Happy Mothers, Successful Children: Effects of Maternal Life Satisfaction on Child Outcomes*

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Abstract

In this paper, I ask if maternal happiness leads to improved child cognitive and noncognitive test scores. Because happiness and family structure are entwined—with marriage potentially increasing happiness and happiness increasing the probability of marriage—I simultaneously model maternal happiness, marital status, and value-added, child skill production functions to identify separate causal effects of both on child skills. I find that life satisfaction promotes *only* noncognitive skills. For example, a 10% increase in mean maternal happiness is predicted to increase social skills by an amount equivalent to £50,000 in income. Marriage has a large positive effect on cognitive skills *and* on select noncognitive skills. For instance, a change from single-parenthood to marriage is predicted to increase cognitive skills by the same amount as £62,000 in household income. My results show an asymmetry in the effects of interest as life satisfaction has a negligible effect on skills that marriage influences and vice versa. These distinct happiness and marriage effects suggest that policies promoting *healthy and happy* marriages might be preferred to policies that simply promote marriage.

JEL Classifications: J12, J13, C33

Keywords: Life Satisfaction, Child Development, Noncognitive Skills, Cognitive Skills, Item Response Theory

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1 Introduction

Whereas much is known about income and family structure as factors that influence child skill formation—with children of more affluent and married families outperforming children of less affluent and non-married families (*e.g.*, Dahl and Lochner 2012; Hill *et al.* 2001)—less is known about the role of happiness. Maternal happiness is important for child development not only because it affects parenting preferences, but because it can also affect the choice of spouses, both of which subsequently determine childhood investments. Because happiness is entwined with family structure—marriage potentially increases happiness and happiness increases the probability of marriage—the effects of family structure on child skill formation should be separated from the effects of happiness. This distinction is crucial on the grounds that part of the beneficial effects of marriage on child development may be driven by maternal happiness. Hence, in the current paper, I ask if maternal happiness leads to improved child cognitive and noncognitive test scores, and if this is a distinct effect from a marital status effect.

Happiness, which I define as self-reported overall satisfaction, can be viewed as an input in the production of child cognitive and noncognitive skills. For example, happier mothers may increase the quantity and quality of child investments or may avoid conflict ridden relationships to ensure child exposure to a constructive familial environment. This suggests that happier mothers may be more likely to marry and may also choose partners who will positively contribute to the production of child skills. This positive selection into a marital status will further enhance maternal happiness, which will, subsequently, have a positive effect on child investments. Therefore, apart from the link between marital status and child skills, there are two other links worth incorporating in analyzing child skill formation; first, happiness may lead to marriage which can further boost happiness and, second, happiness may lead to production of highly skilled children due partly to the attachment of the mother to her child. These links lead to the following question: is the marriage effect in existing work, in fact, a happiness effect?

To answer this question, I use data for U.K. children ages 3-7 from the Millennium Cohort Study. I estimate a three-equation model for maternal happiness, marital status and a value-added, child skill production function to identify the causal effect of maternal life satisfaction and marital status on child outcomes. As alternative child outcomes, I use a cognitive test score and a battery of six behavioral scores: conduct problems, emotional symptoms, hyper-activity/inattention, peer problems, independence/self-regulation and prosocial behaviors. Because maternal happiness is affected by unobserved characteristics that may also affect child outcomes—for example, changes in maternal moods are related to her happiness and

the child is directly exposed to these moods—maternal happiness is endogenous. I use lagged weather conditions and lagged life satisfaction as exclusion restrictions in the life satisfaction model to provide exogenous variation in contemporaneous life satisfaction. Similarly, because mothers select into a marital status based on unobserved preferences—mothers have certain preferences about the characteristics of their future spouses—marital status is also endogenous. Exogenous variation in marital status comes from region-year-age variation in male incarceration rates at the time period the mother started her relationship with the father of the child, and the previous marital status of the mother.

As an extension, I examine a subset of households with the father present (married and cohabiting couples). Fathers may have a beneficial impact on child skill formation because they increase discipline and time investments, and expose the child to distinct gender roles. I use these specifications to evaluate the role of paternal life satisfaction on child skill formation and to examine whether the marriage effect reflects a paternal presence effect.

My paper builds on the family structure literature that documents a positive association between marriage and child outcomes (*e.g.*, Crawford *et al.* 2011; McLanahan and Sandefur 1994; Ribar 2004) and, in particular, on existing research that asks whether marriage has a causal effect on child outcomes (*e.g.*, Francesconi *et al.* 2010). I incorporate three innovations in my analysis. First, I explicitly include life satisfaction as an input in child skill production functions to account for the effect of happiness on child skill formation. Evidence about the effects of life satisfaction on child outcomes is scarce.[1] The only study addressing the causal effect of interest is Berger and Spiess (2011) who show that maternal life satisfaction leads to decreases in behavioral problems and increases in cognitive performance of young children in Germany. However, they do not take into account marital status, so their estimates may reflect positive marriage effects. Second, because happiness and marital status are entwined, I model them as a system of simultaneous equations. Although some prior studies examine the relationship between marriage and life satisfaction (*e.g.*, Stutzer and Frey 2006; Zimmerman and Easterlin 2006), they do not address their simultaneous determination. Accounting for endogeneity of maternal happiness and marital status enables me to identify separate causal effects of both on child cognitive and noncognitive test scores. Third, I use narrowly defined child behaviors which distinguishes my analysis from previous studies that rely on an aggregated measure of child behaviors, a behavioral problem index based on combinations of the six components that I use separately. Also, in contrast to previous studies that use summed scores of individual responses on cognitive and noncognitive tests

[1] Some evidence comes from studies on maternal depression which treat depression as an extremely low level of happiness. These studies document that children of depressed mothers are disadvantaged compared to children raised by non-depressed mothers (*e.g.*, Downey and Coyne 1990; Friedlander *et al.* 1986). As I explain later in the paper, I treat happiness and depression as distinct traits.

to measure child skills, I take into account the latent nature of such skills and uncover their underlying distribution using item response theory. To my knowledge there is no prior study that incorporates within the same framework these three links—marital status affects child outcomes, marital status affects life satisfaction and vice versa, and life satisfaction affects child skill formation—to identify the causal effect of life satisfaction and marital status on latent child skills.

I estimate distinct happiness and marriage effects that differ by child outcome. Maternal happiness promotes *only* noncognitive skills. For example, a 10% increase in maternal life satisfaction is predicted to increase social and self-regulation skills by an amount equivalent to increasing average annual household income by £50,000 and £30,000, respectively. Marriage promotes cognitive skills *and* select noncognitive skills. A change from single-parenthood to marriage is predicted to increase cognitive skills and non-conduct problems by the same amount as £62,000 and £200,000 in annual income; however, marriage is predicted to lower self-regulation skills by the same amount as an income reduction of £82,000. This asymmetry in the estimated effects of interest suggests that promoting only marriage or only maternal happiness will lead to shortages in the accumulation of different types of skill. I also compare children only of married and cohabiting couples to assess the role of paternal life satisfaction on child outcomes. I find that paternal life satisfaction has neither a statistically nor an economically significant relationship with child skills, but marriage still increases child skills relative to cohabitation. This suggests that marriage is inherently beneficial, due perhaps to higher spousal commitment.

My findings can inform policy discussions on the role of marriage in child development. In the last decade, such discussions have been revived partly because of the concern that the higher benefits the married couples enjoy may contribute to maintaining low quality marriages. For example, in the U.K., inheritance tax, transferable allowances and pension rights are available only for legally married couples (see report on Breakthrough Britain 2009). In 2010 the U.K. Marriage Foundation set marriage as the "gold standard" with the goal of forging strong parental relationships and reducing relationship breakdowns, similar to the spirit of the U.S. Healthy Marriage Initiative.[2] Hence, pro-marriage policies should be complemented with policies promoting *healthy and happy* marriages.

[2] Marriage policies in the U.K. aim at supporting strong families and lasting relationships through marriage preparation (1998 Supporting Families report); reducing conflict and providing marriage support to save marriages (Hart Review 1999); extending governmental support to marital and non-marital relationships (Moving Forward Together: A Proposed Strategy for Marriage and Relationship Support for 2002 and Beyond); and providing equal access to counseling services and tax breaks (2004 Married Couples Allowance) for couples identified as "married" or "living together as if married" (see report on Breakthrough Britain 2009). For more information on U.S. healthy marriage policies see Hsueh *et al.* (2012).

2 Conceptual Framework

Link I: Marital Status and Production of Child Skills

In the literature, three main benefits have been associated with marriage over other family structures for the production of child skills. First, marriage involves increasing returns to scale in household production (*e.g.*, Becker 1973), and this pooling of financial and time resources increases the production of household goods including the production of child skills. Also, the lower likelihood of economic hardship also increases the probability of married families residing in more desirable neighborhoods (*i.e.*, higher quality schools or lower crime rates) which exerts a positive effect on child skill formation (*e.g.*, Furstenberg *et al.* 1999). Second, it is potentially beneficial to have a father present in the household because he acts as a role model (*e.g.*, Ginther and Pollak 2004), because he contributes to consistent parenting through increased monitoring and discipline (*e.g.*, McLanahan and Sandefur 1994), or because of the time he devotes to the child (*e.g.*, Neidell 2000). Third, divorce affects child emotional development due to stress experienced when the parental relationship ends (Amato 2005).

Within this literature, non-causal studies dominate documenting a positive correlation between marriage and child outcomes (see Hill *et al.* 2001 for a review) with children from married families having higher educational attainment (*e.g.*, Ginther and Pollak 2004) and less behavioral problems (*e.g.*, Ermisch and Francesconi 2001; Hofferth 2006), followed by children from cohabiting, and single-parent families (*e.g.*, Crawford *et al.* 2011; McLanahan and Sandefur 1994).[3] These positive marriage effects may simply reflect the positive traits of parents who end up marrying which, in turn, exert a positive effect on the production of child skills due to positive selection into marriage (*e.g.*, Bjorklund *et al.* 2010; Hofferth 2006; Ribar 2004). This selection argument suggests that the worse cognitive and behavioral outcomes of divorced parent children (*e.g.*, Hoekstra 2009) are due to preexisting conditions that lead the parents to divorce—in particular, child exposure to parental conflict (Tartari 2006).

However, results from studies on causal effects of marriage are inconclusive as some find that marriage benefits children (*e.g.*, Lang and Zagorsky 2001), while others report no marriage effect on child outcomes (*e.g.*, Finlay and Neumark 2010; Francesconi *et al.* 2010).[4]

[3] There is also evidence of insignificant effects of single-parenthood on child outcomes (*e.g.*, Bjorklund and Sundstrom 2006) and that children born to or living with cohabiting parents perform worse academically and behaviorally (*e.g.*, Brown 2004).

[4] Single-parent families cause worse educational outcomes (*e.g.*, Ermisch and Francesconi 2001; Lang and Zagorsky 2001) and lower performance in cognitive tests (*e.g.*, Liu and Heiland 2010) but they do not cause differences in emotional distress (*e.g.*, Ermisch and Francesconi 2001) or behavioral outcomes (*e.g.*, Liu and Heiland 2010) compared to two-parent families.

My paper naturally belongs to this subset of the family structure literature as I treat marital status as endogenous with respect to child outcomes in order to identify the causal effect of marriage on child skill formation.

Link II: Marital Status and Maternal Happiness

Most studies on the determinants of life satisfaction document that marriage and cohabitation have a positive effect on life satisfaction, while divorce and separation usually exert a negative impact on happiness (*e.g.*, Argyle 1999; Blanchflower and Oswald 2004; Diener *et al.* 1999; Stutzer and Frey 2006; Waite and Gallagher 2000). This positive relationship reflects potential benefits of the chosen marital status. For example, marriage offers protective effects on spouses due to financial benefits as it allows gains from economies of scale and specialization within the family (Becker 1981), which, in turn, enable spouses to fulfill their needs leading to an increase in satisfaction (Diener and Fujita 1995). Marriage may also affect happiness because it shields individuals from loneliness (*e.g.*, Waite and Gallagher 2000) due to social integration and social support networks (*e.g.*, Argyle 1999).[5]

Even though some empirical longitudinal studies suggest that marriage is positively related to happiness (*e.g.*, Zimmerman and Easterlin 2006), there is no consensus that this relationship represents causal effects.[6] Because individuals with happier personalities are more likely to marry and because they select mates to match their personality traits (that are largely stable), the marriage effect will simply capture the selection of happier parents into marriages. There is empirical support for this selection argument; those to be married are already happier than those who remain single (Stutzer and Frey 2006) and those who divorce are less happy even before they enter into marriage (*e.g.*, Gardner and Oswald 2006; Stutzer and Frey 2006).

Despite that marriage and life satisfaction can positively contribute to each other with potential bidirectional causal effects, few studies examine their simultaneous determination. Binder and Coad (2010) and Binder and Ward (2011) adopt a vector autoregressive model and data from the German Socioeconomic Panel and the British Household Panel Study, respectively, to show that increases in happiness are associated with increases in the probability of marriage, while entering into marriage is associated with subsequent decreases in life satisfaction. Although they interpret this finding as evidence of adaptation of life satisfaction, this finding also suggests that there is a reverse causal link between life satisfaction

[5] For mechanisms through which marriage may cause happiness see Waite and Lehrer (2003); for mechanisms on how life satisfaction can lead to marriage see Veenhoven (1989); and for mechanisms on how marriage can affect child outcomes see Weiss (1997).

[6] Frey and Stutzer (2002) find evidence in favor of a causal effect of marriage on life satisfaction as marriage permanently increases happiness, while Easterlin (2003) concludes that there is only partial evidence of a causal effect as marriage only slightly increases happiness.

and marital status. This is central for my study, as I show that once endogeneity of marital status and life satisfaction is accounted for, both a marriage and a happiness effect remains; the main implication is that marriage and happiness both matter when it comes to child skill formation.

Link III: Maternal Happiness and Production of Child Skills

There are several channels through which maternal satisfaction may affect child skill formation. First, happier mothers are more productive in the labor market (*e.g.*, Ferrer-i-Carbonell and Frijters 2004) allowing them to increase the quantity of monetary investments to children. In combination with the higher probability of increasing quality of investments (*e.g.*, Felfe and Hsin 2009), child skills will increase in the presence of more satisfied mothers.

