Beliefs and investment in child human capital : case study from Benin

# Beliefs and investment in child human capital : case study from Benin*

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**Abstract**

Because of its far reaching consequences on income, inequality and welfare, a large economic literature has attempted to uncover the determinants of parental investment in children. So far, most studies in this literature have focused on child characteristics to explain inequalities in parental investment among siblings. As a complement, I investigate whether existing beliefs about child value affect how parents allocate resources among siblings. To test this hypothesis, I use the case of twins which are venerated and worshipped as deities in several parts of Africa. Based on Demographic and Health Survey (DHS) data from Benin, I find a *twins preferential treatment* in parental investment in child health. As this result survives various robustness checks and competing explanations, I explore its underlying mechanisms and discuss whether it should be interpreted as a behavioural anomaly or as the outcome of a rational cost-benefit calculus. Furthermore, a policy implication of my findings is that sustainable improvement of uptake of preventive health care in Sub Saharan Africa requires an increased attention to belief systems affecting parental investment in child health.

Keywords: Beliefs, child human capital, preventive health care.

## 1. Introduction

All over the world, parents attach different values to children, based on gender, birth order, cognitive abilities etc.; often leading to unequal resource allocation among siblings. Well-known illustrations of such situations are male preference and related gender discrimination in child health and education in developing countries (e.g. Barcellos et al., 2014; Pasqua, 2005). Similarly, gender and birth order differences are found in a child's time spent with their parents in developed countries (e.g. Lundberg et al., 2007; Price, 2008).

Alongside, and often linked to, some child characteristics, other factors such as culture and beliefs also affect parental perceptions of child value. For instance, in some ethnic groups in Sub-Saharan Africa, twins are venerated and worshipped as deities (e.g. the Yoruba[i] in Nigeria; Renne, 2001), while they are considered evil and a curse in others (e.g. the Antaboques in Madagascar[ii]). Similarly, children with a birth defect[iii] or disorder are perceived in many cultures as punishments from God for parental sin, and are believed to inflict harm and bring bad fortune (Meyerson, 1990). Children born to women who died during or shortly after delivery, breech born babies and children with disabilities also face social stigma in various cultures.[iv] For example, girls with baldness are held responsible for their family's life struggles and referred to as "*sumpa*" (a curse) in the Philippines (Abad et al., 2014). In rural India, disability is attributed either to a curse and karma or is conversely perceived as extraordinary powers and gifts,[v] whilst in Romania, disabled children are seen as 'bad births' and 'irreparable loss', leading to stigmatization and sometimes to abandonment (Soponaru and Iorga, 2015).

These examples illustrate the motivation of this paper: in the wake of studies linking magico-religious beliefs with development outcomes (e.g. Gershman, 2016; Alonso et al., 2016; Stoop et al., 2019; Alidou and Verpoorten, 2019; etc.), it explores the impact of parental magico-religious beliefs on resource allocation among siblings. More specifically, it investigates whether magico-religious beliefs about twins lead to differential treatment of twins with respect to their singleton counterparts. This hypothesis is tested using child full immunization status - as a measure of parental investment in

child health - from five DHS rounds (over the period 1996-2017) in Benin, and an identification strategy which exploits same-sex twins to remedy non-randomness of twin births. The focus on Benin is motivated by the following three main reasons,[vi] which are further explained in section 3. First, Benin provides unique empirical advantages to explore the relationship between magico-religious beliefs and development outcomes (Stoop et al., 2019); second, the country is invariably noted for its celebration of twins whenever African twins are mentioned in books or media (Piontelli, 2008); and third, Benin has the highest twinning rate in the world (Smits and Monden, 2011).

Overall, results indicate that compared to singleton children, twins are more likely to enjoy full immunization; and this finding survives several robustness checks and competing explanations such as parental compensating behaviour and higher health investment in reaction to early health shocks. In my attempt to examine this *preferential treatment of twins*, I combine a quantitative exploration of various mechanisms, with qualitative insights from fieldwork conducted in southern Benin.[vii] In doing so, I identify the support from the extended family to parents of twins as a plausible explanation for *preferential treatment of twins*. Furthermore, I speculate on the motives for such preferential treatment, providing an interpretation based on beliefs which fits a behavioural approach as well as a rational cost-benefit interpretation in which individuals intend to secure and maximize the good fortune believed to be provided by twins.

Because of its far-reaching consequences for economic growth, distribution and welfare, a large economic literature has developed on parental investment in child human capital. However, relatively little attention has been given to factors such as culture and beliefs; with the notable exception of gender differences, which have been analysed with regard to culture and existing social norms. By pinpointing a twins effect in parental investment in child human capital, and identifying magico-religious beliefs as its most plausible driver, this paper complements the economic literature on inequality in parental investment in child human capital. It also fits within (i) the economics of magico-religious beliefs and (ii) the economic literature on intra-household resource allocation. More generally, it belongs to the literature on the cultural determinants of development.

Finally, despite huge investment in tackling supply-side constraints, the uptake of vaccination (and other cost-effective measures to reduce child mortality) remains low in Sub-Saharan Africa (Dupas, 2011). A deeper understanding of the determinants of parental investment in child health is therefore crucial to 'bridge the last mile' in order to eradicate preventable childhood diseases. Hence, one policy implication of my findings is that the sustainable improvement in the uptake of preventive health care in Sub-Saharan Africa requires increased attention to the belief systems affecting parental investment in children's health.

This paper is structured in 8 sections. The next section briefly reviews the literature on inequality in parental investment in child human capital and section 3 provides a background on Benin. In sections 4 and 5, I present the data and the empirical framework, before discussing the results in section 6. Section 7 tentatively explores the mechanisms behind the findings and section 8 concludes.

## 2. Literature review

There is a large and still growing literature on inequality in parental investment in child human capital, but without a consensus so far on its dominant motive. While some studies have suggested that parental investment reinforces initial endowments, thereby increasing inequality among siblings (Behrman et al., 1994), others have advocated that parents allocate resources in order to alleviate existing gaps in child endowments (Behrman et al., 1982; Pitt et al., 1990). More recent studies have found multiple and more complex motivations including favouritism and guilt in parent's decisions (Li et al., 2010). Moreover, compensating or reinforcing parental behaviour depends on the dimension of human capital of interest. For instance, parents tend to compensate for innate differences in health endowments while educational investments are allocated to reinforce initial differences (Ayalew, 2005; Yi et al., 2015). In all cases, inequality in care time and resource allocation among siblings have been studied essentially with respect to child endowments and abilities (Frijters et al., 2013; Akresh et al., 2012; Ayalew, 2005), gender (Barcellos et al., 2014; Pasqua, 2005) and birth order (Lehmann et al., 2018; Ejrnæs and Pörtner 2004). Furthermore, it is worth noticing that unequal resource allocation among siblings might be rooted in existing social norms and institutions. For instance, gender

discrimination is often based on states of the marriage market, the labor market, laws and social attitudes (Pitt et al., 1990) but also on parents' perceptions of child prospects (Behrman, 1982). Finally, parents may simply prefer a particular child irrespective of the returns (Behrman, 1988).

While all of the above are no doubt important determinants of household's investment in child human capital, other variables (e.g. love, friendship, compassion) may impact on caring preferences of household members (Cherchye et al., 2015), leading to heterogeneity in parental altruism. Often interlinked to some child characteristics (e.g. being a twin, birth defect, breech birth…), factors such as tradition and beliefs might also affect resource allocation among siblings through parents' perception of child value. The current state of the economic literature largely leaves such questions unexplored.

Drawing on evidence of magico-religious beliefs affecting social behavior, human well-being and development outcomes (e.g. Gershman, 2016 ; Stoop et al., 2019; Alonso et al., 2016; Nunn and Sanchez de la Sierra, 2017; Alidou and Verpoorten, 2019), and based on qualitative insights (both from socio-anthropological studies such as Renne, 2001; Pector, 2002; and qualitative fieldwork conducted in southern Benin), this paper attempts to understand how magico-religious beliefs on twins affect parental investment in child human capital. This is closely related to studies exploring the impact of culture and social norms on intra-household resource allocation. For instance, studying household allocation of food in rural Nepal, Gittelsohn et al. (1997) linked part of the unequal intake of micronutrients and calories to specific food beliefs and practices. In Côte d'Ivoire, Duflo and Udry (2004) documented that social norms not only dictate gender specialization in crop cultivation but also constrain the intra-household allocation of income. Based on an experiment conducted in rural areas in northern Nigeria, Munro et al. (2019) found that polygamy tends to increase men's share of available resources and favours an unequal allocation of resources among wives of polygamous households. More generally, this study also belongs to the literature on cultural determinants of human behaviour and development outcomes (e.g. Alesina et al., 2016; La Ferrara and Milazzo, 2017).

## 3. Background on Benin

*Twins veneration and preferential treatment*

In several parts of Africa twins are venerated and assumed to provide good luck to their parents (Renne, 2001). This study features the case of Benin, a small country in West Africa, well known for its highest rating for religious diversity and lowest for government restrictions on religion (Pew Research Center 2014a; 2014b), and where twins are venerated and worshipped as voodoo deities.[viii] Because of voodoo's resilience during troublesome times and its renaissance within the democratic era, most of the magico-religious beliefs attached to it – including twins veneration- are still vibrant in the country. For instance, Benin is invariably noted for its celebration of twins whenever African twins are mentioned in books or media (Piontelli, 2008) and twins gather together in an annual celebration organized each September in Ouidah (southeastern Benin) by the Benin Twins Association. In fact, the veneration of twins can be traced back to at least the early 18$^{th}$ century, when after the death of king Akaba, his twin sister Hangbe ruled the Dahomey kingdom, although this was not customary for women (Attanasso, 2012). Benin has the highest national twinning rate in the World: 27.9 per 1000 compare to an average of 13.1 per 1000 (Smits and Monden, 2011). Overall, the country provides unique empirical advantages to explore the relationship between magico-religious beliefs about twins and development outcomes.

