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Socioeconomic Inequalities in Birth Weight

Novel Distributional Evidence from Linked Population Data

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Research Summary

Why was the research done?

This study is the first to use population-wide birth registration data spanning 18 years, linked to Census records, to examine the relationship between a comprehensive set of socioeconomic factors and the birth weight of more than 1.2 million children in Australia, both at the mean and across the distribution.

What were the key findings?

The study reports five main findings, several of which provide new insights to the literature. First, both maternal and paternal education are positively associated with children's birth weight, with stronger associations observed for maternal education and at the lower end of the birth weight distribution. Second, parental income exhibits a positive but non-linear association with birth weight, with larger effects among lower-birth-weight children. Third, relative to children living in rental housing, those born into families with mortgaged homes have higher average birth weights, whereas those born into families that own their homes outright have lower average birth weights. However, children from home-owning families exhibit higher birth weights at the lower end of the distribution but lower birth weights at the upper end. Fourth, more favourable local socioeconomic conditions are positively but non-linearly associated with birth weight, with stronger associations at the lower end of the distribution. Fifth, children born to mothers who migrated from low- or middle-income countries have lower birth weights than those born to mothers from high-income countries.

What does this mean for policy and practice?

From a policy perspective, the findings suggest that policies aimed at improving socioeconomic conditions may contribute to better early-life health outcomes by reducing the risk of low birth weight, with potentially long-lasting benefits across the life course. Moreover, the finding that more favourable socioeconomic conditions appear to generate larger benefits for children at the lower end of the birth weight distribution suggests that such policies may disproportionately benefit infants at greater risk of low birth weight and their families.

Citation

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We acknowledge the Traditional Custodians of the lands on which we work and live across Australia.
We pay our respects to Elders past and present and recognise their continued connections
to land, sea and community.

Socioeconomic Inequalities in Birth Weight: Novel Distributional Evidence from Linked Population Data

Ha Trong Nguyen*, †

This study is the first to use population-wide birth registration data spanning 18 years, linked to Census records, to examine the relationship between a comprehensive set of socioeconomic factors and the birth weight of more than 1.2 million children in Australia, both at the mean and across the distribution. The study reports five main findings, several of which provide new insights to the literature. First, both maternal and paternal education are positively associated with children's birth weight, with stronger associations observed for maternal education and at the lower end of the birth weight distribution. Second, parental income exhibits a positive but non-linear association with birth weight, with larger effects among lower-birth-weight children. Third, relative to children living in rental housing, those born into families with mortgaged homes have higher average birth weights, whereas those born into families that own their homes outright have lower average birth weights. However, children from home-owning families exhibit higher birth weights at the lower end of the distribution but lower birth weights at the upper end. Fourth, more favourable local socioeconomic conditions are positively but non-linearly associated with birth weight, with stronger associations at the lower end of the distribution. Fifth, children born to mothers who migrated from low- or middle-income countries have lower birth weights than those born to mothers from high-income countries.

Keywords: Birth Weight; Neonatal Health; Education; Socioeconomic Status; Administrative Data; Census

JEL classifications: I14; I26; J13; J15; R23

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1. Introduction

Birth weight is one of the most widely studied indicators of infant health and early-life human capital formation (Almond *et al.* 2018). In economics, birth weight is commonly used as a proxy for fetal health because it predicts later-life educational attainment, labour market outcomes, health status, and intergenerational mobility (Black *et al.* 2007; Currie & Moretti 2007; Royer 2009; Almond & Currie 2011b; Savelyev *et al.* 2022). Following the fetal origins hypothesis and the emergence of the early-life human capital literature, economists have increasingly examined how socioeconomic conditions shape birth outcomes (Currie & Moretti 2003; Kennedy-Moulton *et al.* 2025). The economics literature on birth weight has generally focused on how parental socioeconomic characteristics, such as income, education, employment, and neighbourhood disadvantage, influence birth outcomes (see Currie (2009) for an earlier review and Section 2 for a brief review of the literature).

Despite the substantial growth in the number of studies on this topic, two important gaps remain. First, the relative importance of commonly examined socioeconomic factors in explaining birth weight remains unclear. This is largely because previous studies—often due to data limitations and the lack of comprehensive socioeconomic information—have typically focused on only one or a limited set of these factors (Currie & Moretti 2003; McCrary & Royer 2011; Kennedy-Moulton *et al.* 2025). Moreover, the role of paternal socioeconomic characteristics, such as paternal education and age, has received relatively limited attention, likely because many existing datasets contain insufficient information on fathers. Second, previous studies have predominantly examined the association between socioeconomic factors and either mean birth weight or the probability of low birth weight. Consequently, relatively little is known about how these relationships vary across the birth weight distribution, and potential non-linear associations remain underexplored.

This study contributes to the literature by leveraging, for the first time, population-wide birth registration data spanning 18 years linked to Census records to examine the relationship between a comprehensive set of socioeconomic factors and the birth weight of more than 1.2 million children in Australia, both at the mean and across the distribution of birth weight. The study makes two main contributions.

First, it examines one of the most comprehensive sets of socioeconomic factors considered in the literature, including maternal and paternal education, family income, home ownership, local area socioeconomic conditions, and parental country-of-origin income groups. By jointly analysing these factors using high-quality linked Birth Registrations–Census data and rigorous empirical approaches, including mother fixed-effects models, the study provides novel and robust evidence on the association between socioeconomic conditions and birth weight, as well as the relative importance of different socioeconomic factors.

Second, this study advances the literature by examining not only the relationship between socioeconomic factors and mean birth weight, as most previous studies have done, but also how these relationships vary across the birth weight distribution, using the unconditional quantile regression (UQR) framework proposed by Firpo *et al.* (2009). This approach reveals new and potentially important insights into socioeconomic inequalities in birth outcomes and the intergenerational transmission of disadvantage, with direct implications for policy (Aizer & Currie 2014; Almond *et al.* 2018).

The analysis yields five main findings, several of which provide novel evidence relative to the existing literature. First, both maternal and paternal education are positively associated with children's birth weight, although the association is substantially stronger for maternal education and is more pronounced at the lower tail of the birth weight distribution. Second, parental income displays a positive but non-linear association with birth weight, with the magnitude of the relationship again being larger among children at the lower end of the distribution.

Third, relative to children born into rental households, children from families with mortgaged homes exhibit higher average birth weights, whereas those from outright home-owning families display lower birth weights at the mean. However, distributional analyses reveal substantial heterogeneity: children born into home-owning families tend to have higher birth weights at the lower end of the distribution but lower birth weights at the upper end. Fourth, more advantaged local socioeconomic conditions are positively associated with birth weight in a non-linear manner, with stronger associations observed among lower-birth-weight children. Fifth, children born to mothers who migrated from low- and middle-income countries have lower birth weights than those born to mothers from high-income countries, including Australian-born mothers.

The remainder of the paper is organised as follows. Section 2 briefly reviews the literature, and Section 3 describes the data and sample. Section 4 outlines the empirical models used to examine the determinants of birth weight. Section 5 presents the main empirical results. Section 7 reports robustness checks, and Section 8 concludes.