The quality of the interaction between mother and child is also pivotal to early child development. A happier mother is expected to be more responsive and sensitive towards her child's needs (*e.g.*, Belsky 1997), and because the child's own attachment develops at young ages, child skills will be affected by the distal factors of the mother. This idea relates to findings within the economics literature that early child development is contingent on the amount of the investments and the timing when these investments are realized (*e.g.*, Cunha and Heckman 2008).

Similarly, the quality of spousal relationship determines the degree of child exposure to a non-constructive familial environment. Just by observing how parents interact with each other, children learn behaviors like communication, resolving disputes, or showing respect (*e.g.*, Amato 2005). A happier mother within a given marital status is more likely to resolve disputes in a more constructive way and the child benefits directly from observing the maternal behavior (Emery and O'Leary 1982). Respectively, under lower marital satisfaction, there will be higher tension between parents with deleterious effects on child outcomes due to the prevalence of a destructive environment (*e.g.*, Amato 2005). Overall, maternal satisfaction will benefit child development because a more satisfied mother will have a more positive outlook on life.

Even if these mechanisms can be perfectly accounted for, maternal happiness may still affect child skill formation because of happiness genes that mothers transmit to their children. Evidence from twin studies (*e.g.*, Bartels and Boomsma 2009; Stubbe *et al.* 2005) suggest that happiness is to a large extent predetermined by personality and genetic make-up (*e.g.*, Lykken and Tellegen 1996) and it fluctuates around a fixed point over the lifetime only due to transitory life events.[7]

[7] Life events such as unemployment (*e.g.*, Clark *et al.* 2008; Lucas *et al.* 2003) have long-lasting effects, while changes in marital status have ambiguous effects because marriage can have temporary (*e.g.*, Clark *et al.* 2008; Lucas *et al.* 2003) or more permanent positive effects on life satisfaction (*e.g.*, Zimmermann and

Though such mechanisms have been provided in the literature few studies have empirically explored if maternal happiness affects child skill formation (Berger and Spiess 2011; Proto *et al.* 2011). Among these only Berger and Spiess (2011) has addressed the endogeneity of maternal happiness with respect to child outcomes. Using data from the German Socioeconomic Panel and instrumenting current life satisfaction with lagged life satisfaction, they show that more satisfied mothers are more likely to have better behaving, and more cognitively able children. Although their study examines the causal relationship between child skills and maternal satisfaction, they do not address the two links described above and they do not condition on marital status.[8]

Content of Happiness

Before I describe the empirical strategy, I put happiness into its theoretical context. Happiness is characterized by frequent positive feelings, infrequent negative feelings and high satisfaction with life conditions (Diener 1984). This definition corresponds to psychologists distinguishing among three components of subjective well-being: 1) affective well-being, which consists of positive and negative affects; 2) cognitive well-being, which consists of judgments over global life satisfaction; and 3) domain well-being, which consists of assessments over specific aspects of life satisfaction such as work, family, health, self and finances (*e.g.*, Diener *et al.* 1999). Even though these three components are valid and reliable, the extent to which life satisfaction is equivalent to happiness is an empirical issue (*e.g.*, Diener 1984); life satisfaction can be viewed as both an affective (hedonic) dimension (Veenhoven 1997), as it evaluates the degree to which individuals experience pleasant events and how good they feel, and a purely cognitive judgment of life events, as it evaluates the degree to which an individual perceives his aspirations to have been met (*e.g.*, Diener *et al.* 1999).[9] In conjunction with evidence that happiness is more closely related to cognitive than to affective measures (*e.g.*, Andrews and McKennell 1980) and that life satisfaction exhibits significant correlation with happiness, life satisfaction is a good proxy for chronic happiness when more direct measures of happiness do not exist (*e.g.*, Lyubomirsky *et al.* 2005). For

Easterlin 2006).

[8] Proto *et al.* (2011) examine the relationship between happiness, marital status and child outcomes, but without identifying causal effects. Using an experiment they show that parental divorce does not affect college students' cognitive skills, and conclude that parental experiences do not pass on through genes to child productivity.

[9] Life satisfaction constructs have satisfactory validity and reliability as they are strongly correlated with more objective measures of well-being such as income, inflation, and unemployment (DiTella *et al.* 2003; Easterlin 2003), they are quantitatively consistent with revealed-preference measures of consumption utility (Perez Truglia 2010), and they are strongly correlated with duration of authentic Duchenne smiles, evaluations of an individual's happiness by family, friends and spouses, and physiological measures such as blood pressure and brain activity (Konow and Earley 2008).

example, among individuals who have reported more than average levels of life satisfaction with their overall lives, 85% of them report that they felt happy at least half of the times (Lucas *et al.* 1996). In my paper, I adopt the view that there is a strong correlation between life satisfaction and happiness and use them interchangeably.

I also treat life satisfaction distinctly from depression. Depression may reflect high levels of negative affect and low levels of positive affects (*e.g.*, Watson and Clark 1995) since individuals who feel depressed do not report high levels of happiness (*e.g.*, Headey *et al.* 1991). However, depression may also reflect extremely poor health (*e.g.*, Koivumaa-Honkanen *et al.* 2005) since there is evidence that, even though women are on average more depressed, they are also just as happy as men (Argyle 1987). For my sample, factor analysis showed that life satisfaction and depression are two distinct traits, and so depression corresponds to the left tail of the health distribution.

3 Empirical Framework and Estimation Strategy

3.1 Empirical Framework

My goal is to identify separate effects of maternal happiness and marital status on child outcomes. I incorporate the three links described in the previous section into the same framework using a three-equation model: a value-added skill production function, a life satisfaction model, and a marital status choice model.

I model child skill formation using the following value-added, skill production function:

$$S_{jt}^{k} = \beta_0^k S_{jt-1}^{k} + \beta_1^{-k} S_{jt-1}^{-k} + \beta_2^k LS_{jt} + \beta_3^k MS_{jt} + \beta_4^k X_{jt} + \epsilon_{jt}^{k} \tag{1}$$

where S_{jt}^{k} is skill k for child j at time t, S_{jt-1}^{k} is the lagged skill, S_{jt-1}^{-k} is a vector of complementary skill measures, LS_{jt} denotes maternal life satisfaction and MS_{jt} is a vector of dummies identifying the marital status of the mother (married, cohabiting, divorced, single) at time t. All other observable family inputs that contribute to the production of child skill at time t are included in the vector of explanatory variables X_{jt} and ϵ_{jt}^{k} represents omitted factors that affect the skill formation process.

The vector S_{jt}^{k} includes proxies for k-specific latent child cognitive and noncognitive skills. I take into account the latent nature of these skills while adjusting for measurement error using item response theory, which I describe in the child outcome construction section 4.3.1. I focus on cognitive and noncognitive skills because they are good predictors of educational attainment, risky behaviors, longevity and future labor market productivity (see Almlund *et al.* (2011) for a review on noncognitive skills, and Hanushek and Woessmann (2008) for a review on cognitive skills), and because their formation can be affected at early stages (*e.g.*,

Heckman 2008) allowing for policy interventions to support child development.

This production function assumes that child skill at each period t is a linear function of all current and past parental and family inputs, innate heritable endowments that are inherently unobservable, and shocks to the production of child skill. Because no dataset contains complete histories of family inputs, acquired skills, and endowments, there is the potential of omitting several inputs from the analysis. I proxy for unobserved past inputs and endowments by including a lagged measure of the child outcome. The term S^k_{jt-1} captures this cumulative history of past inputs in the production function and is a sufficient statistic for all inputs employed from *t=0* until *t-1*. This value-added framework has been used extensively in the education and skill formation literature (*e.g.*, Cunha and Heckman 2008; Cunha *et al.* 2010; Todd and Wolpin 2007).[10,11]

Moreover, there is the possibility that cognitive and noncognitive skills are cross-productive (*e.g.*, Cunha *et al.* 2010). Performance on a standardized test may relate not only to the endowment of cognitive skill S^k_{jt-1}, but also to accumulated noncognitive skills S^{-k}_{jt-1}. The reverse is also true as cognitive skill may affect noncognitive skill formation, despite that the link from noncognitive to cognitive skill is usually stronger than the link from cognitive to noncognitive skill (*e.g.*, Borghans *et al.* 2008; Cunha and Heckman 2008; Cunha *et al.* 2010).[12] Therefore, each child skill is produced using the cumulative capital of that same skill k in previous time periods and the capital of its complementary skills *-k*.

My goal is to identify the causal effect of life satisfaction (β^k_2) and marital status (β^k_3) on each child outcome to determine if the marriage effect is fully caused by life satisfaction or whether these effects are distinct. If there are no unobservable characteristics that affect child skills and life satisfaction, β^k_2 will capture the direct effect of maternal happiness on child outcomes or what the psychologists call the "attachment" of the mother to the child (Belsky 1997). This effect would show how much better off a child would be if we could change a mother's self-evaluated happiness. β^k_3 will capture the causal effect of marriage,

[10] The value-added specification assumes that the marginal impact of previous inputs declines geometrically overtime at the same rate ($\beta^k_2 < 1$). It allows for more flexibility compared to a gain-score production function which assumes that previous inputs have a one-time, non-decaying effect on child outcomes, and since the equality of β^k_2 with the unity has been empirically rejected (*e.g.*, Andrabi *et al.* 2011) I adopt the value-added specification.

[11] With the value-added specification I use both within and between variation in life satisfaction to identify its effect on child outcomes. I do not use child fixed-effects for two reasons: first, with child fixed effects all the variation in child outcomes comes from changes within each child, that is, from children whose mothers life satisfaction varies overtime. Observations that are relatively stable within the examined time period are dropped from the analysis. Second, under child fixed effects measurement error is exaggerated if mothers report their life satisfaction differently overtime. This is not a concern for marital status as there is usually no misreporting on if someone is married, cohabiting, divorced or single.

[12] For example, a highly motivated child will perform better on standardized tests compared to an equally cognitive able child but with a lower level of motivation.

which would show how children of married mothers perform relative to children of mothers from other family structures. These causal effects can be interpreted as the difference in average child outcomes that children from one marital status would experience (*i.e.*, married mothers) if they were assigned to an alternative family structure (*i.e.*, single mothers), and the difference in average child outcomes that children of less happy mothers would experience if they were assigned to happier mothers.

Because more able children may affect maternal satisfaction and marital status decisions, LS_{jt} and MS_{jt} may be correlated with child endowments and family inputs in earlier time periods. Even though I include lagged skill measures S_{jt-1}^{-k} to capture cross-complementarities of skills, by incorporating them in (1) I reduce the correlation between life satisfaction and unobserved family inputs and skill. Therefore, even if the lagged measure of a child outcome does not completely meet the criteria to be a sufficient statistic for past inputs, the vector of these six additional lagged skill measures should be an adequate sufficient statistic for past inputs and endowments.

The value-added production function controls for observed heterogeneity in child skills by incorporating contemporaneous family inputs in X_{jt}. However, if there are unobservable contemporaneous characteristics that affect child outcomes, and life satisfaction and marital status, the betas will be inconsistently estimated. For example, happiness is influenced from positive and negative affects which cannot be measured. But, because they affect the attitude of the mother towards her child, they will directly affect child outcomes. Then, if the error term includes maternal pride, which is more positive for a child who is better behaved or for a child who scores higher in standardized tests, and which is also correlated with maternal life satisfaction, β_2^k will be upward biased. Similarly, if between time period t and *t-1* mothers experience a sudden increase in their income due to an inheritance or a wage raise, and because this additional amount of income affects both life satisfaction and child outcomes (as it involves higher child investments) the coefficient of life satisfaction will be biased. In order to identify the effect of life satisfaction independently of such unobserved traits I need exogenous source of variation in life satisfaction.

To formally address this endogeneity problem I model life satisfaction as:

$$LS_{jt} = \gamma_0 S_{jt-1}^{k} + \gamma_1 S_{jt-1}^{-k} + \gamma_2 MS_{jt} + \gamma_3 X_{jt} + \gamma_4 Z_{t-s} + u_{jt} \tag{2}$$

where all the variables included in the right hand side in (1) are present in (2) and Z_{t-s} is a vector of variables measured s time periods before child skill is formed. These exclusion restrictions Z_{t-s} (lagged weather conditions and lagged maternal happiness) directly affect the production of maternal happiness, but not the production of child skill, and will give a

source of exogenous variation in life satisfaction, necessary to identify the causal effect of life satisfaction on child outcomes. Contemporaneous measures of Z_t are also included in X_{jt}. I discuss more about these exclusions variables in section 4.3.4.[13]

Moreover, parents are not randomly assigned to their marital status, but they select the marital status that will increase their expected benefits from entering a certain union. This choice is largely determined by preferences over their partners in the marriage market which are unobservable with more able women having the propensity to be attracted to more able men. Because such maternal preferences affect child outcomes due to positive correlation between S_{jt}^k and ϵ_{jt}^k, they will bias the effect of marital status on child outcomes.

To address this endogeneity problem, I model the marital status choice as:

$$MS_{jt} = \delta_0 S_{jt-1}^k + \delta_1 S_{jt-1}^{-k} + \delta_2 LS_{jt} + \delta_3 X_{jt} + \delta_4 R_{t-s} + v_{jt} \tag{3}$$

where all variables are defined as above and R_{t-s} includes male incarceration rates s time periods before child outcomes are observed when the mother started the relationship with her partner, and the previous marital status of the mother. These exclusion restrictions will provide the necessary variation in marital status to identify the causal effect of marriage on child outcomes. Similar to the life satisfaction model, contemporaneous measures of incarceration rates are included in X_{jt} with further justification given in section 4.3.4.

The identification of separate marital status and life satisfaction effects could be a potential concern because marital status and life satisfaction are closely related. However, prior studies have documented that there is sufficient variation between marital status and life satisfaction as, on average, 40-50% of the variation in life satisfaction is explained by socioeconomic characteristics (*e.g.*, Lykken and Tellegen 1996). Even though marital status is one of the factors that explain a significant portion of life satisfaction (*e.g.*, Clark *et al.* 2003) it is also not the sole characteristic that determines happiness (*e.g.*, Dolan *et al.* 2008). I provide empirical evidence that life satisfaction and marital status are distinct, though related, variables for my sample (section 4.3.2) so that I can isolate the life satisfaction and marital status effects.