In Benin, giving birth to twins is considered as a divine blessing and is followed by specific rituals to learn about the twins' destiny and the forbidding which the family must comply with.[ix] Twins are given special names and believed to possess supernatural powers (Leroy et al., 2002). They symbolize ancestors who gave origin to the human race and are said to be able to affect human beings' destiny through their ability to contact the supreme God (Piontelli, 2008). Upon death, twins are represented by wooden statuettes and are involved in elaborate rituals (Leroy et al., 2002). Moreover, magico-religious beliefs about twins often imply preferential treatment of the twins over the other children, but also equal treatment of twins, irrespective of gender (Pector, 2002; Leroy et al., 2002). As a result, twin girls are likely to be discriminated positively and given higher social status compared to singleton

girls; partly explaining the aforementioned very uncommon situation of the Dahomey kingdom being ruled by a woman.[x]

Although the veneration of twins in Benin largely has its roots in voodoo, it is worth noting that higher consideration and preferential treatment given to twins is not solely observed in voodoo affiliated cultures. For instance, twins are also venerated and considered special human beings by the Bariba (the largest non-voodoo ethnic group in Benin); blurring the lines between voodoo and non-voodoo culture on magico-religious beliefs and preferential treatment related to twins. Finally, the veneration of twins in itself might have faded with modernization but the socio-cultural norms and beliefs derived from it seem to persist. Based on the qualitative fieldwork described in endnote vii, approximately 60% of non-twin adults are from families which still venerate twins and 70% of non-twin respondents give money to unknown mothers of twins. Adult twins (53%) report preferential treatment during their childhood in terms of food quality, time spent with parents, etc. Twins veneration also varies across religious affiliation: 84.21% in families that are voodoo adherents; 60.00% among Muslims and 60.82% among Christians.

*Health care and child mortality*

Substantial progress has been made in Benin's health sector over the past few decades with a significant reduction of under-five child mortality: from 160 deaths per 1,000 live births in 2001 to 96 in 2018 (Benin Government, 2018). However, this level is still high (compared for instance to 39 deaths in the World and 69 deaths in Low Income Countries in 2017)[xi] and might be explained inter alia by limited utilization of modern medical facilities (at about 44% in 2008)[xii] and dangerously low full immunization rate at 57% in the country (Benin Government, 2018).

Benin's national strategy regarding immunization features large-scale campaigns (mainly against Polio and measles) with health workers going into houses trying to reach all children, especially those in remote areas. However, a negative side-effect of such a strategy is that instead of taking responsibility for the vaccination of their children (by following-up their immunization schedule and

vaccinating them for free at the health centre), mothers tend to wait for health workers to pass by their house. And this perverse effect may have actually hampered the endeavours towards universal full immunization in the country (Stoop et al., 2019). Altogether and given the relatively high percentage of bed net use,[xiii] full immunization remains the first challenge in child preventive health care in Benin.

## 4. Data[xiv]

In this paper, I pool data from five DHS rounds collected throughout the period 1996-2017 in Benin and use the full immunization of children as a measure of parental investment. The database contains information on 51,070 children born in the five years preceding the survey, living or not in the surveyed households. All variables entering (Eq.1) below are available for 33,111 children from 2,498 DHS clusters. Full immunization is defined (for all children of at least 12 months of age)[xv] as receiving all eight vaccines stipulated in the routine immunization schedule in Benin. Also, DHS records information on single and multiple births, allowing me to link the likelihood for a child to receive full immunization with whether he/she is a twin. I specifically focus on preventive health care in early childhood to deal with the issue of strategic behaviour of children: becoming increasingly aware of their special status as they grow older, twins might be better at manipulating parents to secure higher share of the household resources.

Table 1 provides summary statistics for the key variables: average or proportion, standard deviation, and comparison in mean/proportion between twins and singleton children. The control variables, used in the baseline specification, the robustness checks and the competing explanations are summarized in Table A2 in Appendix. Children in the sample are on average 34.57 months old, with 49.39% being female. About 40.26% receive full immunization and they mostly live in rural areas (63.61%). On average, mothers of children in the sample are 29.61 years of age and have little education (1.56 years of schooling). Out of the 33,111 children in the sample, 1,370 are twins (4.14%), including 787 same-sex twins (2.38%). On average and compared to singleton children, same-sex twins are 7.73 percentage points more likely to receive full immunization. They are also 3.85 percentage

points less likely to live in the poorest household and are born to mothers that are on average 1.63 years older.

## 5. Empirical strategy

The main intuition of this paper is that because of positive (or negative) beliefs about twins, parents may have higher (lower) level of altruism towards twins and/or perceive a higher expected return in investing in their health and education. Note that this perceived return might completely differ from the actual return as it for instance incorporates parents' beliefs that twins will provide them with blessings, wealth and good fortune in their income generating activities (alternatively they will bring misfortune and poverty in the case of negative beliefs).

Twinning is not exogenous as it correlates with maternal characteristics (Smits and Monden, 2011; Bhalotra and Clarke, 2016). But provided controls for some maternal characteristics, twin births can be considered plausibly exogenous (Bhalotra and Clarke, 2016; Alidou and Verpoorten, 2019). In fact, only monozygotic (identical) twin births are considered a random event and can be used to increase the credibility of twin births as an instrumental variable (Farbmacher et al., 2018). As beliefs about twins equally apply to same-sex and opposite-sex twins, Farbmacher et al. (2018)'s correction which consists in affecting a value of -1 to all opposite-sex twins, is not applicable for this study.

To address the issue of non-randomness of twin births, I use the same-sex twin indicator which is less endogenous than the classic twin indicator (Farbmacher et al., 2018), combined with DHS-cluster (which correspond to villages in rural areas and city blocks in urban areas) fixed-effects. For the sake of comparison, I also provide results based on plausible exogeneity of twin births.

The estimated equation is as follows:

$$y_{cmhv} = \alpha_0 + \alpha_1\, Child\ is\ same\_sex\ twin_{\ cmhv} + \varphi_1\, X_{cmhv} + \varphi_2 X_{mhv} + \varphi_3 X_{hv} + \Delta\, \text{Cluster}_v + \Lambda\, \text{DHS}_{\text{year}} + \varepsilon_{cmhv} \quad \text{(Eq.1)}$$

where $c$ indexes children, $m$ mothers, $h$ households and $v$ DHS clusters. $y_{cmhv}$ is a dummy variable capturing the child's full immunization status. The explanatory variable of interest is the dummy variable $Child\ is\ same\_sex\ twin_{cmhv}$ that takes the value one for same-sex twins and zero for singletons.

$X_{cmhv}$, $X_{mhv}$ and $X_{hv}$ are vectors containing child-, mother- and household-level covariates which are likely to influence child full immunization. $X_{cmhv}$ includes: child gender, age (in months) and birth-order[xvi]; $X_{mhv}$ includes the mother's age, education in years of schooling, ethnicity and religion while $X_{hv}$ contains wealth quintiles and residence (urban/rural) of the household. $\text{Cluster}_v$ captures DHS cluster fixed-effects and $\text{DHS}_{\text{year}}$ is the year in which the DHS survey took place ($\text{DHS}_{\text{year}}$). $\alpha_0$ is a constant and $\varepsilon_{cmhv}$ is an error term (clustered at DHS-cluster level). $\alpha_1$ is the coefficient of interest and captures the difference in likelihood of full immunization between twins and singleton children.

## 6. Results

Figure 1 (in Appendix) presents F-tests for joint significance of the regressors from a regression on twin indicators as outcomes and mother-level characteristics (years of schooling, age, age squared, height, ethnicity, religion, total number of her children who have died, a dummy variable capturing whether these children died before their first birthday) together with household-level characteristics (wealth index of the household, access to prenatal health care, access to a doctor and access to a nurse) as regressors. It indicates that mother's ethnicity, age, age squared, height and the dummy variable capturing whether some of her children died before their first birthday, correlate with twin births, but also shows that dependence of the twins' indicators on socioeconomic characteristics is very low across time, particularly for the same-sex twin indicator (F-statistic from 1.72 to 3.19). It is further reassuring that with only mother age, age squared and her educational attainment as regressors, the F-statistic for the same-sex twin indicator ranges from 0.49 to 2.12 (corresponding values are from 7.43 to close to 20 in Farbmacher et al., 2018, p.461) and from 1.79 to 4.56 for the classic twin indicator (corresponding values from 16.29 to over 50).

Table 2 shows the results with the classic twin indicator (Cols. I to III), with the same-sex twin indicator (Cols. IV and V) and the results with the same-sex twin indicator but using an alternative outcome variable (Col. VI). Further tests and competing explanations are presented in Tables 3 and 4. Table 5 explores heterogeneity in the results with respect to various socio-demographic characteristics.

*Main results*

The OLS results with the classic twin indicator (Cols. I of Table 2) indicate that compared to singleton children, twins are 7.6 percentage points more likely to receive full immunization (significant at 1%). Accounting for DHS-cluster fixed-effects more than doubles the R-squared (from 0.105 in Col. I to 0.271 in Col. II), suggesting that the DHS-cluster fixed-effects explain a large amount of variability in children full immunization; and the estimated coefficient drops to 0.063 (significant at 1%). Non-significance of the estimated coefficient in Col. III (0.040) is due to insufficient power in the Household fixed-effects estimation.[xvii]

While using the same-sex twin indicator combined with the DHS-cluster fixed-effect (Col. IV), the difference between twins and singletons which is hereafter referred to as the *twins preferential treatment*, is estimated at 5.4 percentage points and remains significant at 5% (baseline results; *all results from here onward are based on the same-sex twin indicator*). This sizeable effect corresponds to almost three times the effect of gender on children immunization in India (found to be of 1.9 percentage points by Barcellos et al., 2014). It is also equivalent to more than two-fifths of the effect of a once monthly reliable immunization camp on complete immunization among children aged 1-3 in rural India (estimated at 13 percentage points by Banerjee et al., 2010); and to the effect of an additional 7.7 years of education of the mother. As expected, household wealth index, mother's schooling and her religion are other significant determinants of child full immunization (reported in Table A3 in Appendix). For instance, children who live in wealthy households, of more educated and of non-voodoo adherent mothers are more likely to complete the routine immunization schedule in Benin.