2. A brief literature review

This paper explores the relationship between various socioeconomic factors and children's birth weight, contributing to three broad strands of literature. The first, and most directly related, is the extensive literature examining the determinants of birth weight (see Currie (2009, 2011) for reviews). This literature has investigated the role of a range of individual- and household-level socioeconomic factors, including parental — predominantly maternal — education (Currie & Moretti 2003; Currie & Moretti 2007; Lindeboom *et al.* 2009; McCrary & Royer 2011), parental labour supply (Lindo 2011; Del Bono *et al.* 2012), maternal health behaviours during pregnancy (Del Bono *et al.* 2012; Harris *et al.* 2015), and household income (Hoynes *et al.* 2011; Hoynes *et al.* 2015; Wehby *et al.* 2020; Kennedy-Moulton *et al.* 2025).

Other studies have examined the effects of local socioeconomic conditions, measured through neighbourhood crime (Brown 2018; Currie *et al.* 2022; Grossman & Khalil 2022), access to healthcare (Kose *et al.* 2024), area-level income (Martin *et al.* 2024), and broader macroeconomic conditions (Dehejia & Lleras-Muney 2004; Bozzoli & Quintana-Domeque 2014; Carlson 2015). A large body of research has also explored the effects of public policies on birth weight outcomes (Gans & Leigh 2009; Salmasi & Pieroni 2015; Amarante *et al.* 2016; Deutscher & Breunig 2018; Da Mata *et al.* 2023; East *et al.* 2023; Reader 2023; Flynn & Marcus 2025). In addition, an increasing number of studies have examined the effects of maternal exposure to environmental and climatic factors during pregnancy on birth outcomes (Deschênes *et al.* 2009; Currie & Walker 2011; Currie & Rossin-Slater 2013; Beland & Oloomi 2019).

This study also contributes to the extensive literature examining the consequences of low birth weight for later-life educational attainment, labour market outcomes, health status, and intergenerational mobility (Behrman & Rosenzweig 2004; Black *et al.* 2007; Currie & Moretti 2007; Oreopoulos *et al.* 2008; Royer 2009; Almond & Currie 2011b; Chatterji *et al.* 2014; Lundborg *et al.* 2014; Shiko & Eskil 2020; Savelyev *et al.* 2022). Moreover, the study relates to a third strand of literature investigating the effectiveness of early medical interventions for low-birth-weight infants (Almond *et al.* 2005; Almond *et al.* 2010; Bharadwaj *et al.* 2013) (Barreca *et al.* 2011; Chyn *et al.* 2021; Daysal *et al.* 2022; Yu *et al.* 2025). For broader reviews of this literature, see Currie and Rossin-Slater (2015) and Almond *et al.* (2018).

This brief review of the literature indicates that, although a large number of studies have examined various socioeconomic factors associated with children's birth weight, most have focused on only one or a limited set of factors. As a result, the relative importance of commonly examined socioeconomic determinants remains underexplored. Moreover, the role of paternal socioeconomic characteristics, such as paternal education and age, has received comparatively limited attention. Existing studies have also predominantly focused on either mean birth weight or the probability of low birth weight, with relatively little attention given to how these relationships vary across the birth weight distribution. Leveraging newly available, high-quality, population-wide linked administrative and Census data from Australia, this study aims to address these major gaps in the literature.

3. Data and sample

3.1. Data

This research utilises data from the Australian Bureau of Statistics' (ABS) Person Level Integrated Data Asset (PLIDA) (ABS 2026). PLIDA is a comprehensive, multi-agency longitudinal resource that integrates individual-level data across diverse domains, including income, social security, health, education, and population demographics.

The analytical framework integrates two primary datasets. The first is the 2011 Census of Population and Housing, which provides detailed socio-demographic information, including age, educational attainment, and household structure. Individual-level Census data, together with the mother and father identifiers constructed and provided by the ABS within the Birth Registrations data (described below), are used to link child–mother and child–father pairs and to derive maternal and paternal characteristics, including age, educational attainment, and migration background. In addition, family-level variables—specifically household income and housing tenure—are incorporated as key socioeconomic controls in the empirical models. Spatial information at the Statistical Area Level 2 (SA2), combined with the Socio-Economic Indexes for Areas (SEIFA), is used to capture neighbourhood-level socioeconomic conditions. We also include a variable measuring the number of co-residing children at the time of the Census as an additional explanatory variable.

The second dataset comprises Birth Registrations, a longitudinal administrative dataset containing information on births and parental characteristics from 1 January 2006 to 2023. Variables obtained from this source include birth weight, primiparity (i.e., first birth order), and indicators for multiple births. As these variables are not available in the Census, they are used either as primary outcome measures or as key explanatory variables.

The two datasets are integrated through the Person Linkage Spine, a robust infrastructure designed to reconcile records for individuals residing in Australia during the relevant reference periods. Linkage is undertaken using deterministic matching methods based on personal identifiers, including name, date of birth, sex, and residential address (ABS 2026). We use mother and father identifiers constructed and provided by the ABS within the Birth Registrations data to link children in the Birth Registrations dataset to their parents in the 2011 Census. The Person Linkage Spine enables linkage for children born both before and after the 2011 Census, which was conducted in August 2011.

3.2. Sample

This study investigates how family socioeconomic circumstances shape birth weight, which necessitates the use of detailed and reliable measures of family background wherever possible. Accordingly, the analysis focuses on children in the Birth Registrations dataset who are matched to both parents co-residing within the same household in the 2011 Census and who have valid information on the key variables included in the empirical models, described in more detail below.

Specifically, we restrict the sample to children matched to both parents in order to observe the characteristics of both mothers and fathers. Although this more restrictive sampling strategy does not permit an examination of the effects of single-parent status on birth weight, it is feasible given the large underlying population datasets and enables a more granular analysis of heterogeneity in parental backgrounds—particularly parental educational attainment and age—and their associations with child birth weight. This approach is central to examining the potential moderating role of parental characteristics in the relationship between socioeconomic background and early childhood health and is consistent with the literature on the intergenerational transmission of advantage (Currie 2009; Le & Nguyen 2017; Almond *et al.* 2018; Le & Nguyen 2018).

The analysis further restricts the sample to parents who were co-residing at the time of the 2011 Census because several key family-level socioeconomic variables, including household income and housing tenure, are derived from Census records. Finally, we restrict the sample to observations with valid information on all variables included in the empirical models. These restrictions result in an analytical sample of more than 1.294 million observations for the baseline analysis, drawn from approximately 5 million records in the original Birth Registrations dataset.

4. Empirical models

To examine the factors associated with the birth weight of child i (Y_i), we estimate the following regression model:

$$Y_i = \alpha + X_i\beta + Z_{i(t=2011)}\gamma + \varepsilon_i \qquad (1)$$

where X_i is a vector of individual characteristics measured at the time of birth, including child gender, first-time mother status, multiple births, maternal age group, paternal age group, and year-of-birth fixed effects. $Z_{i(t=2011)}$ denotes a vector of explanatory variables measured at the time of the 2011 Census, including socioeconomic covariates (described in detail below), the number of co-residing children, and state/territory fixed effects. These variables are measured at the 2011 Census primarily because they are constructed from Census data and are not consistently available in other administrative sources. In Equation (1), ε_i denotes the idiosyncratic error term, while α, β and γ are parameters to be estimated.

We focus on six key dimensions of socioeconomic background within $Z_{i(t=2011)}$: maternal education, paternal education, household income, housing tenure, neighbourhood socioeconomic conditions, and, for migrant parents, the income group of their country of origin. To capture potential non-linear relationships and to align with the categorical structure of the underlying data, these variables are modelled using categorical indicators (Nguyen *et al.* 2025; Nguyen *et al.* 2026). Specifically, maternal and paternal education are categorised as: Year 11 or below (the reference group), Year 12, certificate qualification, diploma qualification, and bachelor's degree or higher.