[13] I do not adopt a fixed effects model of life satisfaction for two reasons. First, because identification of a life satisfaction effect on child outcomes comes from between and within variation, I cannot purge the between variation across mothers and use only the within mother variation in the life satisfaction model. Second, to capture time-invariant traits that affect current life satisfaction I include lagged life satisfaction in (2). This is corroborated empirically; a Hausman test, comparing the efficiency of an ordered logit model and an ordered logit model with fixed effects, showed that the null hypothesis of equal coefficients in the two models cannot be rejected.

3.2 Estimation Strategy

I estimate equations (1)-(3) using a two-stage least squares method. In the first stage, I simultaneously estimate the life satisfaction and marital status choice model. I treat marital status as an unordered discrete choice because mothers' choice set includes marriage, cohabitation, single parenthood and divorce or separation. Because of the unordered nature of these outcomes and the mutual excludability of the alternatives (a mother cannot be married and single at the same time) the error terms in equation (3) are independently and identically distributed with the extreme value distribution, and the marital status decision can be approximated through a multinomial logit estimation equation (Madalla 1983). Additionally, life satisfaction is an ordered discrete choice. Under the assumption that the error terms in (2) are i.i.d. with the Gumbel distribution, the conditional probability function for the ordered life satisfaction measure can be approximated with an ordered logit model. I maintain the ordinal structure of life satisfaction despite evidence in the literature that cardinality of life satisfaction is valid and that life satisfaction models can be estimated by ordinary least squares (Ferrer-i-Carbonell and Frijters 2004). I conducted a Hausman specification test to examine if the estimated coefficients from an ordered logit and an ordinary least squares method are similar. I reject the null hypothesis that both models are consistent at the 1% level of significance. The marital status choice model and the life satisfaction model are simultaneously estimated using maximum likelihood estimation. In the second stage, I use these parameters of the simultaneous model to jointly estimate the effect of life satisfaction and marital status on the skill production function (1) for each of the seven child skill measures. Because I observe the same children at least two times during the time period, I cluster the standard errors at the child level.

As an extension, to assess the role of fathers in child skill formation, I examine specifications where both parents are present. Because this corresponds to being married or cohabiting, the choice set for the marital status model is restricted to two alternatives. In the first stage I simultaneously estimate a binary choice marital status model (logit model) and an ordered logit life satisfaction model. In the second stage, the estimates from the simultaneous model are used to estimate the effects of marriage (versus cohabitation) and life satisfaction on child skills.

4 Data

4.1 Millenium Cohort Study Data

The primary data are from the Millennium Cohort Study (MCS), a longitudinal cohort study that follows children born between September 2000 and August 2001 in England and

Wales, and November 2000 and January 2002 in Scotland and Northern Ireland. The MCS is designed to monitor such key domains as cognitive skills, noncognitive skills, and health formation, as well as the socioeconomic status of the children's families. Information has been collected in 2001/2002, 2004/2005, 2006 and 2008 when the cohort members were nine months, three years, five years and seven years old, respectively. Information was reported by the caregiver of the household (typically the mother figure) for the first three rounds. Partners were interviewed if they lived in the same household as the primary caregiver, and teachers were interviewed during the last two rounds of the survey; cohort members were first interviewed at age 7.

I use data from all four rounds of the MCS. A unique feature of the MCS is that it directly interviews the fathers of the cohort members which I use to evaluate the role of the fathers in childhood skill formation in addition to the role of the mothers. The MCS further facilitates the implementation of the value-added production function because it includes repeated measures on child cognitive and noncognitive skills, and the implementation of the item response theory method because it includes detailed information on each of these cognitive and noncognitive assessments.

4.2 Sample Selection Criteria

From the original sample of 18,818 children, I exclude 4,189 children who did not have complete information on the behavioral and cognitive assessment tests or who participated in only one round of the MCS. The remaining children contribute at least two behavioral scores and two cognitive test scores, which allows me to estimate the value-added model in equation (1). I eliminate 130 children for whom the primary respondent was not the mother figure of the household (*i.e.*, father, grandmother, other male or female non-relative figure). I exclude an additional 193 children with insufficient information on maternal life satisfaction (non-response or inability to assess their life satisfaction) because my focus is on the effects of maternal happiness on child outcomes. Next, I eliminate 56 children because the mothers did not clearly indicate their marital status. I do not exclude from my analysis children with incomplete information on other explanatory variables but I impute their missing values and create an indicator variable to identify these imputed cases. These criteria leave me with a sample of 14,250 children—a total of 36,835 child-year observations with an average participation of 2.6 years—for which complete information was available on their behavioral and cognitive outcomes and on maternal life satisfaction and marital status.

I create a paternal subsample with the following additional deletions. I exclude 3,001 children because the fathers were not present in the household or they did not assess their level of life satisfaction. I also drop 208 children to restrict my analysis to married and cohabiting

couples to focus on whether it is paternal presence or marriage per se that influences child outcomes. This subsample consists of 11,041 children or 25,147 child-year observations for which both mothers and fathers provided complete information. Table 1 includes summary statistics for all the variables included in the analysis.

4.3 Variables

4.3.1 Child Outcome Variables

I measure child outcomes with standardized cognitive test scores of the British Ability Scale (BAS) that vary based on the age of the child, and with maternal behavioral assessments based on the generalized Strength and Difficulties Questionnaire. For example, at age 3, children complete one test to assess their verbal skills and one test with six subscales to evaluate their cognitive development; at age 5, they complete three tests to assess their vocabulary, nonverbal reasoning and spatial skills; and at age 7 they complete three tests to assess their verbal, mathematical and spatial skills. For child behaviors, the mothers respond whether certain behaviors that range from social interactions with other children and adults to obedience and emotional stability are not true, somewhat true or certainly true. I give more information on the content of these cognitive and noncognitive skill measures in appendix A1.

Because of the multitude of questions and the different degree of information each question conveys about child skills, I do not use raw, summed (classical) test scores in my analysis, but I use Item Response Theory (IRT) models to construct my child outcome measures.[14] The idea is that the response pattern r_{ij} of individual j to a test item i is affected not only by innate ability but also from extraneous conditions during the day of the interview. By modeling these response patterns, I uncover the true underlying skill that each question in the MCS is intended to proxy. The estimated ability scores from the IRT, also known as theta ability scores, represent the distribution of underlying child skill and allow comparing the position of each child along the same skill distribution.

I choose the appropriate number of child outcomes to include as my S_{jt}^{k} dependent variables by applying exploratory factor analysis (Hays *et al.* 2000) on the thirty questions mothers assess child behavior, and on cognitive tests the children participate in. The four criteria I use to determine if certain questions pertain to the same underlying skill (Kaiser's criterion, Cattell's Scree plot, Horn's Parallel Analysis, Velicer's Minimum Average Partial Correlation), suggest that I should retain six child behaviors: conduct problems, emotional symptoms, hyperactivity/inattention, peer problems, prosocial behaviors and independence/self-

[14] Summed scores assign the same weight to all items and do not control for the possibility that questions may have been designed to capture different levels of information.

regulation. For cognitive skills, I extract only one factor which captures performance in cognitive tests.

The second step is to combine questions, or items, that represent the same outcome into an aggregate measure. The majority of the responses on the standardized cognitive test scores (*i.e.*, vocabulary, arithmetic and picture recognition tests) are dichotomous coded as either correct or incorrect. I model the probability of giving the correct answer to a question with the three parameter logistic (3-PL) model:

$$Pr(r_{ij} = 1|\theta_j) = c_i + (1 - c_i)\frac{exp(\beta_i + \lambda_i\theta_j + \pi_j W_j)}{1 + exp(\beta_i + \lambda_i\theta_j + \pi_j W_j)} \tag{4}$$

where r_{ij} is the response of child j=1,2...n to item i=1,2...m, and θ_j is the latent cognitive ability of each child. β_i captures the difficulty level of each question included in the standardized tests (difficulty parameter). λ_i captures how heavily each question is weighted in determining the underlying child skill (discrimination parameter). For example, answering correctly a more difficult math question has a higher weight on scoring child cognitive ability. c_i captures the likelihood that even a low-ability child may answer correctly a more difficult question just by guessing (guessing parameter). W_j controls for external conditions during the day of the exam that may affect child performance but which are unrelated to the underlying ability level. I net out effects of external conditions on child cognitive performance by including in W_j controls for presence of other individuals, the level of noise and the degree of child energy during the exam.

Because other cognitive tests in the MCS (*i.e.*, pattern construction tests) are not marked simply correct or incorrect, I model the probability of giving a correct answer, a partially correct answer and an incorrect answer with the graded response model (GRM) by Samejima (1969):[15]

$$Pr(r_{ij} \leq \alpha_s) = Pr(r^*_{ij} \leq \tau_s) = \frac{exp(\tau_s - (\beta_i + \lambda_i\theta_j + \pi_j W_j)}{1 + exp(\tau_s - (\beta_i + \lambda_i\theta_j + \pi_j W_j))} \tag{5}$$

where α_s denotes the S observed answer category and τ_s is a set of *s-1* threshold parameters. The probability of choosing a score category s is described by the difference in probabilities for the person having scored greater or equal to s and having scored greater of equal to *s+1*. Everything else is as defined in (4).

The six child behavioral outcomes are evaluated on a Likert-scale ranging from one to three. Due to the ordered categorical nature of these responses, I approximate their probability distribution with the graded response model given in (5). β_i captures how difficult it

[15] The estimated theta scores for these pattern construction tests were very close to the case when I used the generalized partial credit model by Muraki (1992). See van der Linden and Hambleton (1997) for a review of IRT models.

is for a mother to endorse the answer *s-1* instead of the answer s, and λ_i is defined as before. Because child behaviors are reported by the mothers, the child behavioral measures may reflect maternal moods and not child behaviors. Even though there is evidence that maternal assessments can reliably measure child behaviors (*e.g.*, Ferguson *et al.* 1993; Sawyer *et al.* 1998), which also holds for the Strength and Difficulties Questionnaire (Goodman 2001), maternal psychopathology may be correlated with child behavioral assessments (*e.g.*, Ferguson *et al.* 1993; Kim-Cohen *et al.* 2005). Since the assumption of local independence is violated if this is true—rendering implementation of IRT models problematic—I net out potential effects of maternal moods from the response patterns to child behaviors by controlling for maternal depression in W_j.[16]

In Table 2, I examine if this local independence assumption is satisfied. I compare raw scores in five measures on which both mothers and teachers assess child behaviors at age 7 to evaluate if mothers report child behaviors differently than the teachers. These scores range from zero to ten, where zero means the described behavior is absent and ten that the behavior is strongly present. Cronbach's alpha reliability coefficients (column 1) show that there is good internal consistency of the behavioral scales, with the coefficients ranging from 0.70 to 0.87. Pearson correlations (column 2) show that there is moderate to strong positive relationship in the reports of mothers and teachers. These alpha and correlation coefficients verify that mothers and teachers evaluate the same underlying child behavior. However, mothers tend to give responses higher on the scale compared to teachers, with the differences being larger for the domains of conduct problems and prosocial behaviors (columns 3 and 4). Because paired sample tests are statistically significant (column 5), it is possible that mothers and teachers observe slightly different aspects of a child's life, and so assess child behavior differently.[17] These discrepancies may reflect current maternal mood and affect.

In Table 3, I explore if the pattern of maternal responses to child behaviors differs by depression level (differential item functioning, DIF). That is, I show if there are statistically significant differences in the response patterns of depressed mothers (diagnosed and treated for depression) compared to mothers without depression, and of mothers with some depression (diagnosed but not treated) compared to non-depressed mothers. Chi-square statistics from Wald tests show that depressed mothers tend to respond differently, mainly in the

[16] I do not control for maternal depression in (4) because cognitive skills are evaluated through standardized test scores and not by the mothers.

[17] For example, mothers are more likely to observe how the child behaves towards her close friends and familial associates. Teachers, on the other hand, may report child behavior in terms of behavior towards other children at school or other parents and teachers at school. This could explain different reports in maternal and teacher responses for the construct of prosocial behaviors.

emotional symptom and conduct problem questions and, hence, it is necessary to purge such maternal moods from responses on child behaviors.

The local independence assumption is satisfied when I include W_j in (4) and (5) since the response patterns are purified from the effects of external exam conditions and maternal moods. I estimate the previous models through marginal maximum likelihood (MML) via the expected-maximization (EM) algorithm (Bock and Aitkin 1981), and then apply Bayes' rule to uncover the expected posterior distribution of the latent outcomes θ_j.[18] This estimation process yields the seven theta-IRT scores for child outcomes—one cognitive and six noncognitive skill measures—that I use in my empirical analysis.

4.3.2 Life Satisfaction and Marital Status Variables

The remaining two endogenous variables in equation (1) are maternal life satisfaction (LS) and marital status (MS). I proxy LS with maternal responses (on a ten-point scale) to "*how satisfied are you about the way your life has turned out so far?*"; one means *completely dissatisfied* and ten corresponds to *completely satisfied*.

The mothers also completed their relationship history from which I create the marital status measure. I use four indicator variables on whether the mother is currently married, currently cohabiting, never-married, or divorced, separated or widowed (referred to as divorced for brevity).

To determine if there is sufficient independent variation in maternal life satisfaction and marital status so as to identify their separate effects on child outcomes, I conducted an analysis of variance (not shown here). The between marital-status group variation showed that marital status explains only 8% of the total variation in life satisfaction. I also reject the null hypothesis of equal life satisfaction across marital status categories at the 1% level of significance (F=1,095). The variation of life satisfaction within marital status is more evident in Table 4 where I show cross-tabulations of life satisfaction and marital status. It is clear from these distributions that life satisfaction varies considerably within marital status category. A comparison of the coefficient of variation across columns reveals that maternal life satisfaction varies more within single-parent family structures (single or divorced) than within two-parent family structures (married or cohabiting). For example, more of the divorced and single mothers report low levels of happiness (scores less than five) while more of the married and cohabiting mothers believe they are very happy (scores more than eight). These patterns suggest that there is sufficient variation with which to identify independent life satisfaction effects on child outcomes for mothers of different marital status.

[18] For further details in the estimation method refer to Sijtsma and Junker (2006).

