), 540–573.

7 Tables

TABLE 1: Summary Statistics - Panel Data on Slave Birth Events for Table 2

	Mean	Standard Deviation
F_{jt}^{HH} (annually, 1850-1860)	0.259	0.47
F_{jt}^{S} (annually, 1846-1860)	0.334	0.80
Number of slaves (1860)	10.5	15.39
Female age (1860)	26.8	5.00
Male age (1860)	34.2	7.23

Source: See Text.

TABLE 2: Equation 3 Estimation Results

	(1)	(2)	(3)	(4)	(5)
	All Households	<8 Slaves	<4 Slaves	Pre-Trends	With binary event
γ_0	0.0172*	0.0395	0.0536	0.0637	0.0343
	0.0096	0.028	0.053	0.042	0.029
γ_1	-0.00589	-0.0629**	-0.0807	-0.0497	-0.0651**
	0.010	0.029	0.053	0.045	0.030
γ_2	-0.00244	-0.0412	-0.122***	-0.0121	-0.0363
	0.010	0.029	0.051	0.042	0.029
γ_3	-0.0107	-0.00450	-0.0153	0.0298	-0.00212
	0.011	0.029	0.052	0.042	0.030
γ_4	0.00255	-0.0371	-0.0331	0.00912	-0.0343
	0.010	0.029	0.053	0.039	0.030
R-squared	0.14	0.14	0.14	0.20	0.14
Adjusted R-squared	0.01	0.00	0.00	0.00	0.00
# Households	895	543	334	543	543
Slave Fertility Events	1276	414	97	414	414

Source: Author's calculations from Census data described in text.
Notes: The table lists results from estimating Equation 3 for slave fertility events between 1846 and 1860 (and household fertility responses from 1850 through 1864). The coefficient γ_κ represents the impact of slave fertility event in year $t - \kappa$. All specifications also include household and year fixed effects. Column 1 includes all households in the sample. Column 2 includes only those households owning fewer than 8 slaves in 1860. Column 3 includes only those households owning fewer than 4 slaves in 1860. Column 4 contains the pre-trends such that γ_κ represents the impact of slave fertility in year $t + \kappa$. Column 5 uses binary indicators for whether a slave fertility event occurred, rather than the number of such events, as the independent variables. T-statistics are included beneath each coefficient. *** indicates statistical significance at 97.5% confidence, ** at 95%, and * at 90%.

TABLE 3: Summary Statistics - Panel Data on Household Fertility and Slaveholdings, 1860-1870 for Table 4

	Mean	Standard Deviation
$F5^{HH}_{1866-1870}$	1.04	0.93
Slaveowner in 1860	0.81	–
Size Variables		
Owned 1-3 slaves in 1860	0.31	–
Owned 4-7 slaves in 1860	0.19	–
Owned 8+ slaves in 1860	0.32	–
Age and Gender Variables		
Owned slaves 0-2 years old in 1860	0.42	–
Owned slaves 3-6 years old in 1860	0.43	–
Owned slaves 7-10 years old in 1860	0.41	–
Owned slaves 11-15 years old in 1860	0.46	–
Owned slaves 16-35 years old in 1860	0.67	–
Owned females 16-35 years old in 1860	0.58	–
Owned males 16-35 years old in 1860	0.50	–
Owned slaves 36+ in 1860	0.40	–

Source: See Text.