Similarly, household income is measured using categorical income groups.[1] Housing tenure is classified into three groups: renter (the reference category), owner with a mortgage, and outright homeowner. To capture neighbourhood socioeconomic conditions (Chyn & Katz 2021), we use the Socio-Economic Indexes for Areas (SEIFA), linked to residential location at the Statistical Area Level 2 (SA2) from the 2011 Census and measured in deciles, with SEIFA decile 1 as the reference category.[2]

[1] Household income in the Census is reported in income brackets (ABS 2026). For descriptive purposes, we follow standard practice by assigning the midpoint of each bracket when constructing summary statistics. In the regression analysis, some income categories are combined to ensure sufficient sample sizes for robust estimation and to maintain a manageable presentation of results.

[2] Specifically, we employ the Index of Relative Socioeconomic Disadvantage (IRSD), an area-level composite measure produced by the Australian Bureau of Statistics that captures relative disadvantage based on socioeconomic characteristics such as income, educational attainment, employment status, and housing conditions. Higher values indicate relatively more advantaged areas.

To account for parental migration background, we include indicators distinguishing whether each parent was born in Australia (the reference group), in a low- or middle-income country, or in a high-income country, based on the World Bank income classification in 2011. This is particularly important given that approximately half of children in Australia have at least one overseas-born parent and may therefore be exposed to different socioeconomic backgrounds (Nguyen *et al.* 2025). In addition, the models include maternal and paternal country-of-birth fixed effects to account for unobserved ethnic and cultural characteristics, including inherited health endowments such as parental birth weight, which are not observed in the data but may influence child birth weight (Currie & Moretti 2007). Finally, we include state and territory fixed effects to account for geographic and institutional differences across jurisdictions, as well as year-of-birth fixed effects to capture temporal variation in birth outcomes.

In the baseline specification, we include all socioeconomic variables simultaneously to assess their relative contributions to birth weight. This approach, made feasible by the large sample size and the richness of the linked administrative data, allows for a more transparent and nuanced evaluation of the contribution of individual socioeconomic factors to child birth weight, while reducing the potential influence of omitted variable bias on the estimated relationships between these socioeconomic variables and birth weight. In particular, it facilitates an assessment of their relative importance by distinguishing the potentially differential roles of maternal and paternal education, as well as household income and housing tenure, with the latter serving as a proxy for household wealth, in shaping birth outcomes.

Several of these covariates have not been jointly examined in prior international studies. Due to data limitations and the lack of comprehensive linked datasets, most existing studies—particularly those based in the United States—tend to focus on selected socioeconomic dimensions, such as maternal education and neighbourhood socioeconomic disadvantage (Currie & Moretti 2007), parental income (Kennedy-Moulton *et al.* 2025) or neighbourhood socioeconomic conditions (Chyn & Shenhav 2025). As part of the robustness analysis, we also estimate models including each socioeconomic variable separately, with the results indicating even stronger associations.

We begin by estimating Ordinary Least Squares (OLS) regressions to examine the determinants of birth weight at the mean. Motivated by prior studies that focus on low birth weight—typically defined as birth weight below 2,500 grams (Currie & Moretti 2007; Beland & Oloomi 2019; Reader 2023)—and by research employing quantile regression methods (Abrevaya & Dahl 2008), we further examine heterogeneity in these relationships by analysing both the probability of low birth weight and variation across the birth weight distribution. Specifically, we employ the unconditional quantile regression (UQR) framework proposed by Firpo *et al.* (2009) to estimate Equation (1) at selected points of the outcome distribution. This approach is particularly appealing because it enables the estimation of marginal effects on unconditional quantiles of the outcome variable without requiring the rank-preservation assumption inherent in conditional quantile regression methods.

5. Empirical results

5.1. Descriptive results

Table 1 reports summary statistics for the key explanatory variables used in this study, disaggregated by two birth weight subgroups: the "higher birth weight" group, comprising children with birth weight above the sample median of 3,440 grams, and the "lower birth weight" group, comprising the remaining children. The table shows that, relative to children in the lower birth weight group, those in the higher birth weight group are more likely to be male and to come from larger families, but less likely to be first births or part of multiple births. They also tend to have younger mothers, with higher levels of education, and are more likely to have mothers born in Australia or overseas in high-income countries.

Similarly, children in the higher birth weight group tend to have younger fathers and are more likely to have fathers born in Australia or overseas in high-income countries, although there is no clear difference in paternal education between the two groups.

Moreover, children in the higher birth weight group are more likely to come from higher-income households and to reside in areas with more favourable socioeconomic conditions. They are also more likely to live in mortgaged owner-occupied housing and less likely to reside in rental or outright owner-occupied dwellings.

6. Regression results

6.1.1. Parental education

Regression results at the mean (Column 1, Table 2) indicate a positive association between parental education and child birth weight, as estimates for all education levels above Year 11 or lower (the reference category) are positive and statistically significant at the 1% level for both maternal and paternal education.[3]

[3] In line with prior studies (Currie & Moretti 2007; Beland & Oloomi 2019; Reader 2023), this study also examines the probability of low birth weight, with the results reported in Column 1 of Appendix Table A1. The findings are

For maternal education, relative to mothers with Year 11 or below education (the reference group), children of mothers holding a bachelor's degree or higher have birth weights that are, on average, 63 grams higher. This is followed by children of mothers who completed Year 12 (47 grams), obtained a diploma (44 grams), or hold a certificate (36 grams). The pattern of estimates suggests that the relationship between maternal education and child birth weight is not strictly linear with respect to the years typically required to attain each educational qualification. Although the largest estimate is observed for the highest education category (bachelor's degree or higher), and this estimate is statistically distinct from those of all lower education levels—as evidenced by non-overlapping 95% confidence intervals—this distinction does not consistently apply across the lower education categories. For example, the estimates for diploma and Year 12 are not statistically different from each other. These patterns are illustrated in Figure 1, where Panel A presents the estimates of maternal education at the mean (and across selected quantiles).

Estimates for paternal education are also positive and statistically significant at the 1% level. However, the magnitude of these effects—ranging from 25 grams for a certificate qualification to 30 grams for a bachelor's degree or higher—is relatively similar across education levels. The overlapping 95% confidence intervals indicate that these estimates are not statistically different from one another (see Figure 1 - Panel B).

Quantile regression estimates reported in Table 2 indicate that all considered levels of parental education are positively associated with child birth weight and are statistically significant at the 1% level across all nine selected percentiles.[4] Moreover, at each percentile, the pattern of the relationship between parental education and child birth weight is broadly consistent with that observed in the mean regressions.

However, the association between parental education and child birth weight is substantially stronger at the lower end of the birth weight distribution than at the upper end (see also Figure 1). Specifically, the estimated effects are consistently larger at lower quantiles and decline as one moves towards higher quantiles of the birth weight distribution. This pattern holds for both maternal and paternal education. For example, for maternal education, the estimated effect of

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broadly consistent with expectations. Specifically, the estimated coefficients for this outcome exhibit signs opposite to those obtained from the regression of birth weight at the mean (reported in Column 1 of Table 2), indicating that factors associated with higher birth weight correspondingly reduce the probability of low birth weight. For conciseness, these results are not discussed in detail.