4.3.3 Other Variables in the Child Outcome Production Functions

The vector X_{jt} in equations (1)-(3) consists of the following controls shown in Table 1: As measures of other maternal inputs (other than life satisfaction), I construct an index on cognitive investments (*i.e.*, whether and how often the mother teaches her child math, reading, or writing), noncognitive investments (*i.e.*, frequency the mother does activities such as play games or visit the library with her child) and child activities investments (*i.e.*, frequency the child does activities on her own). I control for the time the mother spends with her child to represent time investments, while for the quality of mother-child relationship I create an index by combining information on how the mother behaves towards her child (*i.e.*, listens to the child, smacks the child). To construct each of these maternal investment indices I employ the graded response model (see section 4.3.1) without covariates. More information on variable construction is given in appendix section A2. I also control for indicators on whether the mother smokes when the child is present, and for the frequency she enforces regular bed time hours.

Maternal characteristics include educational level, health conditions as measured by long-lasting limiting health conditions, smoking habits, change in health status and diagnosis of depression, maternal age in quadratic form and current employment status. For maternal skills, I use maternal responses on self-assessed behavioral and cognitive skill questions; locus of control, self-esteem, neuroticism and extraversion measure maternal noncognitive skills, and self-assessed ability on math, reading and writing measures maternal cognitive skills. Similar to child outcomes, I extract the theta-scores for these traits by applying models (4) and (5) but without the W_j covariates.

Household characteristics include the number of siblings, CPI-deflated net annual household income, language spoken at home, and whether the mother is currently pregnant. Birth characteristics such as birth weight and gestation are included to capture the initial endowment of the child which can have a long-term effect on future outcomes (*e.g.*, Black *et al.* 2007), and investments during (or just after) pregnancy such as breastfeeding, antenatal care, smoking or working during pregnancy are included to proxy for early maternal preferences over child quality. Child characteristics control for gender, age in months, health status and an indicator for being white versus non-white.

Health and educational deciles proxy for neighborhood characteristics. I choose these deciles over constructing region-specific average rates of income, health or education, because they correspond to a finer geographical classification compared to the twelve Government Office Regions (GORs) I have access to.[19] I also distinguish among rural, urban and suburban

[19] Northeast, Northwest, Yorkshire and Humber, East Midlands, West Midlands, East of Anglia, London, Southeast, Southwest, Wales, Scotland and Northern Ireland.

areas based on the population density in the area of residence. Additionally, peers may influence child behaviors—conduct and peer problems in particular. I capture such peer effects with the amount of time the child spends with friends through four indicator variables.

When I use the paternal sample, I augment X_{jt} with controls for paternal life satisfaction, age and its square, educational level, race, cognitive and noncognitive skills, long-lasting health conditions, smoking, depression level, and amount of time the father spends with the child. These father-specific characteristics are measured and constructed in the same manner as the maternal characteristics. To proxy for quality of mother-father relationship, I include an indicator variable on whether the partner has used force in the relationship (*i.e.*, hit, kick, shout at the mother) and the frequency the parents go out as a couple.

4.3.4 Variables Used as Instruments

Some region-varying controls in X_{jt} are taken from other sources with more information on the auxiliary data sources given in appendix section A3. I include measures of current weather conditions—hours of sunshine, precipitation and average temperature—in each of the GORs at the time of the interview using data from the British Atmospheric Data Centre (BADC). Weather conditions can have a direct effect on child happiness, as happier children tend to be more cooperative, sociable and exhibit less behavioral problems. I also include the deviation of each weather condition from its historical mean (between 1970 and 1999) to account for the possibility that some families may self-select into regions based on current weather—which can directly affect child outcomes—but not based on weather deviations.

I use lagged region-month specific weather conditions as exclusion restrictions in the maternal life satisfaction model. The construction of weather conditions is a three-step process; First, I use station identifiers from the BADC to identify the location of each weather station, and, based on their location, I match these stations to the respective U.K. counties. Then, I use the ONS classification to match counties with geographic regions, and calculate the average monthly weather conditions for each region-year cell. Finally, I combine these regional weather conditions with the MCS using region and time (year and month) of the interview as the unique identifier combination for each cohort member.

The main assumption justifying the restriction is that, conditional on current weather conditions, weather conditions at previous time periods are uncorrelated to the error term ϵ_{jt}^{k} in (1). By including in X_{jt} current weather conditions to account for potential direct effects of weather on child outcomes and on other individuals who contribute to child development (*i.e.*, fathers or teachers), deviations from historical means to account for selection into region of residence, and birth weight to account for long-run effects of weather conditions on child development while in utero, I guarantee that the orthogonality condition in (1) is

not violated. Moreover, any effects of lagged weather conditions on other variables that may affect current child outcomes will be captured in the lagged child outcome terms S_{jt-1}.

The effect of weather on maternal life satisfaction can be explained by chemical reactions in the brain as higher amount of sunlight induces an increase in the hormone serotonin (*e.g.*, DeNeve *et al.* 2010), while precipitation is linked to secretion of the hormone melanin that causes production of serotonin to subside (Canli and Lesch 2007). Prior studies on the determinants of subjective well-being have used weather conditions as instruments (see Keller *et al.* 2005) documenting that sunshine increases life satisfaction, and decreases negative affects (*e.g.*, Denissen *et al.* 2008), while rainy days exert a negative effect on life satisfaction (*e.g.*, Denissen *et al.* 2008; Connolly 2011). Higher average temperatures in the winter months and lower average temperatures during the summer months are also positively related to happiness (*e.g.*, Rehdanz and Maddison 2005; Connolly 2011). Given this evidence I expect that lagged weather conditions will be a valid instrument for maternal life satisfaction.

I construct current incarceration rates as the ratio of the male prison population with respect to the total male population in each country using information from Home Office and the Departments of Justice. Because incarceration rates represent only a subset of crimes, I complement them with victimization rates and police recorded crime rates. For the victimization crime rates I utilize the British Crime Survey (BCS), the Scottish Crime Survey (SCS) and the Northern Ireland Crime Survey (NICS). I calculate the victimization crime rate as the ratio of the number of individuals who experienced a type of crime over the total number of the respondents in each survey adjusted for ONS weights to calculate U.K. representative crime rates. I include the number of crimes recorded by the police in order to capture crimes that are not included in the crime surveys, that is, crimes that cannot be classified as victimless (*i.e.*, drug offenses or homicides). I construct these police recorded crime rates as the ratio of the crimes reported to the police over the total number of the population in that given geographical region.

I use lagged incarceration rates at the time period when the mother started the relationship with the father to identify the effect of marital status on child outcomes. Given the age group of the incarcerated men, I match these incarceration rates with mothers who are in the same decade of age as the incarcerated men, and then I match these rates with mothers residing in the same region. For married mothers, I use the year when they got married with the father of the child. For cohabiting mothers, I use the year when they started living together with the father of the child or their current partner. For single mothers, I use the year when their period of lone parenthood started.

Incarceration rates will affect maternal marital status because higher incarceration rates

affect the supply of men in the marriage market. Assuming that men who have committed more serious crimes are removed from the market, the supply of good quality men increases relative to the supply of lower quality men. Stated differently, even though the probability of being in a non-married relationship increases, it is also more likely that high quality women will be matched with the higher quality men, leading to higher quality marriages. Women who are uncertain about the quality of the prospective partner will tend to cohabit instead of marrying their partner. These rates will be a valid exclusion restriction as long as they are caused by less lenient punishments or increased control of crimes. In the U.K. there is evidence that the number of incarcerated men increased because legislative changes increased the length of offenses, the supervision of those in custody and the probability of imprisonment for those who break their non-custody sentences (Ministry of Justice 2009).[20]

Previous studies show that these instruments are good predictors for low income level mothers and for Blacks or Hispanics (*e.g.*, Finlay and Neumark 2010). Studies on the effects of male-female ratios on the marriage market also document that lower supply of men suggests lower quality partners or fewer overall marriages for women (*e.g.*, Charles and Luoh 2010). One concern is that these instruments are not relevant for the larger part of the U.K. population because incarceration rates may affect mothers from certain income and ethnicity groups. For the U.K. over the period 1970-2010 approximately 96% of the male prisoners belong to the white race. Even though I cannot exclude the scenario that the majority of imprisoned men come from low income families, in the next section I provide evidence that women of lower and higher income levels are not affected differently by incarceration rates.

5 Results

5.1 OLS Estimates

In Table 5, I report OLS estimates for each child outcome. Column (1) shows the estimated effects of marital status unconditional on life satisfaction, column (2) shows the effects of life satisfaction unconditional on marital status, and column (3) shows their effects when jointly included in the model. The OLS estimates (which treat marital status and life satisfaction as exogenous) provide a useful benchmark for interactions between marital status and life satisfaction. Regardless of whether marital status is included, maternal happiness is a significant predictor of all child noncognitive outcomes. For example, life satisfaction is

[20] I include current crime rates to account for the possibility that incarceration rates may be due to a shift of male preferences towards higher criminal behavior which directly exposes the children to crime in their area. We do not know a priori if mothers will choose the high or low incarceration rate regions as they may choose the amenity of low incarceration rates to have a safer environment for their children, or they may choose the higher incarceration rate region to receive higher compensations for the undesirable unsafe environment.

beneficial for decreasing behavioral problems (conduct, emotional, hyperactivity, and peer problems) and for increasing social (0.026) and self-regulation (0.020) skills. For marital status, the decline in the estimated coefficient between columns (1) and (3) suggests that the marriage effect captures partly a happiness effect. For instance, the positive association between marriage and non-conduct problems is estimated to decrease from 0.074 to 0.054 points, while the marriage effect on cognitive skills remains unchanged. There are two important take-away messages from the OLS estimates: first, the simultaneous estimation of marital status and life satisfaction has merit because the marriage estimates change when I condition on life satisfaction. Second, life satisfaction is significant for noncognitive skill formation, while marriage is primarily important for cognitive skill and some noncognitive skills (conduct problems and self-regulation skills).

5.2 TSLS Estimates

Table 6 shows the estimates of the three-equation model when marital status and life satisfaction are endogenous. Life satisfaction is a significant predictor *only* for noncognitive skills; it increases social (0.022) and self-regulation (0.016) skills, and it decreases emotional problems (-0.010). Marriage has a large beneficial effect on cognitive skills (0.129) and on non-conduct problems (0.084), a beneficial (though imprecisely estimated) effect on hyperactivity and peer problems, and a negative impact on self-regulation skills (-0.043). It is worth noting that child skills caused by higher happiness are not affected by marriage and vice versa, with the exception of self-regulation; this is the outcome that both marriage and life satisfaction can significantly determine. Also, the cohabitation effects are consistent enough with the marriage effects. The main conclusion is that life satisfaction promotes only noncognitive skills (especially social skills) and marriage promotes cognitive skills and selected noncognitive skills.

However, life satisfaction and marital status effects are not directly comparable because they are measured on different scales. In Table 7, I predict income equivalent scores, that is, the change in annual household income that would keep constant the child outcomes when either life satisfaction or marital status change. Take, for example, the case of social skills. If we want to keep constant the child social skills when maternal life satisfaction decreases from the mean (7.62) by one point (6.62), the amount of income we should give to the household to compensate for this change in maternal happiness is equivalent to increasing annual household income by £50,632. Stated differently, this income equivalent is calculated as the predicted score of social skills estimated at mean maternal life satisfaction and the predicted score of social skills estimated at the mean minus one maternal life satisfaction, relative to the marginal effect of average annual household income on social skills. The first

row verifies the TSLS estimates; life satisfaction has a beneficial impact on *all* noncognitive skills with the highest effects being for social skills (£50,632), self-regulation skills (£30,370) and emotional symptoms (£19,051). The next four rows show the income equivalents across the happiness distribution. The income compensations that would counterbalance decreases in maternal happiness monotonically decrease as we move from lower to higher happiness percentiles. For example, if happiness decreases from the 50^{th} to the 25^{th} percentile, child social skills would remain unchanged if we could increase household income by £49,352, while for a mother who moves from the 90^{th} to the 75^{th} percentile the average compensation would be £30,591. All these predicted changes in income are sizable considering that the average household income for my sample is £29,194.

In the last row of Table 7, I show the equivalent income that would produce the same amount of child outcomes if a married mother were to become single. These income equivalents are calculated as the difference in the predicted value of each child outcome evaluated at marriage equal to one and the predicted score of the same child outcome evaluated at single-parenthood equal to one relative to the marginal effect of income. Mothers would have to be compensated with £62,239 per year to maintain the same amount of child cognitive skills. Even though, it may be odd that moving from marriage to single-parenthood is predicted to decrease self-regulation skills by the same amount as £82,137 in income, this negative predicted effect is intuitively valid. Under a single-parent family structure, the mother will rely to the child to perform some tasks without the maternal supervision (*i.e.*, complete homework or help with the chores). Since the child is more likely to take care of tasks that would normally be taken care of from the other parent under a two-parent family structure, single-motherhood will have a positive effect on child self-regulation skills. A second interesting pattern is that the income equivalents for conduct problems (£273,966) and hyperactivity (£60,500) are much higher than the ones of cognitive skills. These higher compensations suggest that there is something beneficial about marriage relative to single-parenthood. The beneficial effect of marriage on dealing with conduct problems and hyperactivity may reflect a paternal presence effect, because paternal presence increases monitoring of the child and disciplinary strategies. The finding that marriage and cohabitation effects are close to each other (see Table 6) further supports a paternal presence argument.[21]

Tables 6 and 7 show distinct asymmetric marriage and happiness effects: when life satisfaction is relatively insignificant (conduct problems and cognitive skills), marital status has a significant effect on child outcomes; when life satisfaction is relatively important for child skills (emotional symptoms and social skills) marriage does not have a significant effect. This asymmetry suggests that marriage and life satisfaction have separable beneficial effects on

[21] I examine explicitly the role of fathers in the following subsection using the paternal sample.

child skills, and so promoting only one of them will lead to shortages in the accumulation of different types of skill. Hence, investing both in marriages and in happy mothers will boost a wider range of child outcomes consistent with recent policies in the U.S. and the U.K. over promoting healthy marriages.