*Robustness checks*

To safeguard the main results, I performed ten robustness tests that can be grouped in three sets of checks. In a first set of checks, I moved from the baseline parsimonious specification to a more inclusive specification by including a set of additional control variables. I also use the number of type of vaccines received as an alternative outcome variable in Eq. 1. The second set is made of "consistency" or external validity tests. As Benin shares similar voodoo-rooted beliefs and twin

veneration with Nigeria, Togo and Ghana, I replicate the baseline analysis on a dataset expanded to these three countries.[xviii] Furthermore, I explored whether twins are worse-off in societies in which they are considered a curse and treated similarly to singletons in cultures where they are not given special status or consideration. To increase the relevance of such tests, I used countries that are similar enough to Benin in terms of development outcomes (HDI of 0.515 in 2017) while geographically far away to exclude potential religious/beliefs assimilation: Madagascar (with an HDI of 0.519 in 2017 and where twins are considered a curse in Vatovavy-Fitovinany region) and Senegal (with a HDI of 0.505 in 2017 and where no special treatment of twins is documented in any of the important ethnic groups).[xix] In a third set of tests, I used other outcome variables to capture parental investment in child health such as the use of bed net,[xx] nutrition (type of food in child diet) and the likelihood for a child to be taken to modern medicine facilities upon fever/cough or diarrhoea; but also child BMI and education of school-age children.

Further controlling for observed variables (the number of under five years old children living in the household, mother's characteristics which correlate with probability of twinning, father's age and education) actually increases the estimated coefficient and the R-squared (respectively from 0.054** and 0.271 in Col. IV to 0.075*** and 0.284 in Col. V, Table 2). Moreover, while considering the number of types of vaccine received by the child (out of the eight needed for full immunization), twins enjoy on average 0.389*** more types of vaccine compared to singletons (Col. VI, Table 2).

The second set of checks also consolidates the main results: the estimated *twins preferential treatment* is estimated at 5.7 percentage points and significant at 1% when including data from Nigeria, Togo and Ghana[xxi] (detailed results in Panel A of Table A4 in Appendix), whereas I find an adverse twin treatment (-31.6 percentage points) in the Vatovavy-Fitovinany region of Madagascar (Panel B of Table A4) and no twins differential treatment in Senegal (Panel C of Table A4), except for ethnic groups for which such a custom is referenced (namely Mandingue, Dioula and Soninke, which represent about 13% of the observations).

In the last set of checks, I found no significant difference between twins and singletons in food variety, in the likelihood to be taken to modern medicine facilities upon fever/cough or diarrhoea, and in education z-score of school-age children (respectively Cols. II, IV, V and VII of Table 3). Compared to singletons, twins also have a lower BMI (Col. VI). Conversely, I found a *twins preferential treatment* in the use of bed nets and in the presence of fruit in the child's diet, as shown in Cols. I and III of Table 3.

*Competing explanations*

The first threat to the identification of the twins effect relates to attrition/truncation; as only children that have reached their first birthday, and are living in the household, are included in the analytical sample. Results in Table A5 (in Appendix) show that attrition is significantly higher for twins, but also indicate a positive selection in the analytical sample: children who are predicted to be fully-immunized are more likely to be observed. Indeed, attrition negatively correlates with wealth quintile which positively affects full-immunization (Table A3 in Appendix). Therefore, the true estimate of the *twins preferential treatment* is closer to Horowitz and Manski (2000)' upper bound (0.111***) than to the lower bound (-0.030**).[xxii] Further, the use of Inverse Probability Weighting to adjust for sample selection in the baseline results yields an estimated coefficient of 0.057**.

A plausible explanation of *twins preferential treatment* is that parents invest more in twins health to compensate for their poorer health conditions at birth in order to mitigate potential adverse consequences on health or cognitive achievements (Rosenzweig and Zhang, 2009). I checked whether my findings pick up such a compensating behaviour by including child birth size[xxiii] in the baseline specification. The coefficient of interest remains stable and significant (Col. II of Table 4).

As close birth spacing (the birth interval is zero between twins) allows for economies of scale in various items such as clothing, food, transport cost, etc. Hence, the marginal cost of raising a child might be lower for twins compared to that of singletons. One explanation for *twins preferential treatment* could be that gains from these economies of scale are reinvested in twins' health. Besides, close birth

space implies the greater possibility of spreading diseases between children; providing an additional reason for parents to guarantee higher immunization coverage to twins. To rule out these explanations, I added preceding birth interval (in months) to the bunch of controls in (Eq.1). The *twins preferential treatment* actually increases to 6.5 percentage points (Col. III of Table 4); the same variation occurs while including preceding birth interval together with child birth size (Col. IV of Table 4).

Finally, because the mechanical effect of two children receiving the vaccines at the same time (in the case of twins) could induce an upward bias in the estimate, I randomly select only one same-sex twin by twins' mother. The resulting coefficient estimate is 0.058** (Col. V of Table 4).

Other competing explanations such as different immunization rates across ethnicities, selection on the marriage market and early health shocks are discussed in Appendix.

*Heterogeneity*

I explored heterogeneity in the results with respect to some child characteristics (gender), mother's characteristics (ethnicity, religion and education) and household characteristics (poverty status and residence area). First and with respect to gender, I included an interaction term $Child\ is\ same\_sex\ twin_{cmhv} * Child\ is\ Female_{cmhv}$ in (Eq.1) to check whether the *twins preferential treatment* equally applies to girls and boys. Second and with respect to ethnicity, I interacted $Child\ is\ same\_sex\ twin_{mhv}$ with $Mother\ is\ of\ voodoo\ ethnicity_{mhv}$ to check if despite similar beliefs related to twins in non-voodoo ethnicities, *twins preferential treatment* is higher in voodoo related ethnicities. Third and with respect to religion, I interacted $Child\ is$ same_sex $twin_{cmhv}$ with mother's voodoo adherence to investigate whether the lesser uptake of preventive health measures among mothers that are voodoo-adherent (Stoop et al., 2019) also applies to twins. Fourth, as moving from poorest to richest wealth quintile increases by 12.1 percentage points the likelihood of getting full immunization, I compared the *twins preferential treatment* across 'poor' and 'non-poor' households. To do so, I defined the 4$^{th}$ and the 5$^{th}$ quintiles of asset ownership quintiles as non-poor households and then introduced an interaction term $Child\ is$ same_sex $twin_{cmhv} * Child\ lives\ in\ non -$

$poor\ household_{mhv}$ in (Eq.1). Finally, if beliefs and social norms about twins stem from a lack of knowledge about human reproduction and/or are no longer useful in dynamic and modern societies, it is very likely that the *twins preferential treatment* will wane with urbanization and education. Hence, I respectively interacted the twin dummy variable with the residence area of the household (urban/rural) and with mother education.

Based on the results summarized in Table 5, there is no evidence of heterogeneity in the estimated *twins preferential treatment* across girls and boys (Col. I); which is consistent with equal treatment of twins irrespective of gender (Pector, 2002; Leroy et al., 2002). As explained in section 3, twins veneration and higher consideration in voodoo ethnicities are also found in non-voodoo ethnicities; hence the homogeneity of twins preferential treatment across the two groups in Col. II.[xxiv] In Col. III, similar *twins preferential treatment* across voodoo adherents and non-voodoo adherents[xxv] likely stems from the high level of syncretism among non-voodoo adherents, with twins also being venerated/highly considered among Muslims and Christians (see last paragraph of section 3). Finally, *twins preferential treatment* is similar across poor and non-poor (Col. IV) and is not reduced with urbanization or education (Cols. V and VI).

## 7. Discussion

Based on the full immunization of children under five years of age, I have established that twins enjoy a higher level of preventive health care compared to singleton children. After ruling out various competing explanations and consistently with the narratives from my fieldwork,[xxvi] beliefs about twins emerges as a very plausible explanation for this *twins preferential treatment*. In this section, I try to uncover the mechanisms behind it. To start with, it is important to recall three things: (i) all eight vaccines stipulated in the routine immunization schedules in Benin are free; (ii) all children encountered by the health workers during the vaccination campaigns (mainly against Polio and measles, leaving other vaccines to be administrated in health centres) are systematically vaccinated; and (iii) families incur transaction costs (transport cost and opportunity cost of time spent at the health facility) to vaccinate

children at the health centre. Moreover, twins are as likely as singletons to be taken to modern medicine facilities upon illness (Cols. IV and V Table 3), considerably reducing the likelihood that higher exposure to medical checks by health workers is driving the results. Consequently, the higher likelihood of twins receiving full immunization most probably stems from closer monitoring and follow-up of the immunization schedule, combined with a higher willingness to bear the transaction costs of vaccination at the health facility. With this in hand, I investigated – in particular for resource-constrained households which are more likely to be overwhelmed by the cost of children – how higher investment (both transaction costs and closer monitoring of the immunization schedule) in twins preventive health care is covered for.

*Family support*

To tentatively test for the family support channel (any kind of help received from the extended family), I added the number of adults living in the household to (Eq. 1); but this inclusion has no effect on the coefficient of interest. In fact, the number of adults living in the household does not affect the full immunization of children; even in the subsample of poor households (Table A9 in Appendix). Also, as the DHS data does not provide information on transfers (in money or in kind) between households (which would allow an in-depth quantitative exploration), I hereafter rely on my fieldwork conducted in southern Benin to gain some qualitative insights into the role of the extended family.

It clearly emerges from the interviews that parents enjoy support upon the birth of twins: *"Relatives and neighbours help to take care of twins" [Focus group Issaba]; "Sisters and sisters-in-law often assist the family to take care of twins" [Focus group Malanhoui]; "However poor the parents of twins are, there will always be assistance from the extended family, neighbours or benevolent people to fulfil the basic needs of the twins" [Focus group Za Tanta];*. And this is not a surprise in itself, given that in most African cultures, family members are bound to act for the benefit of the collective, be it the nuclear family or the extended family, the clan or ethnic

group (Lloyd and Blanc, 1996). For instance, regarding the decision to invest in child schooling, this implies that the benefits of schooling are expected to be shared (Baland et al., 2016).