[4] For presentation and conciseness, regression results for the 20th, 40th, 60th, and 80th percentiles, as well as results where the dependent variable is the probability of low birth weight, are reported in Appendix Table A1. Similarly, some figures present estimates only for selected percentiles for illustrative purposes.

having a bachelor's degree or higher is approximately 2.2 times larger at the lowest quantile than at the highest quantile (95 grams at the 10^{th} percentile versus 43 grams at the 90^{th} percentile; 95/43 = 2.21). Similarly, for paternal education, the corresponding estimate is approximately 9.3 times larger at the lowest quantile than at the highest quantile (65 grams at the 10^{th} percentile versus 7 grams at the 90^{th} percentile; 65/7 = 9.29).

Contrasting maternal and paternal education suggests that maternal education plays a more substantial role in increasing child birth weight than paternal education, as evidenced by two patterns. First, the estimated effects of maternal education are consistently larger in magnitude than those of paternal education, both at the mean and across quantiles. Second, while there is a clear gradient in birth weight with respect to maternal education, the corresponding differences across paternal education levels are comparatively small.

To the best of my knowledge, while prior studies document strong relationships between maternal education and birth weight using both observational and quasi-experimental designs (Currie & Moretti 2003; Currie & Moretti 2007; Lindeboom *et al.* 2009; McCrary & Royer 2011), the relative importance of maternal versus paternal education has received limited systematic attention. This study leverages linked population-wide data to jointly examine both parental education measures and provides novel evidence of a more pronounced role for maternal, relative to paternal, education in determining child birth weight.

Moreover, while most studies focus on mean effects or low birth weight outcomes to document the relationship between maternal education (Almond & Currie 2011a)—which is also confirmed in this study—we extend the analysis by applying quantile regression to high-quality linked data. This allows us to document variation in the maternal and paternal education gradient across the birth weight distribution, showing that the association is stronger at the lower end of the distribution, where the risk of low birth weight is higher.

6.1.2. Family income

The mean regression results, reported in Column 1 of Table 2, indicate a positive association between family income and child birth weight. Estimates for income groups above the reference category of $26,000 per year are positive and statistically significant at the 1% level. However, the relationship is non-linear: the estimated effect increases with income up to the $65,000-77,999 group and declines thereafter. This non-linear relationship between parental income and child birth weight is consistent with evidence from the United States and Sweden (Kennedy-Moulton *et al.* 2025).

Moreover, the quantile regression results reported in Columns 2 onward indicate that this non-linear relationship is more pronounced at the lower end of the birth weight distribution. Specifically, the estimated effects tend to be larger in magnitude and more precisely estimated at lower quantiles. This pattern is also illustrated in Figure 2, which presents estimates for different income groups, relative to the reference category, at the mean and selected quantiles. The figure shows that the estimates are largest at the 10th percentile, followed by the median (which is broadly similar to the mean), and smallest at the 90th percentile. In addition, the 95% confidence intervals across these quantiles generally do not overlap, suggesting statistically significant differences. To the best of my knowledge, the finding that the non-linear association between parental income and child birth weight is more pronounced at the lower end of the birth weight distribution has received limited attention in the existing literature.

6.1.3. Home ownership

The relationship between home ownership status and child birth weight at the mean appears non-linear. Relative to the reference group of parents residing in rented housing, children born to parents living in mortgaged homes have, on average, birth weights that are 6 grams higher, whereas those born to parents in outright-owned homes have birth weights that are 19 grams lower (see Column 1 of Table 2 and Figure 3).

Moreover, the quantile regression results reveal heterogeneity in these relationships across the birth weight distribution (see Figure 3). Specifically, the coefficient on mortgaged home ownership is positive and statistically significant at the 1% level from the 10th to the 40th percentiles, but becomes negative and statistically significant from the 70th percentile onwards. Similarly, the coefficient on outright home ownership is positive and statistically significant at the 10th percentile, but turns negative and remains statistically significant across higher percentiles.

These patterns suggest that children born into home-owning families—whether with a mortgage or owning outright—tend to have higher birth weights at the lower end of the distribution, but lower birth weights at the upper end. This declining association of home ownership (a proxy for family wealth, in the absence of more direct wealth measures) across the birth weight distribution has received limited attention in the literature and highlights the value of using rich population data in conjunction with quantile regression methods. To the best of my knowledge, while prior studies highlight the importance of housing conditions and stability for birth outcomes (DiTosto *et al.* 2021), the relationship between home ownership status and child birth weight has not been documented in prior literature. This study provides new evidence on this relationship and documents substantial heterogeneity across the birth weight distribution.

6.1.4. Local socioeconomic conditions

The mean regression results indicate a positive association between more favourable local socioeconomic conditions, as measured by SEIFA decile, and child birth weight. Relative to the reference category (SEIFA decile 1), estimates for higher SEIFA deciles are positive and statistically significant at the 1% level (Column 1 of Table 2). A positive relationship between neighbourhood socioeconomic conditions and birth outcomes is well established in the literature (Currie & Moretti 2007; Almond & Currie 2011a; Currie 2011; Chetty *et al.* 2016; Chyn & Shenhav 2025). However, the relationship appears non-linear, with the estimated effect increasing up to SEIFA decile 5 before declining thereafter.

The quantile regression results further suggest that the positive relationship between more favourable local socioeconomic conditions and child birth weight is more pronounced at the lower end of the birth weight distribution, where estimated effects are generally larger in magnitude. This pattern is illustrated in Figure 4, which reports estimates for different SEIFA deciles relative to the reference category at the mean and selected quantiles. The estimates are largest at the 10th percentile, followed by the median (which is broadly similar to the mean), and smallest at the 90th percentile. Moreover, the 95% confidence intervals across quantiles generally do not overlap—particularly between the lower and upper ends of the distribution and among higher SEIFA deciles—suggesting statistically significant heterogeneity across the birth weight distribution.

The nature of the non-linear relationship between local socioeconomic conditions and child birth weight also varies across quantiles and appears to be more pronounced at higher quantiles. At the 10th and 20th percentiles, the relationship is approximately linear and positive, with estimates increasing steadily across SEIFA deciles. At the median, the estimates exhibit an inverse U-shaped pattern, peaking around SEIFA decile 5, consistent with the mean regression results. At the 90th percentile, the estimates remain positive and statistically significant for lower SEIFA deciles, peak around SEIFA decile 3, and then decline, becoming statistically insignificant from decile 7 onward and negative and statistically significant at the 5% level for SEIFA decile 10. This negative estimate at the upper end of the birth weight distribution suggests that more favourable local socioeconomic conditions may reduce birth weight among infants already at risk of high birth weight.

To the best of my knowledge, although previous studies have documented the importance of neighbourhood socioeconomic conditions for birth outcomes (Currie & Moretti 2007; Chyn & Katz 2021; Chyn & Shenhav 2025), there is little evidence regarding the non-linear nature of this relationship or the extent to which it varies across the birth weight distribution. The present findings therefore contribute to the literature in several important ways. First, they suggest that improvements in local socioeconomic conditions may yield the largest benefits for infants at greatest risk of adverse birth outcomes, namely those at the lower end of the birth weight distribution. Second, the results indicate that the relationship between neighbourhood socioeconomic conditions and birth weight is not constant across the distribution, highlighting the limitations of relying solely on mean regression estimates. Third, the finding that the non-linear relationship is most pronounced at the upper end of the distribution suggests that favourable neighbourhood conditions may also mitigate risks associated with excessively high birth weight. Collectively, these findings provide new evidence that neighbourhood socioeconomic conditions influence not only average birth outcomes, but also the distributional shape of birth weight outcomes.