I also predicted how much the happiness of a single mother would have to change to counteract the effects of marriage on each child outcome (not shown here). Happiness of single mothers would have to increase by 208% to offset the beneficial impact of marriage on conduct problems, while happiness would have to increase by 1904% to offset the positive effects of marriage on cognitive skills. This last finding suggests that since cognitive skills are to a large extent genetically determined, improving maternal happiness would not be the best possible pathway to tackle deficiencies in such skills.[22]

5.3 Paternal Sample Estimates

The positive effects of marriage on some child outcomes, along with the close effects of marriage and cohabitation for cognitive skills, imply that these effects may reflect positive traits of spouses. In Table 8, I examine if these marriage effects are driven by paternal presence by focusing on a more homogeneous group of households where the fathers are present: married and cohabiting couples. Similar to Tables 6 and 7, maternal life satisfaction exerts a positive effect on social interaction (0.040) and self-regulation skills (0.028), but now it has an additional beneficial effect as it decreases peer problems (-0.009). Paternal life satisfaction has only a detrimental effect, as it only marginally decreases conduct problems (-0.005). Despite that in Table 8 I explicitly control for a number of paternal characteristics, children of married families benefit relative to children of cohabiting families. Children of married couples have less conduct problems (-0.050), hyperactivity (-0.032) and peer problems (-0.028) compared to children of cohabiting couples. This difference implies that it is not just paternal presence that matters for children but some other unobserved characteristics that render marriage beneficial for children.

The increase in the marriage effect under TSLS suggests that there is selection into marital status due to unobservables that leads to a positive correlation between marriage and child outcomes.[23] Because this increase is present even after I focus on married and cohabiting cou-

[22] The predicted change in happiness is 4.6% for emotional symptoms, 86.6% for hyperactivity, 81.0% for peer problems, 1.6% for prosocial behaviors, and -39.7% for self-regulation skills.

[23] The overestimation of the life satisfaction effect and the underestimation of the marriage effect under OLS holds for both the maternal and the paternal sample. Two other explanations are that TSLS exaggerates measurement error problems, and it may reflect a local average treatment effect where identification comes only from variation of a smaller subgroup of the population. The former is not very likely to happen as the parents have a clear view about their marital status. The latter is not an explanation for my sample as mothers are not affected differently by incarceration rates based on their education or income level (see appendix Table A1).

ples, it is something inherent about those who choose to marry. For instance, partners who expect to get more benefits from marriage may also exert more effort to maintain marriages, and so they may be more committed to having a successful marriage. This is consistent with previous findings reporting that marriage is linked with more lifelong commitment, and that married couples tend to invest more in their relationships than cohabiting couples (*e.g.*, Waite and Gallagher 2000; Waite and Lehrer 2003). If such unobserved differences in parental commitment are what drive the positive effects of marriage on child outcomes, then there should be no differential effects on child outcomes based on the type of mother's marriage. I examined the effects of first marriages versus second marriages (available upon request) on child outcomes, but I did not find significant differences for these two groups. Combined with the Table 8 results that marriage causes less behavioral problems relative to cohabiting couples, these findings suggest that the marriage effect may reflect commitment of parents to the relationship, with the happiness effect still capturing the attachment of the mother to the child.

In Table 9, I examine whether the timing of the investments has differential impacts on child outcomes. Even after I examine the timing, paternal life satisfaction still has a minimal impact on child outcomes. However, for mothers there is evidence that higher levels of happiness at early stages of child development (age 3) lead to decreases in conduct problems (-0.060) and hyperactivity (-0.027), two outcomes which appeared to be independent of maternal happiness in Table 6. The importance of timing for inputs in the production of child skill is even more evident at the bottom of the table where maternal investments decrease behavioral problems and improve on their cognitive skills.[24] This is in accordance with findings in the skill formation literature that early investments are beneficial for child development because they improve upon the developmental trajectory (*e.g.*, Heckman 2008). It is also consistent with neuropsychological evidence that the orbitofrontal cortex matures during the first years of life, and that positive effects are experienced for children with higher attachment to their mothers during this time period. Therefore, Table 9 shows that, at earlier ages, maternal happiness is more important for tackling behavioral problems, while, at later ages, it matters more for promoting social skills.

5.4 First Stage Estimates

Table 10 shows the first stage estimates of the marital status and life satisfaction equations. Marginal effects are calculated conditional on all other variables at the sample mean. The marginal effects show that happier mothers are more likely to select into marriages compared to other family structures; the higher the happiness the more likely to be married (3.6%)

[24] I found the same when I estimated timing effects for the full maternal sample.

and the less likely to be cohabiting (1.6%) or divorced (1.9%). Similarly, marriage and cohabitation enhance happiness (0.339 and 0.100 respectively), while divorce does not affect happiness.[25] Thus, there are positive effects from marital status to life satisfaction and vice versa.

The exclusion restrictions are jointly statistically significant for the two models (under-identification tests). For the marital status choice model, lagged marital status increases the probability of not transitioning to an alternative marital status (negative coefficients for the off-diagonal elements). Despite that lagged marital status captures all conditions up to time *t-1*, incarceration rates at the beginning of the relationship exert an independent, statistically significant effect on marital status. Higher incarceration rates increase the probability of being married by 48.9% suggesting that higher incarceration rates decrease the number of bad quality marriageable men, and the mothers who end up marrying form relationships with higher quality partners. These rates negatively affect cohabitation (38.7%). The last column in Table 10 shows the estimates for the happiness formation model. The positive coefficient for lagged life satisfaction suggests that there is an autoregressive process in the formation of happiness with the happier the mother in the previous time period the more likely to be at least as happy in the current time period (0.494). Precipitation and average temperature decrease maternal happiness; the higher the amount of precipitation the lower the maternal happiness and the higher the average temperature the lower the happiness.

A concern with these instruments is that the marriage effect may represent a local average treatment effect if identification comes only from low income and low education level mothers who are more prone to be affected by incarceration rates. I re-estimate the first stage separately for mothers who dropped out of high school and mothers who did not drop out, and examine if the estimated effects of incarceration rates differ for these two groups (results in appendix Table A1). Incarceration rates do not have differential effects on the decision to marry or cohabit based on the mother's educational level. The same holds for mothers at the lowest 10^{th} percentile of the income distribution relative to mothers at higher income percentiles. With the exception of divorced mothers from low income levels, the null hypothesis of equal incarceration rates effects for different education and income levels cannot be rejected. These findings suggest that identification comes from across the distribution of mothers, and so the marriage effects are relevant for all mothers in my sample.

[25] However, divorce has a positive sign which is consistent with recent findings that divorce increases personal well-being because it removes the individual from a stressful relationship.

5.5 Robustness Analysis

In Table 11, I present robustness checks for the validity of my results under alternative definitions of maternal happiness and measures of child outcomes. Panel A is identical to the method I used in Table 8 but replacing the definition of maternal life satisfaction with maternal happiness in the current relationship. The findings differ from the ones I reported in the main analysis; happiness in the current relationship does not affect child outcomes corroborating that more domain-specific measures of global life satisfaction are less strong predictors of child outcomes. In Panel B, I create a happiness index using information on job satisfaction, satisfaction with balancing work over family and satisfaction with current financial status using IRT. Maternal happiness causes more social (0.062) and self-regulation (0.042) skills similar to the findings in Table 6 for the maternal sample. Marriage is also significant as it decreases conduct problems (-0.070) and improves performance in standardized tests (0.113). These first two panels show that the definition of happiness can affect the findings. Consistent with studies on subjective well-being (*e.g.*, Diener *et al.* 1999) the broader the definition of happiness the more information it conveys about all aspects of one's life that contribute to overall happiness. The definition of happiness in Panel A induces the mothers to respond with the mother-father relationship in mind, while the definition in Panel B accounts for more aspects of her life coming closer to measuring overall happiness.

In Panel C, I show how the results compare to traditional approaches in the literature measuring child outcomes as summed, total scores. That is, I replace the IRT-theta scores with the sum of maternal responses in each of the child outcome. The results show that life satisfaction has a positive effect on all measures of noncognitive skills, and the life satisfaction effect is stronger compared to Table 6. The same holds for marriage as well, whose effect on conduct problems is overestimated under summed skill measures. These higher effects may reflect that summed scores do not account for either measurement error in the response patterns or differential responses on child behaviors due to maternal moods. There is also a very large overestimation of the marriage effect on cognitive skills (0.347 versus 0.129 in the last column of Table 6). Since summed scores do not capture that different questions on a test have lower difficulty than other items, and that some children may guess when multiple choice questions are available, they put more weight on items that have less information about child skill leading to overestimation of these effects. In Panel D, I use a more aggregated measure of child behaviors that combines the six behavioral traits into one cumulative measure of noncognitive skill. In other words, I use bifactor IRT analysis where, in the first level, I combine the items into one measure for each of the six behavioral traits and, in the second level, I use the potential interrelations among these six measures

to construct one common noncognitive measure. The results show that life satisfaction and marriage have two distinct effects on child outcomes consistent with the findings in Table 6; maternal happiness decreases behavioral problems, while marriage and cohabitation lead to higher performance in standardized cognitive tests. These findings suggest that maternal happiness directly affects child behavioral development, while marriage matters more for child cognitive development.

6 Concluding Remarks

Numerous studies within the family structure literature have looked for evidence on whether marriage is beneficial for children (*e.g.*, Crawford *et al.* 2011; Hill *et al.* 2001) and conclude that children from married families outperform children from cohabiting, divorced and never-married families. However, there is no conclusive evidence that a causal marriage effect exists (*e.g.*, Francesconi *et al.* 2010). Because high income and education level individuals have the tendency to mate with partners with analogous traits, the marriage effect may just reflect this positive selection into marriages. Most prior studies have focused on the financial benefits associated with marriage and tried to identify a marriage effect net of income effects. Despite that the goal of an individual is to maximize utility and not income, and given the intuitive interrelation between marriage and happiness (which is an approximation of utility), there is lack of evidence on the role of happiness in child skill formation.

In the current study, I claim that maternal happiness is a separate input in the skill production process which is entwined with the choice of marital status, and I ask if the positive association between marriage and child skill reflects a happiness effect. To accomplish the goal of disentangling the happiness from the marriage effect, I specify a three-equation model where, first, life satisfaction and marital status are simultaneously determined and, then, they jointly affect child skill formation. Unlike many existing studies, I allow marital status and life satisfaction to be endogenous, which enables me to identify causal effects of both on child skills. Because child skill is latent, I use item response theory to uncover this underlying skill, which I approximate through six noncognitive (conduct problems, emotional symptoms, hyperactivity, peer problems, sociability, and self-regulation) and one cognitive skill measure using information from the Millennium Cohort Study for young U.K. children.

I identify three key results. First, a separate happiness and marriage effect exist and they significantly affect child skill formation. There is robust evidence that happiness increases social and self-regulation skills, and decreases emotional problems, effects that are equivalent to increases up to £50,000 in family income. Marriage is beneficial for reducing conduct problems and increasing cognitive test score while it decreases self-regulation skills. With the exception of self-regulation skills, I find a significant asymmetry between marriage and

maternal life satisfaction, because certain skills that can be directly affected by happiness they cannot be affected by marriage and vice versa. Given this finding, I conclude that both happiness and marriage are significant for early childhood development, and that the marriage effect does not reflect a happiness effect. Second, the maternal happiness effects are more pronounced at early developmental stages (age 3). Third, paternal life satisfaction does not significantly contribute to child skill formation, but paternal presence is beneficial to child development due to increased discipline and supervision.

These findings suggest that policies should not overlook that there is something inherently good about marriage that benefits children and which may represent the higher commitment of married couples. Because happiness has a dual effect—increasing the probability of marriage and directly improving child outcomes—policies aiming at improving child well-being should complement pro-marriage policies with policies promoting healthy and happy marriages. The need to focus on healthy spousal relationship is prominent in the U.K., where in the last 20 years there has been an increase in cohabitation rates, an increase in divorce rates, and a decrease in marriage rates (Office of National Statistics 2011). This combination of happy parents and marriage has been on the agenda of recent U.K. policies which aim at strengthening spousal relationship (*i.e.*, policies to educate parents on the benefits of marriage and consult them over marital problems) in addition to giving incentives for parents to marry (*i.e.*, inheritance tax, transferable allowances, pension benefits).

Having developed an approach to identify separate marriage and happiness effects on child outcomes, I conclude by suggesting three extensions of interest. First, because of the young age of the children in my sample, child outcomes represent observed child behaviors by the mothers. As more waves of the MCS become available and the children start assessing their own behaviors, one could examine how the happiness of the mother, as the child experiences it, contributes to shaping child self-assessed noncognitive skills. Second, some studies find that there is intergenerational transmission of cognitive and noncognitive skills. It is intriguing to assess if happiness also represents a skill that can be learned and the extent to which it can be transmitted from one generation to the next. If such an intergenerational transmission is present, then investing today in healthy marriages will improve not only the opportunities of the current children but also of the generations to come. Third, because individuals derive happiness from their education and labor force participation, and because a more satisfied mother is more prone to participating in the market (*e.g.*, Dolan *et al.* 2008), modeling selection into education and employment would give a more complete image on the role of maternal happiness and would allow identifying direct and indirect contributions of life satisfaction on child skill formation.

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A Data and Variables Appendix

A.1 Measurements of Traits

The MCS has rich information on cognitive test scores of the cohort members, and on behavioral scores and personality traits of both the cohort members and their co-resident parents. In the next paragraphs I describe the specific items included in the IRT models for the construction of child cognitive and noncognitive test scores as described in Section 4.3.1.

A.1.1 British Ability Scales (BAS) test scores

The British Ability Scales is a battery of tests administered to children between the ages of 2 years 6 months and 7 years 11 months to measure cognitive skills and schooling achievement. During the 2004/2005 and 2006 rounds of the MCS the "Naming Vocabulary" test was administered to cohort members to measure their verbal abilities with a focus on picture recognition and use of vocabulary. The administrator shows a series of colored pictures to the child and asks the child to name the pictures. The main skills measured are vocabulary knowledge of nouns, general language development and recalling words from the long-term memory instead of assessing the understanding of the meaning of words or sentences. In the 2006 round (age 5), cohort members completed the "Picture Similarity" test to assess their nonverbal reasoning. For this test the administrator shows a row of four pictures and also gives a fifth card to the child. The child has to decide with which of the initial four cards the fifth card represents a similar concept. At age 5, the cohort members are also evaluated in their spatial skills through the "Pattern Construction" test to measure non-verbal reasoning and spatial visualization. For this test both accuracy and speed of the response patterns matter, with the child constructing a design by putting together squares or cubes with black and yellow patterns on each side. The 2008 round (age 7) utilizes the "Pattern Construction" test which is similar to the one just described. There is also a "Word Reading" test to assess verbal skill and it is based on the child reading aloud a series of words presented on a card.