Believed to have supernatural powers, twins are honoured in special ceremonies and rituals upon birth. Very importantly, *"these rituals aim to transfer the twins' spirit from the invisible world to the visible one so that they feel welcome in the extended family" [Focus group Azove]*. And it appears that *"no choice is left other than complying with these traditions/prescriptions and give preferential treatment to twins" [Focus-group Za-Tanta]*. Furthermore, the beliefs that twins bring good fortune and happiness is found in some Yoruba songs in praise of twins (Leroy et al., 2002, p.135): *"…They made the poor rich, they clothed those who were naked. Majestic and beautiful looking twins, natives of Ishokun, let me find means of eating, let me find means of drinking…"* and were mentioned in all focus-groups during the fieldwork. Hence, for the extended family, participating in twins' feeding and care might be driven by the following motives: (i) to honour the twins to fulfil beliefs and related traditions and (ii) to share in the luck and blessings that twins are believed to bring in the family. It might also be a way of reducing the financial and chores burden on the parents and thereby strengthen family ties. Actually, these motives give way to two potential interpretations of the *twins preferential treatment* that do not necessarily oppose each other. The first interpretation is that of parents and extended family behaving according to firmly rooted beliefs related to twins as described in the background section while the second interpretation features expected utility maximization and cost-benefit calculus, which resonate well with Becker's (2013) economic approach.

Beside family support, I also tentatively explored other mechanisms through which parents might access resources to cover for the transaction costs of vaccination at the health centre: resource diversion from singleton children, increase in parental labour supply and reallocation of resources from parents to twins. But I found no evidence of either channel (results reported in Tables A10 to A12 in Appendix).

*Twins preferential treatment: making sense of the seemingly irrational?*

Unlike other parental discrimination strategies based on child endowments and prospects, the *twins preferential treatment* as it survives various rationale competing explanations, might appear as a behavioural anomaly (Thaler, 1988) which is not yet well explained (Burnham, 2013). As it relates *twins preferential treatment* to magico-religious beliefs rooted in African Traditional Religion, this paper steps beyond the explanation of customs and social norms. However, in an economic determinism perspective, it is arguable that the beliefs concerning twins themselves stem from a lack of knowledge of human reproduction, and that related social norms and customs which are useful in relatively stationary societies, would disappear or at least fade with dynamic growth and modernization (Becker and Stigler, 1974). However, I did not find evidence of a reduced *twins preferential treatment* with either urbanization or education (as reported in Cols. V and VI of Table 5. A formal test of the beliefs channel is provided in Table A13 in Appendix, based on the prior that the *twins preferential treatment* would be higher among mothers believing in supernatural powers. The test exploits a proxy of such beliefs provided in the DHS survey in the form of the question whether "HIV can be transmitted by witchcraft or supernatural means". The non-significance of the interaction term in Col. II may cast doubt on the beliefs channel; but alternatively, it might be interpreted as an indication of strong social norms in favour of twins in the group of parents no longer believing in their alleged supernatural powers.

According to Becker (2013), all human behaviour can be scrutinized using an economic approach which he describes as a valuable unified framework enriched with non-economic variables and inputs from other fields and disciplines. In this approach, irrationality, values, customs and social norms are seen as 'tempting but useless explanations' for human behaviour as they actually reflect little grasp of the pleasure-pain calculus (in other words a cost-benefit analysis) which govern all human actions, thoughts and behaviour. Applied to twins, the economic approach might imply that parents and extended family give preferential treatment to twins to secure and maximize rewards in the form of

luck/good fortune, prestige and consideration of the community[xxvii] as expressed by participants in the fieldwork : *"When parents take good care of twins, they are in turn blessed with fortune and prosperity. For instance, all my business have been flourishing since the birth of my twins; and there are many similar cases. Therefore, I take special care of them to keep this trend going" [Focus-group Azove].*[xxviii]

Preferential treatment of twins might also be a way of dealing with loss aversion (given uncertainty of the good fortune to actually materialize) and with the punishment that might arise from twins not being well treated. For instance, *"Twins are deities and must be treated with special attention and care, otherwise the family might encounter misfortune and curse" [Focus-groups in Azove, Issaba, Malanhoui and Za-Tanta]*. Moreover, results in Col. III of Table 5 show that twins enjoy higher level of full immunization irrespective of mother's religious affiliation. Given that uptake of child preventive health care is significantly lower among mothers that are voodoo adherent (Stoop et al., 2019)[xxix], these findings suggest that when it comes to twins, modern medicine might be used as a complement to traditional medicine by voodoo adherents.

Overall, as one or the other interpretation of the *twins preferential treatment* could not be completely ruled out, it is likely that they are both (at least partly) in play and even fuel each other, further promoting the idea that parents' decisions to invest in child human capital are based on various and complex stakes (Li et al., 2010). However, the important question of the origin of beliefs about twins is left unanswered in the above tentative explanation/interpretation of *twins preferential treatment*. The persistence of these beliefs among educated and urbanized populations also calls for an in-depth exploration of which specific social or rent-seeking purpose they still serve (Leeson, 2017).

In trying to grasp the overall consistency of beliefs about twins, I conjecture that some core aspects to be considered are availability of resources, population size and twinning rate in pre-industrial societies. As a support to the materialistic explanation of these beliefs, some studies based on pre-industrial ethnographic data already provide evidence of twin infanticide being practised in societies where mothers have a heavy workload and minimal amount of help (Granzberg, 1973); where low-

viability infants are killed (Ball and Hill, 1996); and where population is regulated (Daly and Wilson, 1984). However, to the extent that these findings are mere correlations, further research is needed on the origins of beliefs about twins. An exploration of mechanisms such as positive (negative) selection of mothers with a tendency towards twin deliveries in favourable (non) conditions in pre-industrial societies (Lummaa et al., 2001) is also required for a better understanding of particularly high twinning rates in West and Central Africa.

## 8. Conclusion

The central point of this paper was to stress the importance of magico-religious beliefs as a determinant of parental investment in child human capital and of early childhood inequalities, in the context of developing countries. As a telling example, it investigates the impact of magico-religious beliefs related to twins on child full immunization.

Based on an econometrical analysis enriched with some qualitative insights, and using five DHS rounds from Benin, I found a *twins preferential treatment* in parental investment in child health. In speculating on the motives for this *twins preferential treatment*, I discuss an interpretation based on beliefs which aligns with behavioural economics, and another based on rational cost-benefit calculus in the spirit of Becker (2013)'s economic approach of human behaviour.

Although this paper features a case of magico-religious belief with a positive impact on child health, other beliefs (e.g. beliefs related to children born to women who died during or shortly after delivery and to children with birth defects) might actually be harmful, and in some extreme cases be life-threatening to children.

By linking magico-religious beliefs to parental investment in child human capital and to intra-household resource allocation, this paper aims to be a complement to the mainstream economic literature on these topics. It also further confirms that to improve uptake of preventive health care in Sub-Saharan Africa, more attention should be paid to belief systems and their impact on parental investment in child health. Nevertheless, the *twins preferential treatment* discussed in this paper needs to

be further analysed, for instance using detailed consumption data. Further research is also needed on the origins of beliefs about twins, and to understand why twinning rates are so high in West and Central Africa.

[i] Yoruba is an ethnic group spread across southern Benin and southern-east Nigeria; it also belongs to the group of ethnicities that historically practice Voodoo.

[ii] *'The Cursed Twins of Madagascar'*: https://www.huffingtonpost.co.uk/kiki-king/unreported-world-twins-in-madagascar_b_5293247.html. Last consultation on 28/09/2018.

[iii] Although their impact is particularly severe in middle- and low income countries, birth defects are a global problem: every year an estimated 7.9 million children—6 percent of total births worldwide—are born with a serious birth defect of genetic or partially genetic origin and additional hundreds of thousands more are born with serious birth defects of post-conception origin (Christianson et al., 2005).

[iv] '*I was told to kill my disabled baby*' : https://www.bbc.com/news/world-africa-45670750. Last consultation on 28/09/2018.

[v] A baby girl born in India with a 'trunk-like' protrusion between her eyes is being worshipped by locals who believe she is the reincarnation of the Hindu god Ganesha. https://www.dailymail.co.uk/news/article-3017497/Baby-girl-born-India-trunk-worshipped-locals-believe-reincarnation-Hindu-god-Ganesha.html. Last consultation on 28/09/2018.

[vi] Still, to provide external validity of my findings, the same analysis is conducted on a dataset expanded to neighboring countries which share in similar twins veneration (Nigeria, Togo and Ghana) and also in Madagascar and Senegal (see robustness checks section).

[vii] I undertook qualitative fieldwork in the most populated urban and rural localities in each of the five Benin southern departments in June 2018 to collect data on beliefs and social norms related to twins. Because of low frequency of twin births, random sampling would have resulted in investigating very few twins. Hence, the use of snowball sampling (only for this qualitative fieldwork) with a list of 50 adult twins provided by the Benin Twins Association as entry point. More details are provided in Appendix (section 1. Description of the analytical sample).

[viii] The Voodoo is an African Traditional Religion which originates from Benin. A description of the origin and characteristics of ATR and voodoo is provided in Alidou and Verpoorten (2019).

[ix] Narratives from the fieldwork.

[x] Based on an in-depth analysis of succession patterns in Dahomey kingdom, Bay (2012) argues that Hangbe actually managed to win the power struggle in the ruling monarchy upon death of her twin brother Akaba. She nuances this view, suggesting that Hangbe being a twin has been used as an ex-post explanation for her reign in a patriarchal society. But even in that case, the situation illustrates the importance of twins beliefs in Dahomey kingdom.

[xi] WHO, https://www.who.int/gho/child_health/mortality/mortality_under_five_text/en/. Last consultation on 28/09/2018.