6.1.5. Parental home countries' income groups

Regression results at the mean suggest that, relative to children born to Australia-born mothers (the reference group), children born to mothers who migrated to Australia from low- or middle-income countries have lower birth weights by approximately 106 grams, while no statistically significant difference is observed for children born to mothers from high-income countries.[5] Moreover, the quantile regression results, also illustrated in Figure 5 – Panel A, indicate that this pattern persists across the birth weight distribution, suggesting a persistent intergenerational transmission of maternal country-of-origin income disadvantage to Australia-born children.

By contrast, we do not find comparable evidence for paternal country-of-origin income groups. The estimates for an indicator capturing fathers who migrated from low- or middle-income countries are statistically insignificant both at the mean and across the distribution (Panel B of Figure 5). The coefficient for fathers originating from high-income countries, while statistically

[5] Low- and middle-income countries are combined into a single category to ensure sufficient sample sizes for robust estimation. In addition, as specified in the empirical model, we control for parental country of origin through the inclusion of maternal and paternal country-of-origin fixed effects.

insignificant at the mean, varies across the distribution: it is positive and statistically significant at lower quantiles, suggesting higher birth weight among children of these fathers, but becomes negative and decreasingly so at higher quantiles. This pattern indicates heterogeneous and non-linear associations that warrant further investigation. This evidence aligns with prior literature emphasising the importance of parental country of origin and migrant background for child development outcomes in the host country (Cobb-Clark & Nguyen 2012; Nguyen *et al.* 2020; Nguyen *et al.* 2025).

To the best of my knowledge, while some previous studies document differences in birth weight between children of mothers born in host countries and those born to mothers from selected immigrant groups across various countries, including Australia (Ramraj *et al.* 2015; Martinson *et al.* 2017), and while we account for this dimension using maternal and paternal country-of-birth indicators in our regressions, none explicitly examine the role of parental country-of-origin income group alongside these controls. Our extended specification yields a novel finding that children born to mothers who migrated from low- or middle-income countries exhibit distinct birth weight outcomes. Moreover, we find no comparable association for paternal country of birth.

6.1.6. Other results

Other results reported in Appendix Table A2 are broadly consistent with expectations and prior studies (Currie & Rossin-Slater 2013; Kennedy-Moulton *et al.* 2025; Nguyen *et al.* 2026). For example, boys are born, on average, 124 grams heavier than girls and are 0.91 percentage points less likely to experience low birth weight. Similarly, children born to first-time mothers, from multiple births, or in families with fewer siblings tend to have lower birth weights on average.

The quantile regression results provide additional insights into how these associations vary across the birth weight distribution. For instance, the more favourable birth weight endowment observed among boys is more pronounced at the upper end of the distribution, as indicated by the larger and statistically significant coefficient on the male indicator at higher quantiles. Similarly, children from larger families tend to exhibit higher birth weights at the upper end of the distribution. In contrast, children born to first-time mothers or from multiple births exhibit substantially lower birth weights at the lower end of the distribution, with estimated effects that are larger in absolute value (i.e., more negative) at lower quantiles.

Finally, the relationships between maternal and paternal age at birth and child birth weight warrant discussion, as the results reveal contrasting patterns and provide novel insights into the literature (See Figure 6). Specifically, children born to mothers aged 30 years or older have lower birth weights than those born to younger mothers. The negative association between maternal age and child birth weight has been documented in the existing literature (Rosenzweig & Schultz 1983; Sujan *et al.* 2016; Fredriksson *et al.* 2022; Aradhya *et al.* 2023). Moreover, our results further show that this relationship is more pronounced at the lower end of the birth weight distribution.

By contrast, the relationship between paternal age and child birth weight is less clear. The estimates for paternal age groups are generally positive but relatively small in magnitude and not statistically significant relative to the baseline group (aged 19 years or younger). They are also broadly similar across age categories, both at the mean and across the distribution. Taken together, these results suggest that maternal age plays a more important role in explaining variation in child birth weight than paternal age, an insight enabled by our use of unique linked datasets.

Overall, the results indicate that maternal characteristics—including education, age, and country-of-origin income group—play a more pronounced role than paternal characteristics in explaining variation in child birth weight. Moreover, while the effects vary across specific socioeconomic indicators and along the birth weight distribution, a consistent pattern emerges: more favourable socioeconomic conditions—measured by parental education, family income, and local socioeconomic environment—tend to confer greater benefits at the lower end of the birth weight distribution.

7. Robustness checks

This section assesses the robustness of our findings on the association between socioeconomic factors and birth weight using alternative samples and model specifications. For brevity, these checks focus on the mean regression results. First, we estimate specifications in which each of the six key socioeconomic variables is included separately. This exercise addresses the concern that high correlations among these variables may result in overcontrolling when they are included simultaneously in the baseline specification. The results, reported in Column 2 of Appendix Table A3, are generally larger in magnitude and more statistically significant than the baseline estimates (re-reported in Column 1). This pattern suggests that the baseline estimates are conservative and further reinforces the main conclusions of the paper.

Second, we re-estimate the baseline OLS specifications using a sample of births observed from 2012 onwards, while retaining the original empirical model. This cutoff is chosen relative to the 2011 Census to ensure that birth weight is measured after the socioeconomic variables captured in the Census, thereby mitigating concerns regarding reverse causality. For instance, low birth weight may influence certain socioeconomic outcomes, such as parental labour supply and, consequently, household income, if parents reduce work to care for a low-birth-weight newborn. The results from this exercise, reported in Column 3 of Appendix Table A3, largely replicate the baseline findings, albeit with some differences in magnitude, likely reflecting the substantially smaller sample (reduced by more than half).

Third, we estimate a mother fixed effects model in place of the baseline OLS specifications to assess whether unobserved, time-invariant maternal characteristics confound the relationship between selected socioeconomic factors and child birth weight.[6] Consistent with prior studies (Chyn & Shenhav 2025; Nguyen *et al.* 2026), this approach mitigates, although it does not fully address, concerns that unobserved maternal characteristics—such as genetic endowments or residential preferences—may be correlated with both birth weight and socioeconomic characteristics, thereby biasing the estimated coefficients.

Because identification in the mother fixed effects framework relies on within-mother variation over time, only time-varying covariates can be included. Given the available data, we are able to incorporate a single socioeconomic measure capturing local conditions at the time of birth (linked to the mother's residential address), along with other within-mother time-varying controls, including child gender, an indicator for first birth and multiple births, maternal and paternal age at birth, residential state/territory indicators, and birth year indicators. These variables are obtained from the linked 2011 Census and Birth Registration datasets, and several vary across births to the same mother.