TABLE 4: Equation 4 Estimation Results

		Ages and Gender							
		1 Ages 0-2	2 Ages 3-6	3 Ages 7-10	4 Ages 11-15	5 Ages 16-35 Female	6 Ages 16-35 Male	7 Ages 36+	8 No interaction
Size of Holdings	1-3 Slaves	37.2***	2.4	-9.4	6.4	6.7	8.3	-9.0	0.4
		(2.28)	(0.14)	(-0.63)	(0.58)	(0.64)	(0.72)	(-0.64)	(0.05)
	4-7 Slaves	17.4	-2.8	-1.4	10.7	-13.3	-8.9	-10.1	-3.5
		(1.56)	(0.24)	(-0.12)	(0.96)	(-1.17)	(-0.83)	(-0.89)	(-0.36)
	8 or more Slaves	-1.8	-14.8	-11.6	-8.9	-30.7**	-12.3	-6.1	-16.1
		(-0.16)	(-1.24)	(-1.04)	(-0.80)	(-2.12)	(-1.07)	(-0.57)	(-1.57)
	No interaction	13.9	-3.7	-7.4	2.6	-3.3	-3.5	-8.2	
		(1.58)	(-0.41)	(-0.93)	(0.36)	(-0.42)	(-0.4)	(-1.07)	

Source: Author's calculations from Census data described in text.

Notes: The table reports the estimated marginal (percent) effects on average household fertility under a variety of proxies for P_i in Equation 4. The "No interaction" rows and columns represent the impact of indicator variables for size of holdings and age/gender categories, uninteracted. Each column, 1-7, gives the coefficients for a model including all age/gender categories with interactions with size of holdings for the column specified. For instance, Column 1 contains a vector of indicator variables in P_i including all age/gender categories along with interaction terms between the 0-2 age category and each of the three size of holdings categories. T-statistics are reported in parentheses. *** indicates statistical significance at 97.5% confidence, ** at 95%, and * at 90%.

A Data Appendix

A.1 Data Generation Process

The IPUMS 5% flat sample is a random sample of slaveowners in 1860. The sample was filtered to include only the six states of the deep South, excluding Louisiana (Texas, Mississippi, South Carolina, Georgia, Florida, Alabama). Slaveowners in urban areas (defined by the U.S. Census as locations with a population $\succ 2,500$ people) were eliminated from the sample, as were all slaveowners who owned slaves in partnership or within a corporation. These filters generated a base sample of 6,794 slaveowners from 1860. This base sample of slaveowners was linked to the 1860 Population Schedule through Ancestry.com's search function. Information used to make a match included the slaveowner's name and their (detailed) geographic location. In the case of multiple results (or no result), I first located the original data in the Slave Schedule and then used neighboring slaveowners to find the 1860 population schedule image. This was possible because the slave and population schedules were taken using the same sequence of visitation to households. Only 6,400 of the 6,974 individuals were located in the population schedule (a successful match rate of 92%).

From the population schedule, information on the slaveowner's marital status and age of spouse was recorded. Marriage was implied by the position of the individual and other household members on the population schedule. Any potential wives should have been listed immediately following the slaveowner (if the slaveowner was male). If the slaveowner was a female, the husband should have been listed immediately before them. Of the 6,400 individuals who were located in 1860, 4,377 were married. The final filter for this sample was the age of the female head of household. To ensure that this 1860 household was still fertile in 1870, the second observation point in the panel data, the sample was limited to those households where the female head was ≤ 35 years of age in 1860.

1860 households were next linked to the 1870 census returns. The 1860 population schedules provide information on the names, ages, and birthplaces of individuals in the slaveowning household in 1860. I used this information and Ancestry.com's search function to find the household in the 1870 Population Schedules. Information on the household's geographic location in 1860 was *not* used to search for individuals in 1870 in order to avoid any mover/stayer bias.

Two research assistants transcribed the results from the 1860 and 1870 population schedules, recording the name, occupation, literacy, age, real estate wealth, and personal wealth of each member of the 1860 household. Based on the position of the individual within the household, I determined which persons were part of the nuclear family (slaveowner, spouse, and children). For each individual in the household, I converted the information on age, race, wealth, and occupation using the 1860 and 1870 entries into a panel dataset of household fertility and other socioeconomic characteristics. In each case, the order of individuals on the manuscript results was used to determine which persons were part of the nuclear family as relationships to the head of household were not recorded in 1860 or 1870. In many cases, black or mulatto individuals of the same last name were found to be living with the family in 1870. Their race alone eliminated them from my core family dataset.