[xii] Benin Government 2009, Plan National de Développement Sanitaire 2009-2018.

[xiii] 85% of households own a bednet treated with insecticide and 80% of under five children living in these households sleep under the bednet (Benin Government 2018, EDSB 2017-2018).

[xiv] I provide more details on the analytical sample in Appendix. I also explain why I specifically focus on preventive health care in early childhood.

[xv] This definition implicitly assumes that parents have up to their child's fifth birthday to complete the routine immunization schedule while this should be done by the child's first birthday.

[xvi] Birth order is an endogenous control as it is affected by twin birth. However, provided plausible exogeneity of twin birth and some additional exogeneity conditions described in Lechner (2008, pp.6-9), it can be added to the regression

without biasing the coefficients. The same token justifies the use of other potentially endogenous controls in Col. (IV) of Table 2.

[xvii] There is on average 1.39 observations per household in the analytical sample which is significantly below the recommended 5 observations to have sufficient power in fixed-effects estimation (Hox, 2010). But as explained in the first competing explanation, the true estimate is closer to the Horowitz and Manski (2000)' upper bounds which in this case is estimated at 0.137*** (the number of observations per household increases after the imputation of missing observations).

[xviii] Since some ethnic groups in Nigeria (e.g. the Igbo) consider twins as a curse, I do not use this set of countries for the baseline analysis.

[xix] Data on HDI are from UNDP (2018).

[xx] Except for DHS 2006, the use of bednet is measured at mother level and not at child level, so much less in line with the focus of this paper which is on resource allocation among children.

[xxi] The estimated *twins preferential treatment* is of 5.8*** percentage points when only considering Nigeria, Togo and Ghana.

[xxii] When the outcome variable is a binary as it is here, the idea is to impute the missing data with either the largest or the smallest possible values to compute the largest and smallest possible treatment effects. Unlike parametric approaches to correcting for sample selection bias, Horowitz and Manski (2000)' bounds rest on very few assumptions. They are preferred here to Lee (2009)' bounds which fit best to continuous outcome variables.

[xxiii] Child birth size is a variable in the DHS with the following modalities: very small, smaller than average, average, larger than average and very large.

[xxiv] This also motivates why I do not interact $Child\ is\ Twin_{mhv}$ with $Mother\ is\ of\ voodoo\ ethnicity_{mhv}$ in my baseline specification, as for instance in Alidou and Verpoorten (2019).

[xxv] I replicate Stoop et al. (2019)'s findings of lower uptake of preventive health care among mothers that are voodoo adherent (-0.034***) but the interaction term $Child\ is\ Twin_{mhv} * Mother\ is\ voodoo\ adherent_{mhv}$ is not significant.

[xxvi] *"As we believe twins to be special human beings capable of harnessing supernatural powers in an ambivalent way, we obviously treat them differently compared to singletons children" [Focus-groups in Azove, Issaba, Malanhoui and Za-Tanta].*

[xxvii] *"Parents of twins are given special names (Hoho non, Hoho to, Iya beiji…) and enjoy respect and consideration in their community. [Focus-groups in Azove, Issaba, Malanhoui and Za-Tanta]".*

[xxviii] Similar quotes: *"My life has greatly changed with the twins. I am now much happier and successful in my activities" [Focus-group Issaba]. "My husband and I are treated with more respect and consideration in the extended family and the community since the birth of our twins. In polygamous households, mothers of twins are given more attention and consideration relatively to other co-spouses" [Focus-group Malanhoui].*

[xxix] Stoop et al. (2019) explain their findings by stronger reliance on traditional medicine among mothers that are voodoo adherent.

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## Tables

*Table 1. Sample means and proportions of key variables*

| Variables | Mean/ Proportion | St.Dev | Child is Twin | Child is same-sex twin | Child is singleton | Difference |
|---|---|---|---|---|---|---|
| | | | (I) | (II) | (III) | (II)-(III) |
| Child is fully immunized | 40.26 | - | 48.10 | 47.65 | 39.92 | 7.73*** |
| Child is twin | 4.14 | - | - | | - | - |
| Child is same-sex twin | 2.38 | - | - | | - | - |
| Child's age (months) | 34.57 | 13.86 | 34.59 | 34.88 | 34.57 | 0.31 |
| Child is female | 49.39 | - | 49.71 | 48.53 | 49.37 | -0.84 |
| Mother's age | 29.61 | 6.51 | 31.28 | 31.16 | 29.53 | 1.63 *** |
| Mother's education (completed years of education) | 1.56 | 3.14 | 1.67 | 1.61 | 1.55 | 0.06 |
| Residence area (lives in rural area) | 63.61 | - | 65.62 | 64.68 | 63.52 | 1.16 |
| Household's wealth quintile | | | | | | |
| *Poorest* | *23.42* | - | *20.51* | *19.70* | *23.55* | *-3.85*** |
| *Poorer* | *20.68* | - | *21.31* | *22.36* | *20.65* | *1.71* |
| *Average* | *20.69* | - | *21.17* | *22.11* | *20.67* | *1.44* |
| *Richer* | *19.13* | - | *19.56* | *18.55* | *19.11* | *-0.56* |
| *Richest* | *16.07* | - | *17.44* | *17.28* | *16.01* | *1.27* |
| **Number of observations** | **33,111** | | **1,370** | **787** | **31,741** | |

*Source: Authors, based on data from 5 DHS rounds collected throughout the period 1996-2017 in Benin.*

*Table 2. Twins preferential treatment in children full immunization*

| | DEPENDENT VARIABLE : FULL IMMUNIZATION | | | | | |
|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) |
| Twins indicator | 0.076*** | 0.063*** | 0.040 | 0.054** | 0.075*** | 0.389*** |
| | (0.017) | (0.018) | (0.059) | (0.024) | (0.026) | (0.117) |
| *Classis twin indicator* | *YES* | *YES* | *YES* | *NO* | *NO* | *NO* |
| *Same-sex twin indicator* | *NO* | NO | NO | *YES* | *YES* | *YES* |
| *Control variables as in Eq.* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *With DHS-cluster FE* | *NO* | *YES* | *NO* | *YES* | *YES* | *YES* |
| *With Household FE* | *NO* | *NO* | *YES* | *NO* | *NO* | *NO* |
| *With DHS-cluster FE + additional controls variables* | *NO* | *NO* | *NO* | *NO* | *YES* | *NO* |
| *Alternative outcome variable : number of types of vaccines received* | *NO* | *NO* | *NO* | *NO* | *NO* | *YES* |
| *Clusters* | *2,498* | *2,498* | *2,498* | *2,498* | *2,489* | *2,488* |
| *Observations* | *33,111* | *33,111* | *33,111* | *32,528* | *28,741* | *27,726* |
| *R-squared* | *0.105* | *0.271* | *0,833* | *0.271* | *0.284* | *0.336* |
| *Adj. R-squared* | *0.105* | *0.209* | *0,404* | *0.208* | *0.213* | *0.268* |

*** p<0.01, ** p<0.05, * p<0.1

*Note.— The sample includes children under five years of age. Classic twin indicator is used in Cols. I to III and the same-sex twin indicator is used from Col. IV onward and in all the remaining analysis. Control variables include child level characteristics (sex, age in months and birth order); mother -level characteristics (age, education, religion and ethnicity), household-level characteristics (urban/rural residence, wealth quintile), and indicator variables for the administrative region of residence of the household and for the year in which the DHS survey took place. Additional controls comprise the number of under-fives living in the household, age squared, a dummy variable capturing whether some children of her died before their first birthday, father's age and education, and access to a nurse, to a doctor and to prenatal health care in the DHS-cluster of residence. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table 3. Twins preferential treatment in other dimensions of child human capital*

| | TWIN PREFERENTIAL TREATMENT | | | | | | |
|---|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) |
| | Use of bednet | Food variety | Fruits in child diet | Modern medicine facility for cough/fever | Modern medicine facility for diarrhea | Child BMI | Education z-score |
| Child is same-sex twin | 0.035** | 0.012 | 0.059** | 0.033 | 0.042 | -0.249** | 0.001 |
| | (0.018) | (0.082) | (0.029) | (0.045) | (0.074) | (0.101) | (0.039) |
| *With DHS-cluster FE* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *Control variables as in Eq.1* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *Clusters* | *2,493* | *2,029* | *2,029* | *2,124* | *1,647* | *1,973* | *1,929* |
| *Observations* | *28,367* | *19,074* | *19,074* | *10,004* | *4,435* | *17,132* | *30,504* |
| *R-squared* | *0.437* | *0.333* | *0.300* | *0.382* | *0.484* | *0.272* | *0.528* |
| *Adj. R-squared* | *0,383* | *0.249* | *0,213* | *0,207* | *0,151* | *0,172* | *0,495* |

*** p<0.01, ** p<0.05, * p<0.1

*Note.— The sample includes: mothers of children under five years of age in Col. (I); children aged 9 to 60 months in Cols (II) and (III); and under-fives who have suffered from cough/fever or diarrhea respectively in Cols. (IV) and (V). Food variety is constructed by summing-up dummy variables capturing whether the child has animal protein, plant protein, vegetables and fruits in their diet. It is defined for children of minimum 9 months of age as exclusive breastfeeding is recommended up to 6 months by World Health Organization. Child BMI is measured in standard deviation from the average BMI value for its age group and sex and child birth weight is included in the controls in Col. (VI). Education z-scores are also age specific. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table 4. Competing explanations: birth size and birth spacing.*

| | **DEPENDENT VARIABLE : FULL IMMUNIZATION** | | | | |
|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) |
| Child is same-sex twin | 0.052** | 0.052** | 0.065*** | 0.065*** | 0.058** |
| | (0.025) | (0.025) | (0.025) | (0.025) | (0.025) |
| Birth size *(Very large)* | | - | | - | |
| *Larger than average* | | 0.004 | | 0.005 | |
| | | (0.013) | | (0.013) | |
| *Average* | | 0.005 | | 0.006 | |
| | | (0.012) | | (0.012) | |
| *Smaller than average* | | 0.015 | | 0.016 | |
| | | (0.016) | | (0.016) | |
| *Very small* | | -0.034 | | -0.034 | |
| | | (0.023) | | (0.023) | |
| Preceding birth interval | | | 0.001*** | 0.001*** | |
| | | | (0.000) | (0.000) | |
| *DHS-cluster FE* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *Controls as in Eq.1* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *Clusters* | *2,481* | *2,481* | *2,481* | *2,481* | *2,498* |
| *Observations* | *24,894* | *24,894* | *24,894* | *24,894* | *32,117* |
| *R-squared* | *0.292* | *0.293* | *0.293* | *0.293* | *0.271* |
| *Adj. R-squared* | *0.211* | *0.211* | *0.212* | *0.212* | *0.207* |