The results from the mother fixed effects model, reported in Column 2 of Appendix Table A4, indicate that estimates for the male indicator, first birth and multiple birth indicators, and maternal and paternal age at birth are broadly consistent—in both magnitude and statistical significance—with the baseline findings. Comparable results are obtained from the pooled regression estimated on the same sample (Column 2) and from the sample without restricting to mothers with at least two births during the study period (Column 1). This consistency across samples and specifications suggests that these variables are unlikely to be materially

[6] In this study, the mother fixed effects model is effectively equivalent to a family fixed effects specification due to the restriction to co-residing parents. Moreover, this specification is estimated on the sample of linked Birth Registration and 2011 Census data without imposing additional restrictions on the availability of other Census-based socioeconomic variables (e.g., parental education and country of birth, family income, and homeownership), resulting in a slightly larger sample than that used in the baseline analysis.

endogenous in the birth weight equation. Notably, the estimates for parental age reaffirm the earlier finding that birth weight declines with maternal age but is largely unresponsive to paternal age.

In contrast, the estimates for the SEIFA decile indicators from the mother fixed effects model remain positive across most deciles, consistent with the baseline specifications, but are generally not statistically significant; only the coefficient for decile 4 is statistically significant at the 5% level. While this pattern is consistent with a positive and non-linear association between local socioeconomic advantage and birth weight, the estimates are imprecisely estimated. The lack of statistical significance in the mother fixed effects specification may reflect limited within-mother variation in local socioeconomic conditions over the study period or potential endogeneity arising from residential sorting (Chetty & Hendren 2018; Chyn & Katz 2021; Chyn & Shenhav 2025).

Overall, the results from the above robustness checks support the stability of our key findings. However, certain results—such as the lack of statistical significance in the estimated relationship between local socioeconomic conditions and child birth weight in the mother fixed effects specification—suggest that further research is warranted to more precisely identify and quantify the relationship between socioeconomic factors and birth weight.

8. Conclusion

This study is the first to use high-quality, population-wide linked administrative and census data to examine how a broad range of socioeconomic factors are associated with child birth weight in Australia. Consistent with much of the international literature, the findings indicate that higher parental education, greater family income, and more favourable local socioeconomic conditions are positively associated with birth weight and a lower probability of low birth weight.

The study also provides several novel findings. Relative to children living in rental housing, those born into families with mortgaged homes have higher average birth weights, whereas those born into families that own their homes outright have lower average birth weights. Moreover, the relationship between home ownership status and birth weight varies across the birth weight distribution, shifting from positive at the lower end to negative at the higher end. In addition, children born to mothers who migrated from low- or middle-income countries have lower birth weights than those born to mothers from high-income countries. By simultaneously considering the socioeconomic characteristics of both parents, the study also provides relatively rare evidence that maternal characteristics, particularly maternal education and age, play a more prominent role than paternal characteristics in explaining variation in birth weight. Furthermore, the results reveal non-linear relationships between several key socioeconomic variables—including parental income, home ownership status, and local socioeconomic conditions—and birth weight.

By employing a quantile regression approach, this study further provides novel evidence on the distributional effects of socioeconomic factors on birth weight. Although the magnitude and pattern of the associations vary across socioeconomic indicators and along the birth weight distribution, a consistent finding emerges: more favourable socioeconomic conditions, measured by parental education, family income, and local socioeconomic environment, tend to confer larger benefits at the lower end of the birth weight distribution, where infants face a greater risk of low birth weight.

The evidence presented in this study is primarily descriptive and should not be interpreted as establishing causal relationships, as it remains challenging, if not impossible, to simultaneously identify the causal effects of the broad range of socioeconomic variables considered (Currie & Moretti 2003; Kennedy-Moulton *et al.* 2025). Nevertheless, the findings provide an important foundation for generating hypotheses regarding the potential causal mechanisms linking socioeconomic conditions and birth weight. In particular, the observed non-linear and heterogeneous relationships suggest promising directions for future research, including the application of distributional and causal methods to further examine how these socioeconomic characteristics influence birth outcomes.

From a policy perspective, the findings suggest that policies aimed at improving socioeconomic conditions may contribute to better early-life health outcomes by reducing the risk of low birth weight, with potentially long-lasting benefits across the life course. Moreover, the finding that more favourable socioeconomic conditions appear to generate larger benefits for children at the lower end of the birth weight distribution suggests that such policies may disproportionately benefit infants at greater risk of low birth weight and their families.

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Table 1: Summary statistics by child birth weight group

Variable	Higher birth weight	Lower birth weight	Difference (Higher – Lower)
	(1)	(2)	(3)
Male [a]	0.568	0.460	0.108***
First time mother [a]	0.333	0.398	-0.065***
Multiple birth [a]	0.001	0.060	-0.059***
Number of all children in family at 2011 Census	2.068	2.025	0.043***
Mother age at child birth (years)	31.405	31.528	-0.123***
Mother education: Year 11 or lower [a]	0.185	0.202	-0.017***
Mother education: Year 12 [a]	0.250	0.245	0.005***
Mother education: Certificate [a]	0.144	0.137	0.008***
Mother education: Diploma [a]	0.106	0.105	0.001**
Mother education: Bachelor degree or higher [a]	0.314	0.311	0.003***
Mother born in Australia [a]	0.817	0.765	0.052***
Mother low- or middle-income country migrant [a]	0.095	0.148	-0.054***
Mother high income country migrant [a]	0.088	0.087	0.001***
Father age at child birth (years)	33.791	33.960	-0.170***
Father education: Year 11 or lower [a]	0.187	0.198	-0.01***
Father education: Year 12 [a]	0.188	0.189	-0.001
Father education: Certificate [a]	0.307	0.287	0.020***
Father education: Diploma [a]	0.081	0.080	0.001*
Father education: Bachelor degree or higher [a]	0.236	0.245	-0.009***
Father born in Australia [a]	0.803	0.755	0.048***
Father low- or middle-income country migrant [a]	0.095	0.147	-0.052***
Father high income country migrant [a]	0.101	0.098	0.003***
Family income at 2011 Census (midpoint, $1,000/year)	83.572	82.877	0.695***
Renter [a]	0.295	0.297	-0.002**
Mortgage homeowner [a]	0.598	0.582	0.016***
Outright homeowner [a]	0.106	0.121	-0.015***
SEIFA decile	5.622	5.567	0.055***
Birth weight (grams)	3,835.837	2,980.064	855.773***
Number of individuals	641,659	652,526	

Notes: Figures report sample means. Variables marked with [a] are binary indicators. Statistical tests assess the significance of differences in mean values between the “higher birth weight” group (defined as birth weight above the median) and the “lower birth weight” group (defined as birth weight at or below the median). The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.