This process involved hundreds of subjective decisions in order to "match" individuals between Census years. For instance, suppose in 1860 the family has two children close in age with the initial "W". In 1870, only one child exists within the correct age band, and is listed as "William". Which 1860 "W" does "William" correspond to? In other cases, young children were listed as "infant" in 1860. By 1870, they would be 10 years old, but I could never know for sure whether a 9-year-old in 1870 was this same infant child or whether the infant died and the 9-year-old represented another pregnancy and birth entirely. Mistakes are probably quite frequent but should also represent white noise in these results and, if anything, contribute to attenuation bias in the estimated coefficients.

The process above generated a sample of 1,211 slaveowners who could be linked from the 1860 Population Schedules to the 1870 Population Schedules. As described in Section 4, the dataset had to be further limited to those households in which the marital relationship was intact between 1860 and 1870 in order to capture marital fertility. Divorce, death of a spouse, and/or separation were all criteria under which individuals were removed from the data set.

The data generation process for non-slaveowners is described in Section 4. The matching process from the 1860 Population Schedules to the 1870 Population Schedules is the same for the non-slaveowners as for slaveowners.

A.2 Variable Definitions

Variable definitions used in Section 5.1 are explained therein. For Section 5.2, more explanation is needed. Components of P_{it} and X_{it} are defined as follows:

- Fertility (1866-1870): Number of children in the household whose year of birth is between 1866 and 1870.

- Fertility (1856-1860): Number of children in the household whose year of birth is between 1856 and 1860. Where there is ambiguity about the date of birth (e.g., implied to be 1855 in the 1860 Census but 1856 in the 1870 Census), I use the date reported in the 1860 Census.
- Female age (1860): Age of the female head of household as recorded in the 1860 Census.
- Male age (1860): Age of the male head of household as recorded in the 1860 Census.
- Household RE Wealth 1860: Combined real estate wealth of all members of the slaveowner's nuclear family (spouse and children) in the 1860 Census.
- Household PE Wealth 1860: Combined personal wealth of all members of the slaveowner's nuclear family (spouse and children) in the 1860 Census.
- Male Place of Birth: Indicators for the male head's place of birth. Birthplaces were classified as one of the following: Alabama, Florida, Georgia, Mississippi, South Carolina, Texas, other Southern states, Atlantic states, Midwest states, New England states, Canada, or Europe.
- Male Occupation Category: The occupation of the male head of household was categorized into a binary agriculture/non-agriculture variable. The following qualitative responses (and variants thereof) to "What is your occupation" in the 1860 and 1870 Census schedules were coded "1" for employment in agriculture: farmer, planter, dairyman, farm agent, farm manager, farm renter, manager of farm, orange planter, overseer, cattle raiser, stock driver, stock raiser, and stockman.
- The remaining variables are indicators for the composition of the slaveowner's holdings and are self-explanatory.

In addition, the literacy dummies recorded in the Population Census in 1860 are not likely to be sound proxies for a household's education level. But because education is often found to correlate strongly with fertility, it is important to control for education in some other manner. A "numeracy" variable is calculated from the information contained in this sample. Numeracy here is defined as the ability of a household to correctly report the ages of its household heads in the 1870 and 1880 Census enumerations, given that they were correctly reported in the 1860 enumeration.[42] Formally, numeracy, bounded between 0 and 100, is:

[42] For other purposes, I have linked households forward to the 1880 census as well and use their reported ages in this census to gain a better proxy for numeracy.