For the naming vocabulary (36 questions in each round) and the picture similarity (33 items) tests I apply the 3-PL model as the answers are coded as correct or incorrect. For the pattern construction test there are 23 and 26 questions at ages 5 and 7 respectively, for which the child can get partial credit and I estimate the theta-ability score using the graded response model. For the word reading test at age 7 there are 90 questions available which I combine with a 3-PL and a 2-PL model to estimate the theta-ability score; I use the 3-PL model for the first 80 items and the 2-PL model for the last 10 items. The 2-PL can be derived from model (4) by imposing the constraint the there is no guessing taking place ($c_i = 0$). The reason for not applying the 3-PL model in the last ten items is that

convergence could not be achieved. After examining my data, the reason was that children who continued answering these last questions were also more likely to answer them correctly and so there was no guessing. Children who did not do well in the previous questions just stopped responding to the test.

A.1.2 Bracken School Readiness Assessment (BSRA)

The Bracken School Readiness Assessment is portion of the Bracken Basic Concept Scale - Revised (BBCS-R) to assess the cognitive development of children in the 2004/2005 round of the MCS. It captures how far into their cognitive development children are and the degree of their readiness to continue into further education. This scale is constructed from six sub-scales that assess 88 concepts relating to colors (primary and basic colors), letters (knowledge of upper and lower case letters), numbers (recognition of single and double digit number or ascribing a number to a set of values), sizes (describing one, two or three dimensions), comparisons (matching objects based on their characteristics) and shapes (distinguishing among linear shapes, circles, squares, triangles, cubes and pyramids). I use 11 items from the colors test, 16 items from the letters test, 19 items from the numbers test, 12 items from the sizes test, 10 items from the comparisons test and 20 items from the shapes test to estimate the parameter for the 3-PL model.

A.1.3 Number Skills test scores

This test is included in the 2008 round when the cohort members were age 7. It is an adaptation of the National Foundation for Education Research (NFER) Progress in math tests to assess child knowledge in the topics of numbers, shapes, measures and data handling. The underlying skill measured is knowledge of and problem solving of pre-numerical and numerical concepts. There are 20 questions on this math test which I use to estimate the 3-PL model described in (4).

A.1.4 Strengths and Difficulties Questionnaire (SDQ)

The Strengths and Difficulties Questionnaire was collected in rounds 2004/2005, 2006 and 2008 of the MCS. It is a 25-item forced choice questionnaire designed to measure the psychopathology and social behaviors of young children. The SDQ taps into five distinct dimensions (*e.g.*, Goodman 1997):

1. Conduct Problems Scale (*often has temper tantrums, generally obedient*^{R}; *fights with or bullies other children*; *can be spiteful to others*; *often argumentative with adults*).
2. Emotion Symptoms Scale (*complains of headaches, stomachaches or sickness; often seems worried*; *often unhappy*; *nervous or clingy in new situations*; *many fears or easily scared*).

3. Hyperactivity / Inattention Scale (*restless, overactive, cannot stay still for long*; *constantly fidgeting*; *easily distracted*; *can stop and think before acting*^{R}; *sees tasks through to the end*^{R}).
4. Peer Problems Scale (*tends to play alone*; *has at least one good friend*^{R}; *generally liked by other children*^{R}; *picked on or bullied by other children*; *gets on well with adults*).
5. Prosocial Behavior Scale (*considerate of others feelings*; *shares readily with others*; *helpful if someone is hurt, upset or ill*; *kind to younger children*; *often volunteers to help others*).

where responses with the superscript ^{R} have been reversed. In addition to the SDQ questionnaire, the mothers evaluated the level of independence/self-regulation shown by the cohort member (*likes to work things out for self*; *does not need much help with tasks*; *chooses activities on their own*; *persists in face of difficult tasks*; *move to new activities after finishing task*) which is scored as the above measures.

I proxy for parental noncognitive skills by using test scores on parental personality traits. Because of the ordered categorical nature of these questions, I apply to each score the graded response model.

A.1.5 Rotter scale of self-control

The Rotter locus of control was collected as part of the 2001/2002 round of the MCS. It is a three-item abbreviated version adapted from the 60-item Rotter Adult scale developed by Rotter (1966). The scale measures the extent to which the respondents have control over their life (internal control) as opposed to the extent that fate or chance controls their life (external control). Parents have to choose for each pair of statements the one that most accurately describes their life, with higher values indicating individuals who are more in control of their life (internal locus of control)

1. I never really seem to get what I want out of life / I usually get what I want out of life
2. I usually have a free choice and control over my life / Whatever I do has no real effect on what happens to me^R
3. Usually I can run my life more or less as I want to / I usually find life's problems just too much for me^R

A.1.6 Rosenberg scale of self-esteem

The Rosenberg scale of self-esteem was administered in all four rounds of the MCS with different items in each round. In the analysis I use the 2001/2002 round so as to avoid reverse causality issues between parental self-esteem and child personality traits. It is a

six-item scale on which parents are asked to strongly agree (4), agree (3), disagree (2) or strongly (1) disagree with the following: *On the whole, I am satisfied with myself*^{R}, *At times I think I am no good at all*, *I am able to do things as well as most other people*^{R}, *I certainly feel useless at times*, *All in all, I am inclined to feel I am a failure*, *I take a positive attitude toward myself*^{R}.

A.1.7 Big Five Facets—Extraversion and Neuroticism

In 2008, the parents assessed responded on questions to assess their extraversion and neuroticism, which are both parts of the Big Five taxonomy (*e.g.*, Goldberg 1990). Extraversion refers to the degree the parent is sociable, gregarious or talkative and captures how individuals behave within groups of people. Neuroticism characterizes how parents experience strong positive and negative emotions. The responses vary between 1 (strongly disagree) and 5 (strongly agree) with higher values indicating individuals who are more extraverted, and more neurotic (less emotionally stable), respectively. The Extraversion Scale is based on the questions: *I take charge*^{R}, *I don't talk a lot*, *I talk to a lot of different people at parties*^{R}, *I bottle up my feelings*, *I feel at ease with people*, *I am a very private person*, *I wait for others to lead the way*, *I am skilled in handling social situations*^{R}. The Neuroticism Scale includes the items: *I get stressed out easily*^{R}, *I get angry easily*^{R}, *I feel threatened easily*^{R}, *I get overwhelmed by emotions*^{R}, *I take offense easily*^{R}, *I get caught up in my problems*^{R}, *I grumble about things*^{R}.

A.2 Variable Construction for Maternal Investments, Mother-Child Quality of Relationship and Happiness Index

I measure parental investments with three indices on cognitive investments, noncognitive investments and child activities investments. I use factor analysis with rotated varimax factor loadings to determine which of the separate questions represent the same underlying type of investment. For all three rounds of the survey, factor analysis showed that between 2 and 4 factors should be retained, and the minimum distance criterion and Horn's nonparametric analysis were in favor of extracting 2 and 4 factors, respectively.

The cognitive investments measure comes from the questions *how often do you teach the alphabet to the cohort member*, *how often do you teach counting to the cohort member*, *how often do you teach poems/songs to the cohort member* for round 2 and from the questions *how often do you read to the cohort member*, *how often you help the cohort member with math*, *how often you help the cohort member with writing* for rounds 3 and 4. For rounds 3 and 4, I combine questions on whether the parent does this activity with the child (indicator variable) with the variable that refers to the frequency of doing the specific activity. If the

frequency is missing and the parent has responded that this activity is not performed, I code the frequency of doing the activity as a zero (which refers to never helping the child with the reading, math or writing). Cronbach's alpha coefficients for internal consistency of the construct are 0.63, 0.64 and 0.78 respectively.

The second scale of parental investments refers to activities done with the child where the parent was actively involved or was just present in the activity. For round 2 the relative questions are: *how often do you read to the cohort member*, *how often have you visited the library*, *how many hours per day the cohort member watches TV or plays video games.* For rounds 3 and 4, the questions include: *how often you do indoor activities together*, *how often you read to the cohort member*, *how often tell stories to the cohort member*, *how often plays physically active games*, *how often play indoor games with cohort member*, *how often does musical activities with cohort member*, *how often exercises with cohort member*, *how often takes cohort member to recreational parks*, *how often visited the library*, *how often attended religious services.*

The third scale represents activities done by the child, and includes: *how often cohort member draws/paints at home*, *how often cohort member reads for own enjoyment*, *how often cohort member does a sport*, *how often cohort member does physical activity*, *how many days per week cohort member exercises*, *how many hours per day cohort member watches TV or plays video games.* I reverse all the above variables used for the construction of the three scales so that higher values represent higher frequency of endorsing the activity.

For the quality of mother-child relationship I create a scale using nine questions which are ranked on a Likert scale from 1 to 5: never, rarely, sometimes (about once a month), often (about once a week or more), and daily. For rounds 2, 3 and 4, I use questions on *how often do you smack her when she is naughty*, *how often do you shout at her when she is naughty*, *how often do you send her to her bedroom/naughty chair etc*, *how often do you take away treats*, *how often do you tell her off*, and *how often do you bribe her (e.g., with sweats, or a treat).* For rounds 3 and 4, in addition to the previous questions, I use information on *how often do you try to reason with her.* For round 3 only I also use *when you give her an instruction or make a request to do something, how often do you make sure that he does it*, while for round 4 only I also include responses on *how often do you enjoy listening to and enjoy doing things with her*, and *how often do you express affection by hugging, kissing and holding her.*

I use the graded response model to create an overall measure of maternal happiness that takes into account not only responses on: *how satisfied or dissatisfied are you about the way your life has turned out so far* (rounds 2, 3, and 4) but also on *how satisfied or dissatisfied are you with your job* (round 3) and on *how satisfied or dissatisfied are you with the balance*

between the amount of time you spend with your family and the amount of time you spend at work (rounds 3 and 4). These additional happiness measures range from 1 to 5 corresponding to 1 very satisfied; 2 fairly satisfied; 3 neither satisfied nor dissatisfied; 4 fairly dissatisfied; and 5 very dissatisfied.

A.3 Data Sources on Crime Statistics and Weather

The British Crime Survey (BCS) is commissioned by the Home Office and measures the amount and type of crimes experienced by people in England and Wales. The reference period is from first of January of the calendar year preceding the BCS up to the time of the interview. Its importance lies in the fact that it includes crimes that have not been reported to the police such as sexual assaults, domestic violence and stalking but significantly affect their victims. Moreover, the wording of the questions has remained uniform over time that allows direct comparability of the crime incidents for different time periods. In that sense, the BCS can provide a better reflection of crime in England and Wales, but should be complementary to official police crime statistics since the BCS does not cover less frequent but more serious crimes such as homicides. Up to 2012 twenty waves have been conducted: biennially since 1982 and annually starting from 2001. I use information from the 2000, 2002, 2004, 2006 and 2008 waves with corresponding samples of 24,238, 38,329, 43,120, 53,389 and 46,983 individuals.

The Scottish Crime and Justice Survey (SCJS) is commissioned by the Scottish Government and covers crimes experienced in Scotland. The topics covered in this crime survey are analogous to the ones in BCS and has been carried out nine times up to date: in 1982 and 1988 as part of the BCS, and as a separate survey explicitly for Scotland in 1993, 1996, 2000, 2003, 2006, 2008 and 2010. The increase in the sample size of the interviews since 1993, the coverage of all Scotland, the stability of the questions asked in every wave of the survey and the reporting of all crime types have made SCJS an important alternative to police records. The sample sizes are 5,483 (1999), 5,041 (2002), 5,007 (2004), 4,988 (2006) and 16,003 (2008) for my analysis.

The Northern Ireland Crime Survey (NICS) is under the jurisdiction of the Northern Ireland Office (NIO) and has taken place twelve times up to date: 1994/1995, 1998, 2001, 2003/2004 and annually starting in 2005. For the purpose of my paper I use information from the 1998, 2001, 2004 and 2006 waves. The main flaw of the NICS is that the microdata are not currently available and the information has to be drawn from the officially published reports from the NIO.

All three of these crime surveys collect information from individuals living in private households aged more than 16 years old that have experienced any type of crime in the

geographical area they examine. Apart from information on prevalence and frequency of exposure to crime, these surveys also collect details on attitudes towards crime, worry about crime experiences of the police forces, and information about the crime incident itself (*i.e.*, characteristics of the assailant, location, time of occurrence etc.).

Police recorded crimes include the total number of notifiable offenses in each of the four U.K. countries. These notifiable offenses refer to violence against the person with and without injury, sexual offenses, robbery, burglary, fraud and forgery, criminal damage and drug offenses. The difference of police recorded crimes from victimization crimes is that in order for an offense to be included in the dataset the victims must have reported it to the police and the police must have decided to record this incident. Also, the police recorded crimes incorporate crimes against individuals less than the age of 16, crimes against organization or crimes against the state, drug offenses and crimes where the victim is absent. Data on police recorded crimes come from Home Office for England and Wales, from the Scottish Government and from the Police Service of Northern Ireland. I use information from all police departments in each of the four countries apart from the British Transport Police. This force was introduced in 2002 to document crimes in the railways in England, Wales and Scotland. Because the region where these crimes take place is not documented I cannot match these police recorded crimes with any of the regions in the U.K. However, because only 0.005% (in 2002, 2004 and 2006) and 0.012% (in 2008) of these offenses are not captured by the BCS (homicide or infanticide), I do not expect that I will underreport the level of crime in each region. One potential problem with these data is that because they are administrative data, they are affected by rules relating to the recording of crimes over time even though there has been an attempt to follow uniform rules for recording crimes (*i.e.*, the Scottish Crime Recording Standard, or the National Crime Recording Standard for England and Wales).

Country-specific incarceration rates are based on reports from the Home Office, the Scottish Government and the Northern Ireland Office. These rates represent the prison population who has been sentenced by courts to immediate custody for criminal offenses, fine defaulters and remand prisoners. Fine defaulters are individuals who have been convicted to pay a fine, but because they have not paid the fine they have been sentenced to prison. Remand prisoners are those individuals who have been charged with an offense but because of the severity of their offense they have been ordered to be kept in custody pending the trial. I draw information from these three groups of male prisoners from secondary data sources; I use the published reports on prison statistics as the prison population data are not available it their raw format.