Table 2: Estimates of socioeconomic gradients in birth weight at the mean and across selected percentiles

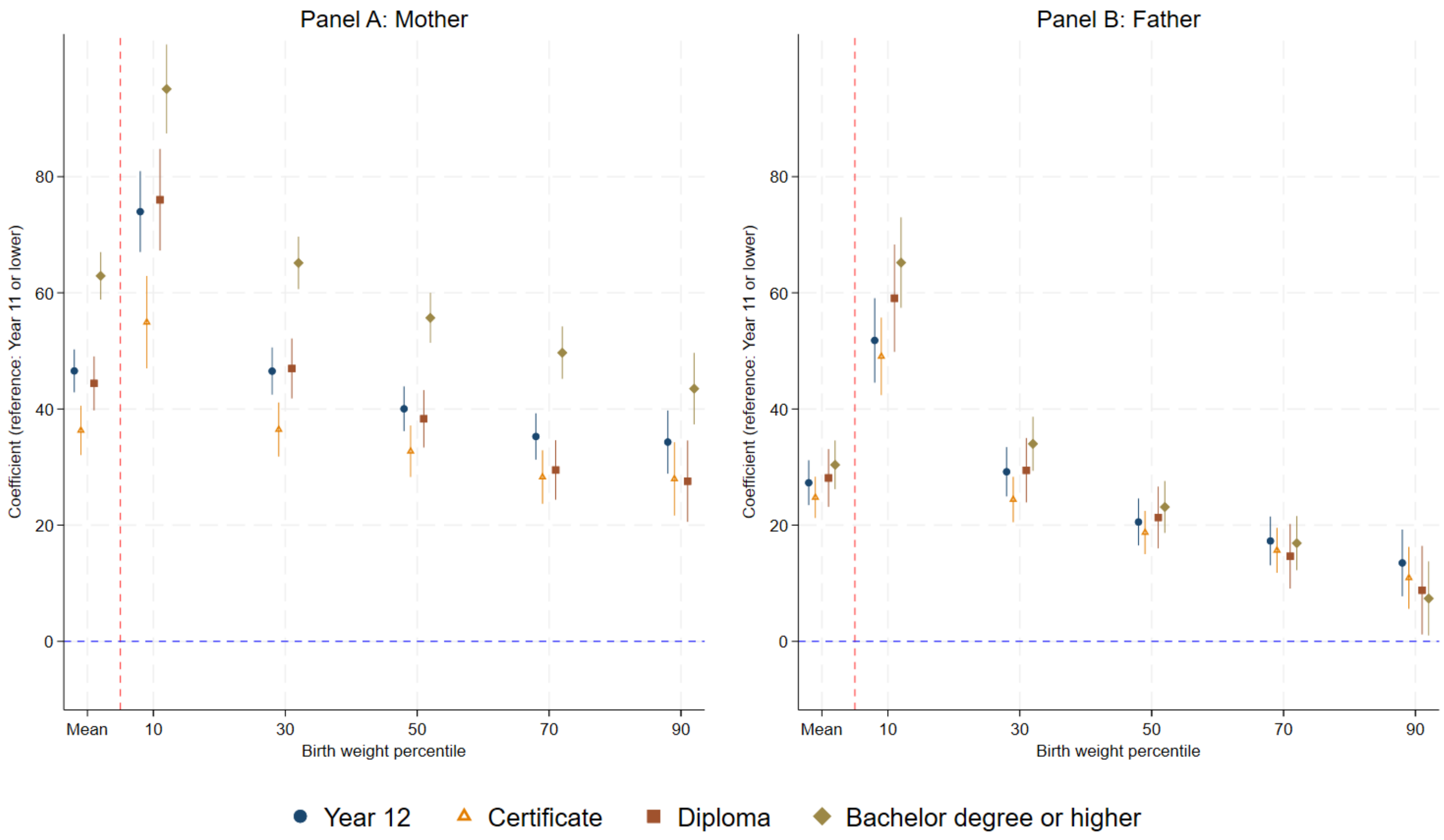
Regression at:	Mean	P10	P30	P50	P70	P90
	(1)	(2)	(3)	(4)	(5)	(6)
Mother education: Year 12 [(a)]	46.57***	73.99***	46.53***	40.04***	35.28***	34.32***
	(1.88)	(3.55)	(2.07)	(1.96)	(2.04)	(2.77)
Mother education: Certificate [(a)]	36.32***	54.95***	36.47***	32.73***	28.29***	27.97***
	(2.17)	(4.06)	(2.37)	(2.26)	(2.35)	(3.22)
Mother education: Diploma [(a)]	44.41***	76.03***	46.98***	38.32***	29.51***	27.58***
	(2.37)	(4.46)	(2.63)	(2.52)	(2.61)	(3.57)
Mother education: Bachelor degree or higher [(a)]	62.93***	95.10***	65.17***	55.71***	49.70***	43.51***
	(2.08)	(3.90)	(2.30)	(2.20)	(2.30)	(3.14)
Mother migrant – Low or middle income country [(b)]	-105.65***	-105.04***	-99.59***	-97.43***	-90.67***	-84.65***
	(14.84)	(28.58)	(17.59)	(16.19)	(16.72)	(21.14)
Mother migrant – High income country [(b)]	47.62	114.80	8.14	110.16	87.08	75.71
	(120.18)	(162.24)	(208.24)	(231.06)	(118.61)	(172.63)
Father education: Year 12 [(a)]	27.31***	51.81***	29.20***	20.56***	17.29***	13.51***
	(1.97)	(3.71)	(2.17)	(2.06)	(2.14)	(2.93)
Father education: Certificate [(a)]	24.78***	49.06***	24.41***	18.74***	15.67***	10.93***
	(1.82)	(3.41)	(1.99)	(1.90)	(1.98)	(2.72)
Father education: Diploma [(a)]	28.13***	59.08***	29.47***	21.34***	14.65***	8.81**
	(2.53)	(4.72)	(2.83)	(2.72)	(2.83)	(3.89)
Father education: Bachelor degree or higher [(a)]	30.40***	65.21***	34.02***	23.14***	16.91***	7.39**
	(2.14)	(3.97)	(2.37)	(2.28)	(2.38)	(3.25)
Father migrant – Low or middle income country [(b)]	-4.45	-1.17	-5.59	-5.52	-2.67	-9.33
	(13.65)	(24.57)	(15.55)	(15.11)	(16.14)	(21.49)
Father migrant – High income country [(b)]	-88.48*	219.27**	410.01***	-657.18***	-427.45***	-227.43***
	(48.54)	(92.16)	(46.91)	(43.77)	(46.33)	(67.14)

Regression at:	Mean	P10	P30	P50	P70	P90
	(1)	(2)	(3)	(4)	(5)	(6)
Family income $26,000-$33,799 [c]	19.97***	28.18***	21.65***	19.06***	18.82***	12.72***
	(3.44)	(6.79)	(3.81)	(3.51)	(3.56)	(4.78)
Family income $33,800-$41,599 [c]	30.98***	53.64***	34.03***	27.37***	21.42***	20.14***
	(3.28)	(6.39)	(3.64)	(3.38)	(3.43)	(4.65)
Family income $41,600-$51,999 [c]	37.33***	56.77***	40.78***	34.08***	29.02***	21.82***
	(3.02)	(5.88)	(3.34)	(3.10)	(3.17)	(4.28)
Family income $52,000-$64,999 [c]	46.69***	77.22***	50.82***	40.38***	35.10***	32.36***
	(3.02)	(5.81)	(3.33)	(3.12)	(3.20)	(4.36)
Family income $65,000-$77,999 [c]	47.97***	77.57***	51.16***	42.72***	37.09***	31.13***
	(2.77)	(5.38)	(3.07)	(2.86)	(2.92)	(3.94)
Family income $78,000-$90,999 [c]	42.77***	75.86***	48.34***	39.47***	28.41***	19.92***
	(2.91)	(5.66)	(3.24)	(3.03)	(3.09)	(4.17)
Family income $91,000-$103,999 [c]	45.51***	85.91***	51.30***	40.97***	29.62***	17.33***
	(2.95)	(5.69)	(3.29)	(3.09)	(3.16)	(4.25)
Family income $104,000-$129,999 [c]	35.43***	71.58***	44.24***	31.27***	21.78***	9.01*
	(3.24)	(6.24)	(3.64)	(3.44)	(3.51)	(4.71)
Family income $130,000-$207,999 [c]	25.77***	67.40***	35.33***	20.76***	10.50***	-4.92
	(3.23)	(6.22)	(3.64)	(3.41)	(3.48)	(4.63)
Family income $208,000 or more [c]	31.73***	58.23***	37.82***	31.90***	24.68***	17.08***
	(3.53)	(6.78)	(3.91)	(3.65)	(3.74)	(5.03)
Mortgage homeowner [d]	5.80***	31.76***	10.23***	1.49	-5.58***	-14.45***
	(1.44)	(2.66)	(1.58)	(1.51)	(1.58)	(2.19)
Outright homeowner [d]	-19.36***	15.16***	-15.88***	-27.65***	-32.40***	-40.93***
	(2.11)	(4.01)	(2.38)	(2.25)	(2.31)	(3.07)