$$Numeracy = Average\ (\sum_{j=Male,\ Female} Q_{j,t})$$

where

$$Q_{j,t} = 100\, if\ \ |Age_{j,1870} - Age_{j,1860}| = 10$$

$$or\ \ |Age_{j,1880} - Age_{j,1860}| = 20$$

$$Q_{j,t} = 60\, if\ \ |Age_{j,1870} - Age_{j,1860} - 10| = 1$$

$$or\ \ |Age_{j,1880} - Age_{j,1860} - 20| = 1$$

$$Q_{j,t} = 20\, if\ \ |Age_{j,1870} - Age_{j,1860} - 10| = 2$$

$$or\ \ |Age_{j,1880} - Age_{j,1860} - 20| = 2$$

and

$$Q_{j,t} = 0,\ otherwise$$

where the average is taken only over those cells where data exists. (For instance, if the female head of household is not present in 1880, there will be no data point in that cell.) If the household correctly reports the ages in 1870 and 1880 of both the male and female heads of household, under the assumption the 1860 value was correct, it receives 100 points for each of 4 data cells (the male in 1870, male in 1880, female in 1870, and female in 1880). For each age that the household misses by one year, it receives 60 points; if it misses by two years, it receives 20 points and if it misses by more than two years, it does not receive any points.

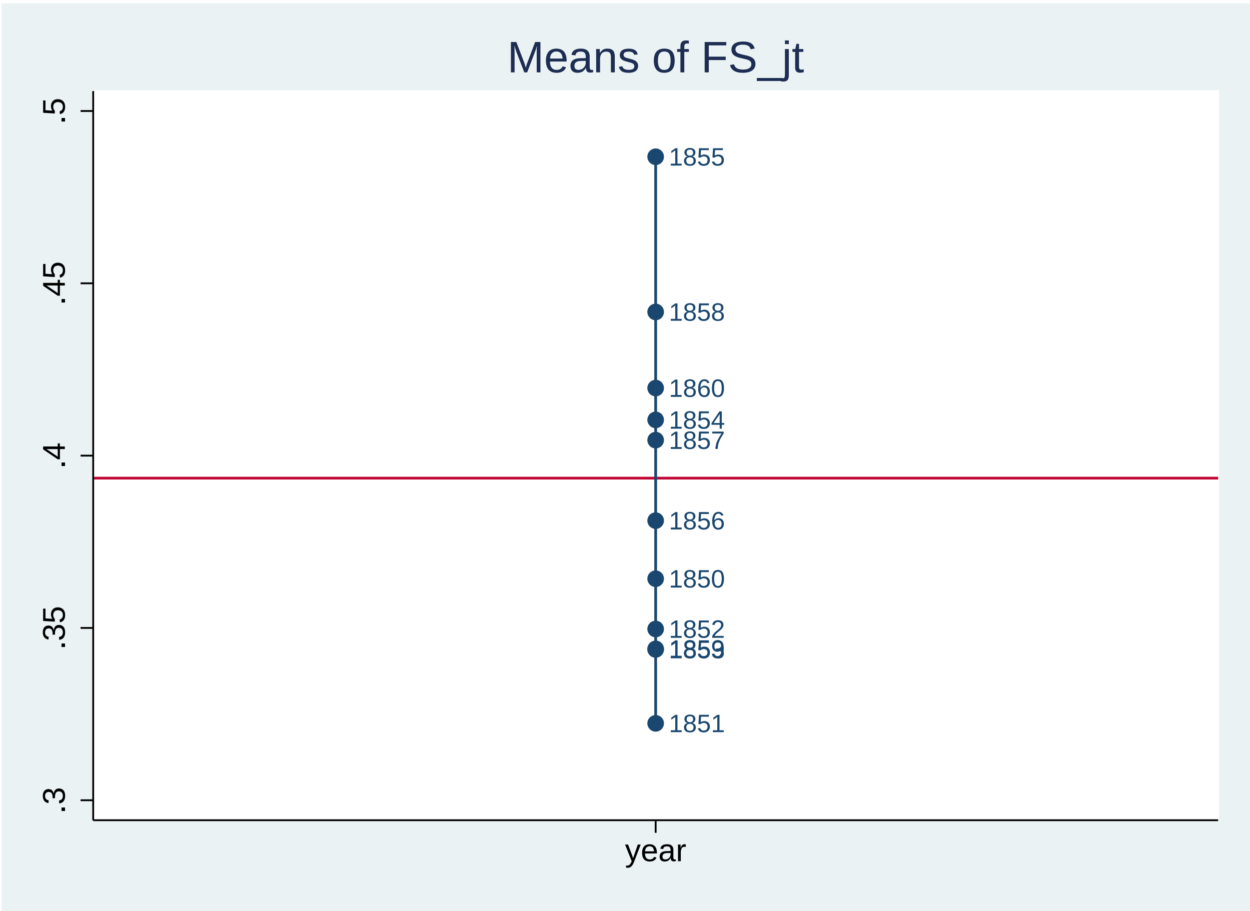
B The Impact of Age-Heaping on the Measured Response to Slave Fertility Events