*** p<0.01, ** p<0.05, * p<0.1

*Note.— To allow for a meaningful comparison, the sample includes under-fives whose birth size and preceding birth interval are available, except in Col. (V) where by household, only one twin is randomly selected among same-sex twins in the initial sample. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table 5. Heterogeneity in the twins preferential treatment*

| | DEPENDENT VARIABLE : FULL IMMUNIZATION | | | | | |
|---|---|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) | (V) | (VI) |
| Child is same-sex twin | 0.068** | 0.055** | 0.057 | 0.061** | 0.023 | 0.059** |
| | (0.031) | (0.025) | (0.046) | (0.029) | (0.044) | (0.027) |
| Child is same-sex twin * Child is Female | -0.027 | | | | | |
| | (0.047) | | | | | |
| Child is same-sex twin * Mother is of voodoo ethnicity | | -0.001 | | | | |
| | | (0.054) | | | | |
| Child is same-sex twin * Mother is voodoo adherent | | | -0.007 | | | |
| | | | (0.068) | | | |
| Child is same-sex twin * Child lives in non-poor household | | | | -0.016 | | |
| | | | | (0.050) | | |
| Child is same-sex twin * Child lives in rural household | | | | | 0.048 | |
| | | | | | (0.052) | |
| Child is same-sex twin * Mother education | | | | | | -0.003 |
| | | | | | | (0.008) |
| *With DHS-cluster FE* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *Controls as in Eq.1* | *YES* | *YES* | *YES* | *YES* | *YES* | *YES* |
| *Clusters* | *2,498* | *2,498* | *2,498* | *2,498* | *2,498* | *2,498* |
| *Observations* | *32,528* | *32,528* | *32,528* | *32,528* | *32,528* | *32,528* |
| *R-squared* | *0.271* | *0.271* | *0.269* | *0.270* | *0.271* | *0.271* |
| *Adj. R-squared* | *0.208* | *0.208* | *0.207* | *0.207* | *0.208* | *0.208* |

*** p<0.01, ** p<0.05, * p<0.1

*Note.— The sample includes under-fives. In Col. IV, I consider 4th and the 5th asset ownership quintiles as non-poor households. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

## Appendix

### 1. Description of the sample

Detailed data on parental investment in their offspring's human capital together with information on magico-religious beliefs is very rare, hence the difficulty to study the relationship between the two. In this paper, I pool together data from five DHS rounds collected throughout the period 1996-2017 in Benin and use the full immunization of children as a measure of parental investment. The database contains information on 51,070 children born in the five years preceding the survey, living or not in the surveyed households. Out of the 51,070 children under five years of age, 3,906 have passed away; 1,296 do not live in the household at the moment of the survey; and 10,919 have not yet reached their first birthday at the time of the survey. All variables entering (Eq.1) below are available for 33,111 children from 23,767 households (including 34.13% of polygamous ones) living in 2,498 DHS clusters. In the DHS, there is a specific variable indicating whether a child is part of a twinship or not. The classic twin indicator takes value 1 for each child of multiple births. Twins are born to 778 households, 770 (resp. 420) of which have at least two (resp. at least three) children under five at the time of the survey. Sample means and proportions of key variables at household level are reported in Table A1.

Full immunization is defined (for all children of at least 12 months of age) as receiving all eight vaccines stipulated in the routine immunization schedule in Benin: a dose of Bacillus Calmette-Guerin (BCG) vaccine at birth (or as soon as possible); three doses of diphtheria, pertussis and tetanus (DPT) vaccine at 6, 10 and 14 weeks after birth; at least three doses of Oral Polio Vaccine (OPV) at birth and at 6, 10 and 14 weeks after birth; and one dose of measles vaccine 9 months after birth. This definition implicitly assumes that parents have up to the child's fifth birthday to complete the routine immunization schedule, whereas this should actually be done by the child's first birthday. Also, DHS

records information on single and multiple births, allowing me to link the likelihood for a child to get full immunization with whether he/she is a twin.

I specifically focus on preventive health care in early childhood to deal with the issue of strategic behaviour of children. Indeed, becoming increasingly aware of their special status as they grow older, twins might be better at pressuring parents to secure a higher share of the household resources and enjoy less strict education/discipline (in the form of less regular school attendance, parental tolerance of mediocre school performance, fewer household chores, etc.). Moreover, any difference in educational outcomes (available in the DHS) between twins and singletons might also capture the psychological effect of being considered a special child, as well as parental reinforcing behaviour in educational investment (not available in the DHS); hence considerably reducing my ability to attribute it to beliefs about twins. In any case, I find no significant difference in age-standardized education z-score (based on completed years of schooling) between twins and singletons of school age (Col. VII of Table 3).

Finally, the study also exploits results from qualitative fieldwork undertaken in the most populated urban and rural localities in each of the five Benin southern departments in June 2018 to collect data on beliefs and social norms related to twins. Because of low frequency of twin births, random sampling would have resulted in investigating very few twins. Hence, the use of snowball sampling (only for the qualitative fieldwork) with a list of 50 adult twins provided by the Benin Twins Association as an entry point. Approximately 500 twins and 500 singleton adults were interviewed based on a semi-structured questionnaire. Singletons were randomly selected among individuals of the same sex, of the same age group and living in the immediate neighbourhood of each interviewed twin. In addition, 4 focus-groups (with about 10 mothers and caregivers each) were conducted with mothers and caregivers.

## 2. Other competing explanations

Table A6 below shows the results of a regression of the probability of same-sex twinning on mother-level characteristics such as her age, age squared, years of schooling, height, ethnicity, religion, the total number of her children who have died, and a dummy variable capturing whether these children died before their first birthday. I also control for wealth index of the household, access to prenatal health care, access to a doctor and access to a nurse. Out of these variables, mother ethnicity, age, age squared and the dummy variable capturing whether these children died before their first birthday significantly affect the probability of twinning; some of them are directly included in the baseline specification and all of them are accounted for in Col. IV of Table 2.

As child full immunization is significantly lower in some ethnic groups, the twin preferential treatment might simply reflect relatively higher child immunization rate in some ethnicities. In such a case, the estimated *twins preferential treatment* would be biased as significant heterogeneity would be observed across ethnicities. Results in Table 5 (Col. II) and Table A7 rule out this possible explanation, all coefficients on interaction terms $Child\ is\ same\_sex\ twin_{cmhv} *$ with ethnicity dummies being non-significant.

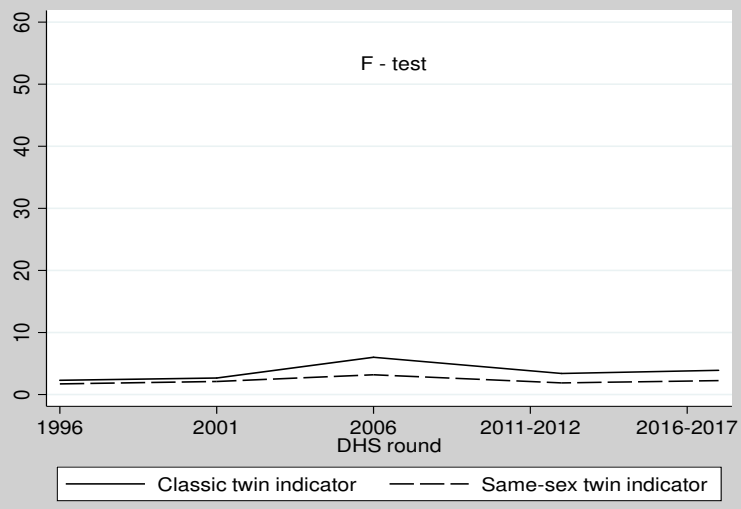
In theory, selection in the marriage market could pose a threat to my findings to the extent that women from families with high occurrence of twinning (observed before marriage in previous generation and for older siblings) might be considered more valuable on marriage market, and therefore more likely to settle with a particular type of men (for instance wealthy men able to provide good care to their offspring). In the absence of information on twinning occurrence in women' family, non-significant correlation between probability of twinning and wealth index (as shown in Col. III of Table A6) tempers this possibility.

Moreover, as children affected by early health shocks are likely to receive higher parental health investment (Yi et al, 2015), I introduce a dummy variable capturing whether the child has suffered

from either diarrhoea, fever or cough in the two weeks preceding the survey[3] in (Eq.1). Results in Cols. II of Table A8 indicate that higher parental investment in twins' immunization is not explained by health shocks.

[3] I here assume that suffering from either diarrhea, fever or cough in the two weeks preceding the survey is a signal (imperfect) for global vulnerability to health shocks.