Finally, information on weather conditions comes from the British Atmospheric Data

Centre (BADC) of the National Environment Research Council (NERC). The specific data source is the MIDAS Land Surface Stations dataset which contains daily reports from over 500 weather stations located across the U.K. Temperature is measured in Celsius degrees with an accuracy level of 0.1^oC, precipitation is measured in millimeters with a precision of 0.1 mm, while hours of sunshine are expressed in 0.1 hour.

Table 1: Means and Standard Deviations of Variables

Variables	Mean	S.D.	Variables	Mean	S.D.
Child Outcomes			**Noncognitive & Cognitive Skills**		
Conduct problems	-.04	(.79)	Locus of control	.03	(.59)
Emotional symptoms	-.02	(.73)	Self-esteem	.01	(.89)
Hyperactivity / inattention	-.03	(.86)	Extraversion	.00	(.88)
Peer problems	-.03	(.68)	Neuroticism	.00	(.84)
Prosocial behaviors	.03	(.80)	Cognitive self-assessed skills	.04	(.53)
Independence / self-regulation	.02	(.78)	**Household Characteristics**		
Cognitive skills	.03	(.93)	Number of siblings	1.32	(1.03)
Life Satisfaction	7.62	(1.87)	1 if Currently pregnant	.05	
Marital Status			Language spoken at home:		
1 if Married	.63		1 if No English (omitted)	.06	
1 if Cohabiting	.18		1 if Only English	.91	
1 if Single (omitted group)	.12		1 if English, plus language	.02	
1 if Divorced	.07		1 if Unknown	.02	
Child Demographics			Annual household income	29194	(20865)
Age (in years)	5.23	(1.66)	**Birth Characteristics**		
1 if Male; 0 if female	.51		Birth weight	3.38	(.57)
1 if White: 0 if non-white	.89		Gestation	277.36	(13.54)
1 if No long-lasting illness (omitted)	.82		1 if Fertility treatment	.03	
1 if Long-lasting, not limiting illness	.13		1 if Breastfed	.70	
1 if Long-lasting, limiting illness	.05		1 if Ill in pregnancy	.38	
Maternal Characteristics			1 if Received antenatal care	.98	
Age (in years)	34.02	(6.09)	1 if Attended antenatal class	.41	
Education level:			1 if Smoked during pregnancy	.15	
1 if No high school diploma	.08		1 if Worked during pregnancy	.70	
1 if High school diploma (omitted)	.37		**Weather Conditions**		
1 if Some college	.49		Hours of sunshine	121.65	(13.26)
1 if College degree	.06		Precipitation	12.74	(2.38)
Depression:			Average Temperature	9.73	(.86)
1 if No treatment (omitted)	.62		**Weather Conditions Deviations**		
1 if Diagnosed, not treated	.29		Hours of sunshine	-.02	(3.69)
1 if Diagnosed and treated	.09		Precipitation	3.92	(.94)
1 if Long-lasting illness	.23		Average Temperature	.42	(.33)
1 if Same health condition	.65		**Crime Rates**		
1 if Worse health condition	.09		Male incarceration crime rates	.53	(.15)
1 if Better health condition	.26		Police recorded crime rates	3.61	(3.24)
1 if Smoker; 0 if non-smoker	.28		Victimization crime rates	23.43	(6.15)
Employment status:			Area of residence:		
1 if Employed (omitted)	.54		1 if Urban	.75	
1 if Self-employed	.06		1 if Suburban	.11	
1 if Unemployed	.04		1 if Rural (omitted)	.13	
1 if Out of labor force	.33		1 if Unknown area	.01	
1 if Unknown employment status	.03				

(continued)

Table 1 *(continued)*

Variables	Mean	S.D.	Variables	Mean	S.D.
Frequency Child Meets Friends			**Paternal Characteristics**[a]		
1 if Never/no friends (omitted)	.21		Life satisfaction	7.74	(1.71)
1 if Rarely (once a week)	.41		Age (in years)	37.35	(6.33)
1 if Sometimes (2 or 3 per week)	.22		Education:		
1 if Frequently (5+ per week)	.16		1 if No high school diploma	.11	
Instrumental Variables			1 if High school diploma (omitted)	.43	
Lagged hours of sunshine	127.73	(13.75)	1 if Some college	.39	
Lagged precipitation	12.06	(2.28)	1 if College degree	.07	
Lagged average temperature	9.96	(.87)	1 if White; 0 if non-white	.89	
Lagged life satisfaction	7.73	(1.82)	1 if Long-lasting illness	.23	
Lagged male incarceration rates	.18	(.07)	Frequency of depression:		
Lagged married	.63		1 if Never (omitted)	.72	
Lagged cohabiting	.21		1 if Little	.18	
Lagged divorced	.04		1 if Sometimes	.06	
Maternal Investments in Child			1 if Most times	.02	
Cognitive investments	.01	(.88)	1 if Unknown depression	.01	
Noncognitive investments	.14	(.90)	Cognitive & Noncognitive Skills:		
Child activities investments	.03	(.49)	Locus of control	.05	(.51)
Frequency of regular bed time:			Self-esteem	.07	(.82)
1 if Never (omitted)	.05		Extraversion	.01	(.81)
1 if Sometimes	.08		Neuroticism	-.02	(.83)
1 if Usually	.32		Cognitive self-assessed skills	.03	(.55)
1 if Always	.55		1 if Smoker	.29	
1 if Smoked with child present	.15		1 if Currently working	.92	
Time spent with child:			Amount of time spent with child:		
1 if Not quite enough (omitted)	.06		1 if Not enough time (omitted)	.16	
1 if Quite enough	.22		1 if Quite enough time	.39	
1 if Just enough	.35		1 if Just enough time	.31	
1 if Plenty of time	.38		1 if Plenty of time	.14	
Mother-child quality of relationship	-.03	(.74)	**Alternative Happiness Measures**		
1 if Partner used force	.05		Happiness in current relationship[a]	5.93	(1.35)
Frequency parents go out as a couple:			Maternal happiness theta score	.13	(.91)
1 if Never (omitted)	.22				
1 if Rarely	.23				
1 if Frequently	.25				
1 if Often	.08				
1 if Missing outings	.18				

Note: Sample consists of 14,250 children, and 36,835 child-year observation from rounds 2-4 of the MCS. [a]Variables for paternal sample for 11,041 children and 25,147 child-year observations.

Table 2: Maternal and Teacher Assessments of Child Behaviors, Correlations and Mean Differences

Panel A: Correlations for Mother and Teacher Responses on Child Behaviors

Maternal response / Teacher response on:	[1] Alpha Reliability[a]	[2] Pearson Correlation[b]
Conduct problems / Conduct problems	.75	.34
Emotional symptoms / Emotional symptoms	.74	.25
Hyperactivity / Hyperactivity	.87	.48
Peer problems / Peer problems	.70	.33
Prosocial behaviors / Prosocial behaviors	.79	.26

Panel B: Mean Differences in Maternal and Teacher Responses

	[3] Maternal Response		[4] Teacher Response		[5]
Child behavioral outcome:	Mean	S.E.	Mean	S.E.	Difference[c] [3]-[4]
Conduct problems	1.33	(.017)	.75	(.016)	.58**
Emotional symptoms	1.48	(.020)	1.41	(.022)	.07**
Hyperactivity	3.27	(.028)	2.84	(.032)	.43**
Peer problems	1.15	(.017)	1.13	(.018)	.02
Prosocial behaviors	8.63	(.018)	7.84	(.026)	.79**

** p<.01

[a]Alpha reliability coefficients are calculated based on Cronbach's method.

[b]Pearson correlations between 0.20 and 0.29 show weak positive correlations; 0.30 to 0.39 moderate positive correlations; and 0.15 to 0.25 strong correlations.

[c]Difference between maternal and teacher responses in child behaviors.

Notes: Sample consists of 7,623 children from wave 4 of the MCS for whom both mothers and teachers assessed child behaviors.

Table 3: Differential Item Functioning for Child Behaviors, by Level of Maternal Depression

		Conduct Problems	Emotional Symptoms	Hyperactivity / Inattention	Peer Problems	Prosocial Behaviors	Independence / Self-regulation
Items	Comparison Groups[a]	Chi-square[b]	Chi-square[b]	Chi-square[b]	Chi-square[b]	Chi-square[b]	Chi-square[b]
Item 1	Depression vs. No depression	99.6**	70.2**	1.2	5.5	17.6**	27.1**
	Some depression vs. No depression	9.8*	9.2*	1.9	2.8	6.2	14.8**
Item 2	Depression vs. No depression	15.9**	8.8*	1.1	64.2**	15.2**	1.2
	Some depression vs. No depression	2.2	4.5	7.5*	15.3**	5.4	3.9
Item 3	Depression vs. No depression	6.1	27.4**	6.9	25.0**	15.4**	5.2
	Some depression vs. No depression	6.6	16.8	3.4	4.7	5.4	1.9
Item 4	Depression vs. No depression	51.5**	13.3**	16.0**	24.4**	14.8**	17.4**
	Some depression vs. No depression	2.0	4.1	24.2**	6.1	1.7	7.7
Item 5	Depression vs. No depression	18.6**	30.0**	21.1**	0.6	12.9**	34.2**
	Some depression vs. No depression	1.6	5.1	16.9**	0.0	9.3*	10.9**

[a]Depression refers to mothers who have been diagnosed and treated for depression. Some depression refers to mothers who have been diagnosed, but not treated for depression. No depression refers to mothers who do not have depression symptoms.
[b]Chi-square statistic for null hypothesis that the response patterns of the mothers to the child behavioral questions do not differ by maternal depression. ** p<.01, * p<.05.
Note: Sample consists of 14,250 children from waves 2-4 of the MCS.

Table 4: Maternal Life Satisfaction by Marital Status

Life satisfaction score	Married	Cohabiting	Single	Divorced	All marital status groups
1	.6	.7	1.2	1.5	.7
2	.7	1.1	1.7	2.2	1.0
3	1.2	2.2	3.6	5.1	1.9
4	1.9	3.8	6.5	6.8	3.1
5	4.2	8.5	15.5	15.3	7.1
6	5.9	10.3	13.8	12.7	8.1
7	14.7	18.1	20.4	22.3	16.5
8	28.3	25.9	20.1	20.2	26.3
9	24.7	16.9	9.3	7.0	20.2
10	17.8	12.6	8.0	7.1	14.9
Means	8.00	7.47	6.80	6.57	7.62
Overall life satisfaction	62.8	18.1	14.4	6.7	100.0
Coefficient of variation	21.1	25.5	29.8	31.2	24.5

Notes: Sample consists of 14,250 mother-child pairs, and 36,835 child-year observations from waves 2-4 of the MCS. The table shows the maternal life satisfaction distribution for each marital status category.

Table 5: OLS Estimates of Child Outcome Models (Life Satisfaction and Marital Status are Exogenous)

	Conduct Problems			Emotional Symptoms			Hyperactivity / Inattention			Peer Problems		
Variables	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]
Life satisfaction		-.021**	-.020**		-.016**	-.015**		-.018**	-.017**		-.015**	-.014**
		(.002)	(.002)		(.002)	(.002)		(.002)	(.002)		(.002)	(.002)
Married	-.074**		-.057**	-.002		.010	-.036*		-.022	-.029*		-.018
	(.014)		(.014)	(.014)		(.014)	(.015)		(.015)	(.013)		(.013)
Cohabiting	-.031*		-.021	-.013		-.006	-.017		-.008	-.003		.004
	(.014)		(.014)	(.014)		(.014)	(.015)		(.015)	(.013)		(.013)
Divorced	-.005		-.008	.043*		.041*	-.007		-.009	.003		.001
	(.018)		(.018)	(.018)		(.018)	(.020)		(.020)	(.017)		(.017)
R-squared	.427	.427	.427	.410	.410	.410	.545	.545	.545	.398	.398	.398

	Prosocial Behaviors			Self-regulation			Cognitive Skills		
Variables	[1]	[2]	[3]	[1]	[2]	[3]	[1]	[2]	[3]
Life satisfaction		.026**	.026**		.019**	.020**		.003	.002
		(.002)	(.002)		(.002)	(.002)		(.003)	(.003)
Married	.028^{+}		.006	-.026^{+}		-.043**	.076**		.075**
	(.014)		(.014)	(.014)		(.014)	(.017)		(.017)
Cohabiting	.009*		-.004	-.030*		-.040**	.054**		.053**
	(.014)		(.014)	(.015)		(.015)	(.017)		(.017)
Divorced	.010		.013	-.018		-.015	.028		.028
	(.019)		(.019)	(.019)		(.019)	(.022)		(.022)
R-squared	.463	.465	.465	.463	.463	.463	.433	.433	.433

** p<.01, * p<.05, $^{+}$ p<.10

Notes: Sample consists of 14,250 mother-child pairs, and 36,835 child-year observations from waves 2-4 of the MCS. Robust standard errors clustered in the individual level are given in parenthesis. Estimates for covariates not shown here are available in Table B1 at http://dimitriosnikolaou.weebly.com/research.html.