Age-heaping is the tendency of households to report ages of household members and slaves that end in 0 or 5 - effectively rounding ages up or down to the nearest multiple of five.[43] To illustrate age-heaping in this sample, Figure 1 contains a plot of the average slave fertility rate ($\bar{F}^S_{jt}$), by year, for households with an observed own fertility event

[43] See Zelnik (1961).

($F_{jt}^{HH} > 0$), by year. In other words, conditional on bearing a child of their own, Figure 1 plots the average value of F_{jt}^{S} for $\forall t \in [1850, 1860]$. In the absence of age-heaping, this average would presumably be equivalent across years. But Figure 1 clearly implicates 1855 as an outlier. Households who reported a five-year-old child to census enumerators in 1860 were much more likely to also report a five-year-old slave child to census enumerators than households who reported a child of any other age were to report a slave child of that same age.

FIGURE 1: Evidence of Age-Heaping at 1855



Age-heaping generates a spurious correlation between a household's own fertility events and slave fertility events in the year of the slave fertility event, and this tends to bias the estimates of γ_0 away from 0. It also serves to generate a negative bias for γ_κ when $\kappa \neq 0$. Households who "round" the births of slaves and own children to years ending in 0 or 5 will display reduced fertility in the years preceding and following slave fertility events.

The correction for age-heaping is not obvious. Year fixed effects do not eliminate the heaping of births in 1855 as only a few households are age-heapers. Another option is to eliminate $t = 1855$ from the estimation. This effectively deals with the bias in γ_0 (indeed, γ_0 is no longer significant in the specification from Column 1 of Table 2) but does not address bias in the lagged effects.

Table 5 repeats the analysis from Table 2 and corrects for age-heaping by defining all households with $F^{HH}_{j,155} \succ 0$ and $F^{S}_{j,1855} \succ 0$ as "age-heapers" and dropping them from the sample. This is not an ideal remedy as there will be some households in the sample for whom the above conditions are legitimately true. But without a method for identifying these households, they cannot be identified separately from age-heapers. This change affects approximately 7.8% of the sample, and the majority are large slave owners. Of the households owning fewer than 8 slaves, 3.5% are defined as age heapers and dropped from the sample in Table 5. Eliminating these "age-heapers" from the sample eliminates the positive and significant impact of a slave fertility event on contemporaneous fertility as indicated by γ_0. It also reduces somewhat the economic significance of $\gamma_1 - \gamma_4$, but not substantially. Table 5 still provides strong evidence of fertility reduction following the birth of a slave child.

The correction above generates its own bias, the magnitude of which can be better understood by performing the same correction using a different year as the standard for dropping observations. Presumably, there is no age-heaping in 1856 and coincident slave and household fertility events are accurate. Dropping all households from the sample where $F^{HH}_{j,1855} \succ 0$ and $F^{S}_{j,1855} \succ 0$ (not shown) generates coefficients for γ_0 and γ_1 between those exhibited in Tables 2 and 5. Thus, some of the correction exhibited in Table 5 is over-compensation for the age-heaping bias. The corrected and uncorrected coefficients may be viewed as upper and lower bounds on the true coefficient values.