*Figure 1: Assessing selection on observables*




*Note: F-test for joint significance of the regressors from the regression reported in Col. III of Table A6 in Appendix, run separately on each DHS round.*

*Table A1. Sample means and proportions of key variables at household level*

| **Variables** | **Mean/ Proportion** | **St.Dev** | **Household with twins (I)** | **Household with same-sex twins (II)** | **Household with no twins (III)** |
|---|---|---|---|---|---|
| Fully immunized children (%) | 41.59 | 46.62 | 46.81 | 46.71 | 41.42 |
| Average child's age | 34.35 | 11.14 | 35.42 | 35.71 | 34.32 |
| Average mother's age | 29.68 | 6.50 | 31.23 | 31.17 | 29.63 |
| Average mother's education | 1.69 | 3.23 | 1.56 | 1.51 | 1.70 |
| Residence area (lives in rural area) | 62.27 | - | 67.35 | 66.21 | 62.09 |
| Household's wealth quintile | | | | | |
| *Poorest* | *22.23* | - | *20.57* | *19.95* | *22.28* |
| *Poorer* | *20.39* | - | *21.72* | *22.45* | *20.34* |
| *Average* | *20.29* | - | *21.85* | *22.68* | *20.24* |
| *Richer* | *19.60* | - | *19.92* | *19.05* | *19.59* |
| *Richest* | *17.49* | - | *15.94* | *15.87* | *17.54* |
| **Number of households** | **23,767** | | **778** | **441** | **22,989** |

*Source: Authors, based on data from 4 DHS rounds collected throughout the period 1996-2017 in Benin.*

*Table A2. Sample means and proportions of control variables*

| Variables | Mean/ Proportion | St.Dev | Child is Twin (I) | Child is same-sex twin (II) | Child is singleton (III) | Difference (II)-(III) |
|---|---|---|---|---|---|---|
| Mother's height (cm) | 159.08 | 6.36 | 159.42 | 159.34 | 159.07 | 0.27 |
| Mother's BMI | 22.77 | 4.07 | 23.07 | 22.87 | 22.76 | 0.11 |
| Mother is of voodoo ethnicity | 61.94 | - | 73.80 | 74.84 | 61.43 | 13.41*** |
| Mother's dead children (number) | 0.19 | 0.83 | 0.17 | 0.20 | 0.19 | 0.01 |
| Mother's infant death (dummy) | 5.03 | - | 17.00 | 17.79 | 4.51 | 13.28*** |
| Mother' religion | | | | | | |
| *ATR‡* | *14.93* | - | *16.20* | *16.01* | *14.87* | *1.14* |
| *Christian* | *47.59* | - | *51.97* | *51.97* | *47.40* | *4.57*** |
| *Islam* | *28.74* | - | *22.63* | *22.11* | *29.00* | *-6.89**** |
| *Others* | *1.60* | - | *1.82* | *1.78* | *1.59* | *0.19* |
| *No religion* | *7.15* | - | *7.37* | *8.13* | *7.14* | *0.99* |
| Mother is currently working | 81.07 | - | 81.60 | 81.58 | 81.04 | 0.54 |
| Access to prenatal health care | 0.87 | 0.20 | 0.90 | 0.90 | 0.87 | 0.03*** |
| Access to a doctor | 0.06 | 0.11 | 0.06 | 0.06 | 0.05 | 0.01 |
| Access to a nurse | 0.63 | 0.37 | 0.66 | 0.65 | 0.62 | 0.03 |
| Number of under five years children in the household | 2.30 | 1.39 | 2.90 | 2.88 | 2.27 | 0.61*** |
| Father's age | 37.67 | 9.56 | 39.64 | 40.21 | 37.58 | 2.63*** |
| Father's education | 2.97 | 4.45 | 3.22 | 3.13 | 2.96 | 0.17 |
| Number of adults living in the household | 4.46 | 3.99 | 3.94 | 4.03 | 4.48 | -0.45*** |
| Child' birth size | | | | | | |
| *Very small* | *3.11* | - | *7.15* | *7.50* | *2.84* | *4.66**** |
| *Smaller than average* | *10.85* | - | *22.85* | *22.87* | *10.02* | *12.85**** |
| *Average* | *57.17* | - | *53.80* | *52.60* | *55.68* | *-3.08** |
| *Larger than average* | *20.11* | - | *10.51* | *10.80* | *19.95* | *-9.15**** |
| *Very large* | *8.76* | - | *4.09* | *4.07* | *8.71* | *-4.64**** |
| Preceding birth space | 36.46 | 17.58 | 17.01 | 17.50 | 37.47 | -19.97*** |
| Child has suffer a health shock | 32.82 | - | 31.19 | 30.86 | 32.90 | 2.04 |
| Use of bed net | 57.59 | - | 59.62 | 59.63 | 57.91 | 1.72 |
| Food variety | 1.38 | 1.33 | 1.49 | 1.41 | 1.37 | 0.04 |
| Fruits in child diet | 29.76 | - | 34.37 | 34.07 | 29.58 | 4.49* |
| Modern medicine facility for cough/fever | 35.64 | - | 39.94 | 38.59 | 35.46 | 3.13 |
| Modern medicine facility for diarrhea | 26.54 | - | 26.36 | 30.77 | 26.55 | 4.22 |
| **Number of observations** | **33,111** | | **1,370** | **787** | **31,741** | |

*Source: Authors, based on data from 5 DHS rounds collected throughout the period 1996-2017 in Benin. ‡African Traditional Religion.*

*Table A3. Twins preferential treatment and other determinants of child full immunization*

| | **DEPENDENT VARIABLE : FULL IMMUNIZATION** |
|---|---|
| Child is same-sex twin | 0.054** |
| | (0.024) |
| Mother education | 0.007*** |
| | (0.001) |
| Mother religion (*ATR*) | - |
| *Christian* | *0.041*** |
| | *(0.012)* |
| *Muslim* | *0.036*** |
| | *(0.015)* |
| *Other* | *0.048** |
| | *(0.028)* |
| *No religion* | *-0.001* |
| | *(0.014)* |
| Household's wealth quintile(*Poorest*) | - |
| *Poorer* | *0.036**** |
| | *(0.010)* |
| *Average* | *0.048**** |
| | *(0.010)* |
| *Richer* | *0.075**** |
| | *(0.012)* |
| *Richest* | *0.121**** |
| | *(0.016)* |
| | |
| *DHS-cluster FE* | *YES* |
| *Control variables as in Eq.1* | *YES* |
| *Clusters* | *2,498* |
| *Observations* | *32,528* |
| *R-squared* | *0.271* |
| *Adj. R-squared* | *0.208* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes children under five years of age. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A4. Twins preferential treatment: external validity tests*

| DEPENDENT VARIABLE: FULL IMMUNIZATION | |
|---|---|
| **PANEL A: TWINS PREFERENTIAL TREATMENT USING DATA FROM BENIN, NIGERIA, GHANA AND TOGO** | |
| Child is same-sex twin | 0.057*** |
| | (0.015) |
| *With DHS-cluster FE* | *YES* |
| *Control variables as in Eq.1* | *YES* |
| *Clusters* | *6,882* |
| *Observations* | *86,877* |
| *R-squared* | *0.364* |
| *Adj. R-squared* | *0.308* |
| **PANEL B: TWINS ADVERSE TREATMENT IN VATOVAVY-FITOVINANY REGION IN MADAGASCAR** | |
| Child is same-sex twin | 0.063 |
| | (0.050) |
| Child lives in Vatovavy-Fitovinany | - |
| Child is same-sex twin * Child lives in Vatovavy-Fitovinany | -0.316*** |
| | (0.114) |
| *With DHS-cluster FE* | YES |
| *Control variables as in Eq.1* | *YES* |
| *Clusters* | *1,155* |
| *Observations* | *14,634* |
| *R-squared* | *0.371* |
| *Adj. R-squared* | *0.314* |
| **PANEL C: ABSENCE OF TWINS DIFFERENTIAL TREATMENT IN SENEGAL** | |
| Child is same-sex twin | -0.018 |
| | (0.032) |
| Child is of ethnic group with reference to twins | -0.048*** |
| | (0.016) |
| Child is same-sex twin * Child is of ethnic group with reference to twins | 0.137** |
| | (0.055) |
| *With DHS-cluster FE* | YES |
| *Control variables as in Eq.1* | *YES* |
| *Clusters* | *1,088* |
| *Observations* | *24,711* |
| *R-squared* | *0.376* |
| *Adj. R-squared* | *0.345* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: In Panel A, the sample includes children under five years of age from DHS rounds carried out in Nigeria, Ghana and Toga over the period 1993-2012, added to my analytical sample on Benin. In Panel B, the sample includes under-fives from Madagascar (DHS rounds 1997, 2003-2004 and 2008-2009); mother's ethnicity is not included in the controls as it is missing in the data. In Panel C, the sample includes under-fives from Senegal (DHS rounds 1997, 2005, 2010-2011 and 2012-2013). In Senegal, ethnicities for which a twin preferential treatment is documented are Mandingue, Dioula and Soninke. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A5. Attrition and sample selection*

| | DEPENDENT VARIABLE | |
|---|---|---|
| | Attrition | Child lives in non-poor household |
| Child is same-sex twin | 0.141*** | -0.009 |
| | (0.013) | (0.016) |
| Child is same-sex twin* Attrition | | -0.031 |
| | | (0.024) |
| Attrition | | -0.016** |
| | | (0.007) |
| Mother education | -0.000 | 0.014*** |
| | (0.000) | (0.001) |
| Mother religion (*ATR*) | - | - |
| *Christian* | -0.005 | 0.046*** |
| | (0.005) | (0.009) |
| *Muslim* | -0.009 | 0.059*** |
| | (0.006) | (0.012) |
| *Other* | -0.010 | 0.038* |
| | (0.010) | (0.022) |
| *No religion* | -0.006 | 0.024** |
| | (0.006) | (0.011) |
| Household's wealth quintile (*Poorest*) | - | |
| *Poorer* | 0.002 | |
| | (0.004) | |
| *Average* | -0.000 | |
| | (0.005) | |
| *Richer* | -0.008 | |
| | (0.005) | |
| *Richest* | -0.020*** | |
| | (0.007) | |
| *With DHS-cluster FE* | *YES* | *YES* |
| *Clusters* | *2,501* | *2,501* |
| *Observations* | *45,604* | *45,604* |
| *R-squared* | *0.743* | *0.593* |
| *Adj. R-squared* | *0.727* | *0.568* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes under-fives whose immunization status is observed or not. Control variables include child level characteristics (sex, age in months and birth order); mother-level characteristics (age, education, religion and ethnicity), household-level characteristics (urban/rural residence, wealth quintile), and indicator variables for the administrative region of residence of the household and for the year in which the DHS survey took place. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A6. Probability of (same-sex) twinning*