Table 6: TSLS Estimates of Child Outcome Models (Life Satisfaction and Marital Status are Endogenous)

Variables	Conduct Problems	Emotional Symptoms	Hyperactivity / Inattention	Peer Problems	Prosocial Behaviors	Independence / Self-regulation	Cognitive Skills
Maternal life satisfaction	-.006	-.010*	-.007	-.006	.022**	.016**	-.001
	(.005)	(.005)	(.005)	(.004)	(.005)	(.005)	(.005)
Married	-.084**	.003	-.041	-.033	.002	-.043*	.129**
	(.041)	(.020)	(.030)	(.021)	(.020)	(.020)	(.024)
Cohabiting	-.035^{+}	-.023	-.004	-.003	-.016	-.046*	125**
	(.020)	(.021)	(.024)	(.028)	(.022)	(.022)	(.026)
Divorced	-.045	.020	-.010	.020	.020	-.045	.040
	(.028)	(.028)	(.031)	(.026)	(.029)	(.029)	(.034)
Excludability χ^2 tests on:[a]							
Instruments for	5.79	6.23	5.78	6.18	5.16	5.77	7.61
life satisfaction	[.216]	[.183]	[.216]	[.186]	[.271]	[.217]	[.102]
Instruments for	4.76	2.42	7.79	7.69	3.24	6.81	8.10
marital status	[.313]	[.658]	[.100]	[.103]	[.519]	[.146]	[.100]
LR $\chi^2(105)$	14778	6613	13159	7471	11085	7577	9368
Log-likelihood	-31496	-32473	-34872	-30169	-34265	-34743	-39072

** p<.01, * p<.05, $^{+}$ p<.10

[a]Wald tests for orthogonality of exclusion restrictions to the error child of child outcome models

Notes: Sample consists of 14,250 mother-child pairs, and 36,835 child-year observations from waves 2-4 of the MCS. Robust standard errors clustered in the individual level are given in parenthesis. The brackets include p-values. Estimates for covariates not shown here are available in Table B2 at http://dimitriosnikolaou.weebly.com/research.html.

Table 7: Predicted Marginal Effects of Changes in Life Satisfaction and Marital Status Expressed in "Income Equivalents"

Marginal Effect	Conduct Problems	Emotional Symptoms	Hyperactivity / Inattention	Peer Problems	Prosocial Behaviors	Independence/ Self-regulation	Cognitive Skills
Lower life satisfaction from:							
Mean to mean minus one[a]	£18,482	**£19,051**	£10,410	£8,865	**£50,632**	**£30,370**	£683
p25 to p10[b]	£21,100	**£21,749**	£11,885	£10,121	**£57,804**	**£34,672**	-£780
p50 to p25[b]	£18,015	**£18,569**	£10,147	£8,641	**£49,352**	**£29,602**	-£666
p75 to p50[b]	£14,244	**£14,662**	£8,012	£6,823	**£38,968**	**£23,374**	-£526
p90 to p75[b]	£11,167	**£11,510**	£6,290	£5,356	**£30,591**	**£18,349**	-£413
Change marital status from:[c]							
Married to Single	**£273,966**	-£5,954	£60,500	£47,626	£5,469	**-£82,137**	**£62,239**

[a]Income equivalent is the predicted value of each child outcome at the mean life satisfaction and the predict value one point below the mean relative to the marginal effect of annual household income.
[b]Similar to [a] but evaluated at different percentiles of the life satisfaction distribution.
[c]Income equivalent is the difference in the predicted value of each child outcome evaluated at (marriage=1) and the predicted value of the outcome at (single=1) relative to the marginal effect of annual household income.
Notes: Predictions based on estimates in Table 6. Statistically significant predictions are in bold.

Table 8: OLS and TSLS Estimates of Child Outcome Models, Paternal Sample

	Conduct Problems		Emotional Symptoms		Hyperactivity / Inattention		Peer Problems		Prosocial Behaviors		Independence / Self-regulation		Cognitive Skills	
Variables	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS	OLS	TSLS
Maternal life satisfaction	-.017**	-.002	-.013**	-.007	-.017**	-.002	-.014**	-.009^{+}	.027**	.017**	.020**	.017**	.001	.004
	(.003)	(.005)	(.003)	(.005)	(.003)	(.006)	(.003)	(.005)	(.003)	(.006)	(.003)	(.006)	(.003)	(.007)
Paternal life satisfaction	-.005^{+}	-.005^{+}	.003	.002	-.001	-.002	.005^{+}	.005	.000	.000	-.003	-.005	-.002	-.004
	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)	(.003)	(.004)	(.003)	(.003)	(.003)	(.003)	(.003)	(.004)
Married	-.034**	-.050**	.013	.015	-.010	-.032*	-.023*	-.028*	.025^{+}	.033*	.015	.017	.004	-.004
	(.013)	(.015)	(.013)	(.014)	(.014)	(.016)	(.012)	(.014)	(.013)	(.015)	(.013)	(.015)	(.015)	(.018)
R-squared	.37		.32		.46		.32		.36		.35		.35	
LR $\chi^2(130)$		9889		4457		9169		5142		8093		5357		6286
Log-likelihood		-21450		-22071		-23734		-20501		-23606		-23964		-26487

** p<.01, * p<.05, $^{+}$ p<.10

Notes: Sample consists of 11,041 children, and 25,147 child-year observations from waves 2-4 of the MCS. Robust standard errors clustered in the individual level are given in parenthesis. Estimates for covariates not shown here are available in Table B3 at http://dimitriosnikolaou.weebly.com/research.html.

Table 9: Effects of Parental Investments at Different Stages of Child Development, Interaction Models

Variables	Conduct Problems	Emotional Symptoms	Hyperactivity / Inattention	Peer Problems	Prosocial Behaviors	Independence / Self-regulation	Cognitive Skills
Maternal happiness*Age 3	-.060**	-.000	-.027**	-.010	.019*	.021*	.020*
	(.008)	(.008)	(.009)	(.008)	(.009)	(.009)	(.010)
Maternal happiness*Age 5	.003	.002	.007	.012^{+}	-.000	.002	.015
	(.007)	(.008)	(.008)	(.007)	(.009)	(.009)	(.009)
Paternal happiness*Age 3	-.008	.016*	.009	.007	.017*	.001	-.015*
	(.006)	(.006)	(.007)	(.006)	(.007)	(.007)	(.008)
Paternal happiness*Age 5	.009^{+}	-.013*	.010^{+}	.003	-.002	.007	-.000
	(.005)	(.006)	(.006)	(.005)	(.006)	(.006)	(.007)
Noncognitive investments*Age 3	-.028*	-.058**	-.074**	-.038**	.016	.020	.178**
	(.012)	(.012)	(.013)	(.011)	(.013)	(.013)	(.015)
Noncognitive investments*Age 5	.002	.003	-.024^{+}	.001	.008	.011	.060**
	(.011)	(.012)	(.012)	(.011)	(.013)	(.013)	(.014)
Cognitive investments*Age 3	-.043**	-.034**	-.088**	-.044**	.049**	.116**	.172**
	(.012)	(.012)	(.013)	(.011)	(.013)	(.013)	(.015)
Cognitive investments*Age 5	-.007	-.018*	-.044**	-.006	.026^{+}	.114**	.116**
	(.013)	(.014)	(.015)	(.013)	(.015)	(.015)	(.017)
Maternal time with child*Age 3	-.323*	.113	.123	.224	-.332*	-.256	-.380*
	(.142)	(.151)	(.159)	(.140)	(.162)	(.165)	(.180)
Maternal time with child*Age 5	-.147**	-.044**	-.113**	-.006	.075**	.058**	-.035**
	(.008)	(.008)	(.009)	(.008)	(.009)	(.009)	(.010)

** p<.01, * p<.05, $^{+}$ p<.10

Notes: Sample consists of 11,041 children, and 25,147 child-year observations from waves 2-4 of the MCS. The table shows whether maternal investments vary by stage of child development. Same variables included as in the previous tables but the vector X_t is augmented with interactions between each type of parental investment and time period. Robust standard errors clustered in the individual level are given in parenthesis.

Table 10: First Stage Estimates of Marital Status and Life Satisfaction Models

	Equation (3)						Equation (2)
Variables	Married		Cohabiting		Divorced		Life Satisfaction
	Coefficient	M.E.[a]	Coefficient	M.E.[a]	Coefficient	M.E.[a]	Coefficient
Maternal life satisfaction	.354**	.036**	.096**	-.016**	-.114*	-.019**	
	(.047)	(.004)	(.036)	(.003)	(.049)	(.002)	
Married							.339**
							(.054)
Cohabiting							.100^{+}
							(.060)
Divorced							.084
							(.074)
Lagged incarceration rates	7.453**	.489**	1.758	-.387**	5.299*	.069	
(period t-s)	(2.122)	(.169)	(1.568)	(.121)	(2.428)	(.085)	
Lagged marriage	10.004**	.540**	3.881**	-.415**	7.532**	.080**	
(period t-1)	(.323)	(.023)	(.319)	(.018)	(.328)	(.010)	
Lagged cohabitation	2.330**	-.033**	3.194**	.062**	1.956**	.018*	
(period t-1)	(.126)	(.014)	(.074)	(.008)	(.156)	(.008)	
Lagged divorced	3.214**	-.032	2.088**	-.088**	6.364**	.135**	
(period t-1)	(.226)	(.023)	(.184)	(.014)	(.190)	(.012)	
Hours of sunshine							.004
(period t-2)							(.003)
Precipitation							-.037**
(period t-2)							(.014)
Average temperature							-.361**
(period t-2)							(.126)
Maternal life satisfaction							.494**
(period t-1)							(.007)
Under-identification χ^2 test[b]	1081.55		1880.92		1934.47		4640.21

[a]Marginal effects are estimated at mean values

[b]Wald tests for relevance of the exclusion restrictions in the first stage of the estimation process

** p<.01, * p<.05, $^{+}$ p<.10

Notes: Sample consists of 14,250 mother-child pairs, and 36,835 child-year observations from waves 2-4 of the MCS. Robust standard errors clustered in the individual level are given in parenthesis.

Table 11: Robustness Analysis, by Alternative Definitions of Life Satisfaction and Measures of Child Outcomes

Variables	Conduct Problems	Emotional Symptoms	Hyperactivity / Inattention	Peer Problems	Prosocial Behaviors	Independence / Self-regulation	Cognitive Skills
Panel A: Life Satisfaction Measured as Happiness in Current Relationship[a]							
Maternal happiness	.003	-.005	.006	-.006	.012	-.003	.003
	(.007)	(.008)	(.009)	(.008)	(.009)	(.009)	(.010)
Paternal happiness	-.007^{+}	.002	-.002	.002	-.001	-.001	-.006
	(.004)	(.005)	(.005)	(.004)	(.005)	(.005)	(.006)
Married	-.035**	.023	-.038*	-.007	.020	.032*	.003
	(.013)	(.015)	(.015)	(.013)	(.015)	(.016)	(.018)
Panel B: Life Satisfaction Measured as a Happiness Index[b]							
Happiness index	-.003	-.007	-.007	.001	.062**	.042**	-.030*
	(.011)	(.013)	(.013)	(.011)	(.013)	(.013)	(.015)
Married	-.070**	.006	-.033	-.041*	.003	-.023	.113**
	(.018)	(.021)	(.021)	(.019)	(.021)	(.022)	(.025)
Cohabiting	-.033^{+}	-.014	.010	-.017	-.018	-.041^{+}	.096**
	(.019)	(.022)	(.022)	(.020)	(.022)	(.023)	(.027)
Divorced	-.034	-.004	.017	.015	-.008	-.051^{+}	.013
	(.025)	(.029)	(.029)	(.026)	(.029)	(.030)	(.035)
Panel C: Child Outcomes Measured as Raw Summed Scores[c]							
Life satisfaction	-.039**	-.045**	-.058**	-.026**	.073**	.083**	.061
	(.010)	(.010)	(.014)	(.008)	(.011)	(.011)	(.079)
Married	-.115**	.019	-.044	-.063	.001	-.075	.347
	(.048)	(.047)	(.068)	(.041)	(.050)	(.054)	(.378)
Cohabiting	-.026	-.056	.022	-.028	-.071	-.097^{+}	.745^{+}
	(.052)	(.051)	(.073)	(.044)	(.055)	(.059)	(.412)
Divorced	-.081	.031	.004	.100^{+}	.020	-.144*	.487
	(.063)	(.062)	(.008)	(.053)	(.066)	(.071)	(.496)

(continued)

Table 11 ***(continued)***

Panel D: Child Outcomes Measured as Cumulative Measures of Noncognitive and Cognitive Skills[d]		
Life satisfaction	-.023**	-.001
	(.005)	(.006)
Married	-.034	.127**
	(.023)	(.024)
Cohabiting	.006	.125**
	(.024)	(.026)
Divorced	-.017	.038
	(.031)	(.034)

** p<.01, * p<.05, + p<.10

[a]Same specification as in Table 9 but maternal happiness is measured as happiness in the current relationship.

[b]Information on job satisfaction, satisfaction with balancing work over family and satisfaction with current financial status is combined using the graded response model to create the happiness index.

[c]Child outcomes are constructed by summing the responses to each of the five questions in each of the six behavioral outcomes, and the correct answers across all tests for the cognitive skill questions. Each question is assigned the same weight.

[d]IRT-theta scores for the six behavioral outcomes are further aggregated into the measure of noncognitive skills. This is a three level model where each item is assigned to each of the six sub-traits and these sub-traits are combined further into the aggregate score accounting for the discrimination and difficulty parameters.

Notes: Sample consists of 11,041 children for panel A and 14,250 children for panels B-D from waves 2-4 of the MCS. Robust standard errors clustered on individuals are in parenthesis.

Table A1: Differences in Effects of Exclusion Restrictions on Marital Status, by Education and Income Levels

	Difference between High School Dropouts [1] and Non High School Dropouts [2]			Difference between $< 10^{th}$ income percentile [3] and $> 10^{th}$ income percentile [4]		
Variables	Married [1]-[2]	Cohabiting [1]-[2]	Divorced [1]-[3]	Married [3]-[4]	Cohabiting [3]-[4]	Divorced [3]-[4]
Lagged incarceration rates	2.003	-.237	4.478	.907	2.390	5.473^{+}
	(3.808)	(2.891)	(3.745)	(3.498)	(2.592)	(3.362)
Lagged marriage	1.086	1.366*	.496	.364	.823^{+}	.403
	(.746)	(.699)	(.720)	(.567)	(.496)	(.533)
Lagged cohabitation	.024	.203	.417	.721*	-.012	.393
	(.344)	(.164)	(.303)	(.353)	(.146)	(.293)
Lagged divorce	-.233	.135	-.633	1.478**	.108	.481
	(.461)	(.298)	(.320)	(.476)	(.380)	(.385)

** p<.01, * p<.05, $^{+}$ p<.10

Notes: Sample consists of 14,250 mother-child pairs, and 36,835 child-year observations from waves 2-4 of the MCS. Robust standard errors are given in parentheses. Each entry shows the difference in the effect of each variable in the first column between mothers who dropped out of high school [1] and those who did not drop out of high school [2], and mothers in families in the tenth percentile of the income distribution [3] and those in families above the tenth percentile of the income distribution [4].