TABLE 5: Equation 3 Estimation Results - Correcting for Age Heaping

	(1)	(2)	(3)	(4)	(5)
	All Households	<8 Slaves	<4 Slaves	Pre-Trends	With binary event
γ_0	-0.00269	-0.00111	0.0263	-0.0338	-0.00940
	0.0104	0.030	0.055	0.046	0.0306
γ_1	-0.00123	-0.0576*	-0.0601	-0.0398	-0.0630**
	0.011	0.031	0.054	0.049	0.0317
γ_2	-0.00200	-0.0442	-0.126***	-0.0484	-0.0416
	0.011	0.031	0.052	0.046	0.031
γ_3	-0.0145	-0.00214	-0.0218	0.0493	0.000863
	0.012	0.031	0.054	0.046	0.032
γ_4	0.00807	-0.0389	-0.0298	0.0127	-0.0386
	0.011	0.031	0.054	0.042	0.0321
R-squared	0.15	0.14	0.14	0.21	0.14
Adjusted R-squared	0.01	0.01	0.00	0.00	0.01
# Households	819	522	331	522	522
Slave Fertility Events	1030	360	90	360	360

Source: Authors' calculations from Census data described in text.
Notes: The table lists results from estimating Equation 3 for slave fertility events between 1846 and 1860 (and household fertility responses from 1850 through 1864). Households with an own fertility event and a slave fertility event in 1855 are excluded from the dataset. The coefficient γ_κ represents the impact of slave fertility event in year $t - \kappa$. All specifications also include household and year fixed effects. Column 1 includes all households in the sample. Column 2 includes only those households owning fewer than 8 slaves in 1860. Column 3 includes only those households owning fewer than 4 slaves in 1860. Column 4 contains the pre-trends such that γ_κ represents the impact of slave fertility in year $t + \kappa$. Column 5 uses binary indicators for whether a slave fertility event occurred, rather than the number of such events, as the independent variables. T-statistics are included beneath each coefficient. *** indicates statistical significance at 97.5% confidence, ** at 95%, and * at 90%.

C Appendix C: X_{it} and β from Equation 4

The estimation of Equation 4 includes a vector of household characteristics, X_{it}. The average values for variables contained in X_{it} are contained in Table 6 and the coefficients on those variables for the estimation specification corresponding to Column 1 of Table 4 are contained in Table 7.

TABLE 6: Summary of Variables Contained in X_{it}

	Mean	Standard Deviation
$F^{HH}_{i,1856-1860}$	1.52	0.99
Female age (1870)	37.0	5.42
Male age (1870)	44.4	7.28
Male employed in agriculture (1870)	0.71	–
Numeracy	63.4	25.8
Household real estate wealth (1870)	2705	5196
Household personal wealth (1870)	1800	9684
Change household real estate wealth (1870-1860)	(1584)	7384
Change household personal wealth (1870-1860)	(8826)	20260

Source: See text.

TABLE 7: β Estimates for Equation 4

	Coefficient	T-Statistic
$F^{HH}_{i,1856-1860}$	0.200	6.02
Female age (1870)	-0.00617	-0.08
Female age (1870) Squared	-0.000712	-0.71
Male age (1870)	-0.0283	-0.66
Male age (1870) Squared	0.000368	0.81
Numeracy	0.00309	2.39
Male employed in agriculture (1870)	0.134	1.80
Log total household wealth (1870)	-0.00257	-0.19
Δ personal wealth (1860-1870) (in 000s)	0.00123	0.46
Δ real wealth (1860-1870) (in 000s)	0.00418	0.87

Source: Author's calculations from Census data described in text.
Notes: Coefficients reported are for a specification of Equation 4 including all age variables and an interaction between age 0-2 and size variables. The coefficients do not change remarkably under alternative specifications.