| | PROBABILITY OF SAME-SEX TWINNING | | |
|---|---|---|---|
| | (I) | (II) | (III) |
| Mother age | 0.142** | 0.159** | 0.164** |
| | (0.066) | (0.066) | (0.066) |
| Mother age squared | -0.002 | -0.002 | -0.002* |
| | (0.001) | (0.001) | (0.001) |
| Mother education | 0.021 | 0.028 | 0.040 |
| | (0.049) | (0.049) | (0.049) |
| Mother education squared | -0.004 | -0.003 | -0.004 |
| | (0.004) | (0.004) | (0.004) |
| Mother is voodoo adherent | -0.049 | -0.160 | -0.175 |
| | (0.204) | (0.202) | (0.203) |
| Mother height | 0.000 | 0.001 | 0.001 |
| | (0.001) | (0.001) | (0.001) |
| Access to prenatal health care | -0.629 | -0.385 | -0.332 |
| | (0.470) | (0.466) | (0.467) |
| Access to a nurse | 0.422 | 0.448 | 0.468 |
| | (0.414) | (0.410) | (0.413) |
| Access to a doctor | 0.467 | 0.475 | 0.609 |
| | (0.639) | (0.632) | (0.648) |
| Infant death | | 4.779*** | 4.767*** |
| | | (0.369) | (0.368) |
| Number of dead children | 0.074 | 0.117 | 0.097 |
| | (0.369) | (0.345) | (0.347) |
| Wealth index *(Poorest)* | | | - |
| *Poorer* | | | *0.065* |
| | | | *(0.186)* |
| *Middle* | | | *0.133* |
| | | | *(0.202)* |
| *Richer* | | | *-0.196* |
| | | | *(0.205)* |
| *Richest* | | | *-0.128* |
| | | | *(0.257)* |
| *Clusters* | *33,426* | *33,426* | *33,426* |
| *Observations* | *48,601* | *48,601* | *48,601* |
| *R-squared* | *0.002* | *0.015* | *0.015* |
| *Adj. R-squared* | *0.002* | *0.015* | *0.015* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes all births given in the five years preceding the survey, randomly selecting one twin in each twins birth. Probability of same-sex twinning is multiplied by 100. Control variables include mother's religion and ethnicity, household-level characteristics (urban/rural residence, wealth quintile) and indicator variables for the administrative region of residence of the household and for the year in which the DHS survey took place. I additionally control for the year in which the birth occurred. Robust standard errors are clustered at the mother-level and reported in parentheses.*

*Table A7. Heterogeneity in the twins preferential treatment across ethnicities*

| DEPENDENT VARIABLE : FULL IMMUNIZATION | |
|---|---|
| Child is same-sex twin | 0.149 |
| | (0.158) |
| Child is same-sex twin x Other ethnicities | - |
| Child is same-sex twin x Adja | -0.094 |
| | (0.170) |
| Child is same-sex twin x Bariba | -0.143 |
| | (0.178) |
| Child is same-sex twin x Dendi | -0.094 |
| | (0.237) |
| Child is same-sex twin x Fon | -0.068 |
| | (0.162) |
| Child is same-sex twin x Yoa | 0.136 |
| | (0.193) |
| Child is same-sex twin x Betamaribe | -0.229 |
| | (0.184) |
| Child is same-sex twin x Peuhl | -0.076 |
| | (0.179) |
| Child is same-sex twin x Yoruba | -0.178 |
| | (0.167) |
| | |
| *With DHS-cluster FE* | *YES* |
| *Controls as in Eq.1* | *YES* |
| *Clusters* | *2,498* |
| *Observations* | *32,528* |
| *R-squared* | *0.271* |
| *Adj. R-squared* | *0.209* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes under-fives. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A8. Competing explanation: health shocks.*

| | DEPENDENT VARIABLE: FULL IMMUNIZATION | |
|---|---|---|
| | (I) | (II) |
| Child is same-sex twin | 0.051** | 0.051** |
| | (0.024) | (0.024) |
| Health shock | | 0.009 |
| | | (0.007) |
| *With DHS-cluster FE* | *YES* | *YES* |
| *Controls as in Eq.1* | *YES* | *YES* |
| *Clusters* | *2,498* | *2,498* |
| *Observations* | *31,943* | *31,943* |
| *R-squared* | *0.273* | *0.273* |
| *Adj. R-squared* | *0.209* | *0.209* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes under-fives whose information on health shocks is available. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A9: Mechanism: family support?*

| | DEPENDENT VARIABLE : FULL IMMUNIZATION | | | |
|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) |
| Child is same-sex twin | 0.055** | 0.054** | 0.063** | 0.063** |
| | (0.024) | (0.024) | (0.030) | (0.030) |
| Number of adults in the household | | -0.001 | | 0.000 |
| | | (0.001) | | (0.001) |
| *With DHS-cluster FE* | *YES* | *YES* | *YES* | *YES* |
| *Controls as in Eq.1* | *YES* | *YES* | *YES* | *YES* |
| *Clusters* | *2,498* | *2,498* | *1,959* | *1,959* |
| *Observations* | *32,349* | *32,349* | *20,993* | *20,993* |
| *R-squared* | *0.271* | *0.271* | *0.289* | *0.289* |
| *Adj. R-squared* | *0.208* | *0.208* | *0.212* | *0.212* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes children under five years of age. In Cols. (III) and (IV) the sample is restricted to children from poor households (which are 1st to 3rd asset ownership quintiles). Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A10. Mechanism: resource diversion from singletons children?*

| | DEPENDENT VARIABLE: FULL IMMUNIZATION | | | |
|---|---|---|---|---|
| | (I) | (II) | (III) | (IV) |
| Singleton raised with a same-sex twin | -0.015 | -0.010 | -0.009 | -0.005 |
| | (0.026) | (0.026) | (0.030) | (0.031) |
| Number of under five years children in the household | | -0.004 | | -0.004 |
| | | (0.002) | | (0.003) |
| *With DHS-cluster FE* | *YES* | *YES* | *YES* | *YES* |
| *Controls as in Eq.1* | *YES* | *YES* | *YES* | *YES* |
| *Clusters* | *2,498* | *2,948* | *1,958* | *1,958* |
| *Observations* | *31,741* | *31,741* | *20,592* | *20,592* |
| *R-squared* | *0.272* | *0.272* | *0.288* | *0.288* |
| *Adj. R-squared* | *0.207* | *0.207* | *0.210* | *0.210* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes singleton children under five years of age. Cols. (II) and (IV) includes the number of under-fives in the household at the difference of Cols. (I) and (III). In Cols. (III) and (IV) the sample is restricted to children from poor households (which are 1st to 3rd asset ownership quintiles). Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*

*Table A11. Mechanism: increased labour supply?*

| | DEPENDENT VARIABLE: WORK STATUS OF THE MOTHER | |
|---|---|---|
| | (I) | (II) |
| Mother of same-sex twins | -0.000 | 0.002 |
| | (0.008) | (0.010) |
| *With DHS-cluster FE* | *YES* | *YES* |
| *Clusters* | *2,495* | *1,941* |
| *Observations* | *24,747* | *15,913* |
| *R-squared* | *0.213* | *0.255* |
| *Adj. R-squared* | *0.127* | *0.152* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes mothers of children under five years of age. In Col (II) the sample is restricted to mothers living in poor households (which are 1st to 3rd asset ownership quintiles). Robust standard errors are clustered at the DHS-cluster level and reported in parentheses. Control variables include mother's age, education, ethnicity, religion, occupation and household-level characteristics (urban/ rural residence, wealth quintile), and indicator variables for the administrative region of residence of the household and for the year in which the DHS survey took place.*

*Table A12. Mechanism: resource diversion from parents to twins (using mother's body mass index as dependent variable)?*

| | **DEPENDENT VARIABLE: MOTHER BODY MASS INDEX** | |
|---|---|---|
| | (I) | (II) |
| Mother of same-sex twins | -14.889 | -11.578 |
| | (16.890) | (16.748) |
| *With DHS-cluster FE* | *YES* | *YES* |
| *Clusters* | *2,487* | *1,948* |
| *Observations* | *26,833* | *17,262* |
| *R-squared* | *0.304* | *0.295* |
| *Adj. R-squared* | *0.231* | *0.203* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: The sample includes mothers of children under five years of age. In Col (II) the sample is restricted to mothers living in non-richer households (which are 1st to 3rd asset ownership quintiles). Robust standard errors are clustered at the DHS-cluster level and reported in parentheses. Control variables include mother's age, education, ethnicity, religion, occupation and household-level characteristics (urban/rural residence, wealth quintile), and indicator variables for the administrative region of residence of the household and for the year in which the DHS survey took place.*

*Table A13. Mechanism: beliefs channel?*

| | **DEPENDENT VARIABLE: FULL IMMUNIZATION** | |
|---|---|---|
| | (I) | (II) |
| Child is same-sex twin | 0.026 | 0.059 |
| | (0.030) | (0.048) |
| Child is same-sex twin* Mother believes in supernatural powers | | -0.058 |
| | | (0.060) |
| Mother believes in supernatural powers | | 0.001 |
| | | (0.009) |
| *With DHS-cluster FE* | *YES* | *YES* |
| *Controls as in Eq.1* | *YES* | *YES* |
| *Clusters* | *2,029* | *2,029* |
| *Observations* | *21,145* | *21,145* |
| *R-squared* | *0.263* | *0.263* |
| *Adj. R-squared* | *0.181* | *0.181* |

*** p<0.01, ** p<0.05, * p<0.1

*Note: To allow for meaningful comparison, the sample includes children under five years of age whose information on whether the mother believes that HIV can be transmitted by means of supernatural powers is available. Robust standard errors are clustered at the DHS-cluster level and reported in parentheses.*