Regression at:	Mean	P10	P30	P50	P70	P90
	(1)	(2)	(3)	(4)	(5)	(6)
SEIFA decile 2 [(e)]	16.88***	19.97***	15.08***	14.82***	16.10***	15.26***
	(2.83)	(5.36)	(3.10)	(2.92)	(3.00)	(4.10)
SEIFA decile 3 [(e)]	24.04***	26.83***	22.40***	19.53***	19.25***	17.93***
	(2.80)	(5.32)	(3.08)	(2.90)	(2.98)	(4.09)
SEIFA decile 4 [(e)]	23.03***	33.21***	20.18***	16.68***	17.34***	14.44***
	(2.76)	(5.25)	(3.05)	(2.88)	(2.95)	(4.02)
SEIFA decile 5 [(e)]	29.26***	40.15***	30.47***	25.45***	22.03***	14.24***
	(2.77)	(5.24)	(3.04)	(2.88)	(2.97)	(4.06)
SEIFA decile 6 [(e)]	26.83***	41.65***	28.72***	22.82***	18.82***	13.60***
	(2.76)	(5.20)	(3.04)	(2.88)	(2.97)	(4.04)
SEIFA decile 7 [(e)]	24.95***	39.26***	27.09***	18.24***	16.08***	7.65*
	(2.74)	(5.18)	(3.03)	(2.86)	(2.94)	(4.00)
SEIFA decile 8 [(e)]	23.86***	44.12***	27.16***	17.98***	14.00***	1.26
	(2.76)	(5.23)	(3.07)	(2.91)	(2.99)	(4.05)
SEIFA decile 9 [(e)]	23.29***	46.16***	26.32***	18.23***	11.62***	-2.56
	(2.78)	(5.26)	(3.10)	(2.94)	(3.02)	(4.08)
SEIFA decile 10 [(e)]	20.41***	54.68***	26.34***	14.73***	6.84**	-9.38**
	(2.85)	(5.39)	(3.19)	(3.03)	(3.11)	(4.18)
Observations	1,294,185	1,294,185	1,294,185	1,294,185	1,294,185	1,294,185
R-squared	0.133	0.138	0.091	0.065	0.045	0.022
Mean dependent variable (grams)	3404.36	2745.00	3180.00	3440.00	3692.00	4070.00

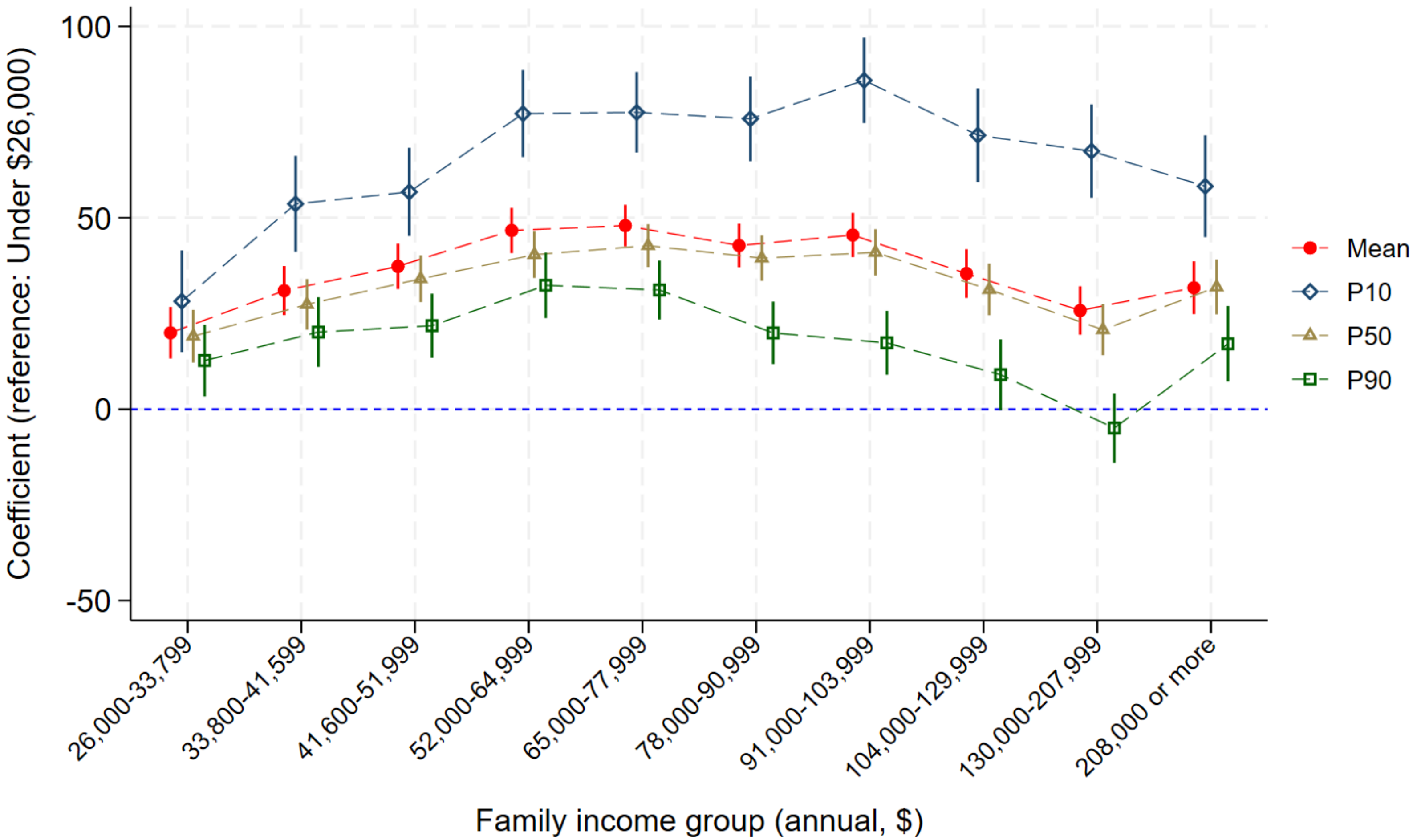
Notes: Estimates in each column are derived from Ordinary Least Squares (OLS) models for mean regressions and from unconditional quantile regression (UQR) models at selected percentiles (P10–P90). [(a)], [(b)], [(c)], [(d)], and [(e)] denotes the reference categories: "Year 11 or below", "Australian-born", "Under $26,000", "Renter", and "SEIFA decile 1", respectively. Additional covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Robust standard errors clustered at the family level are reported in parentheses. The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.

Figure 1: Associations between maternal and paternal education and child birth weight at the mean and selected percentiles



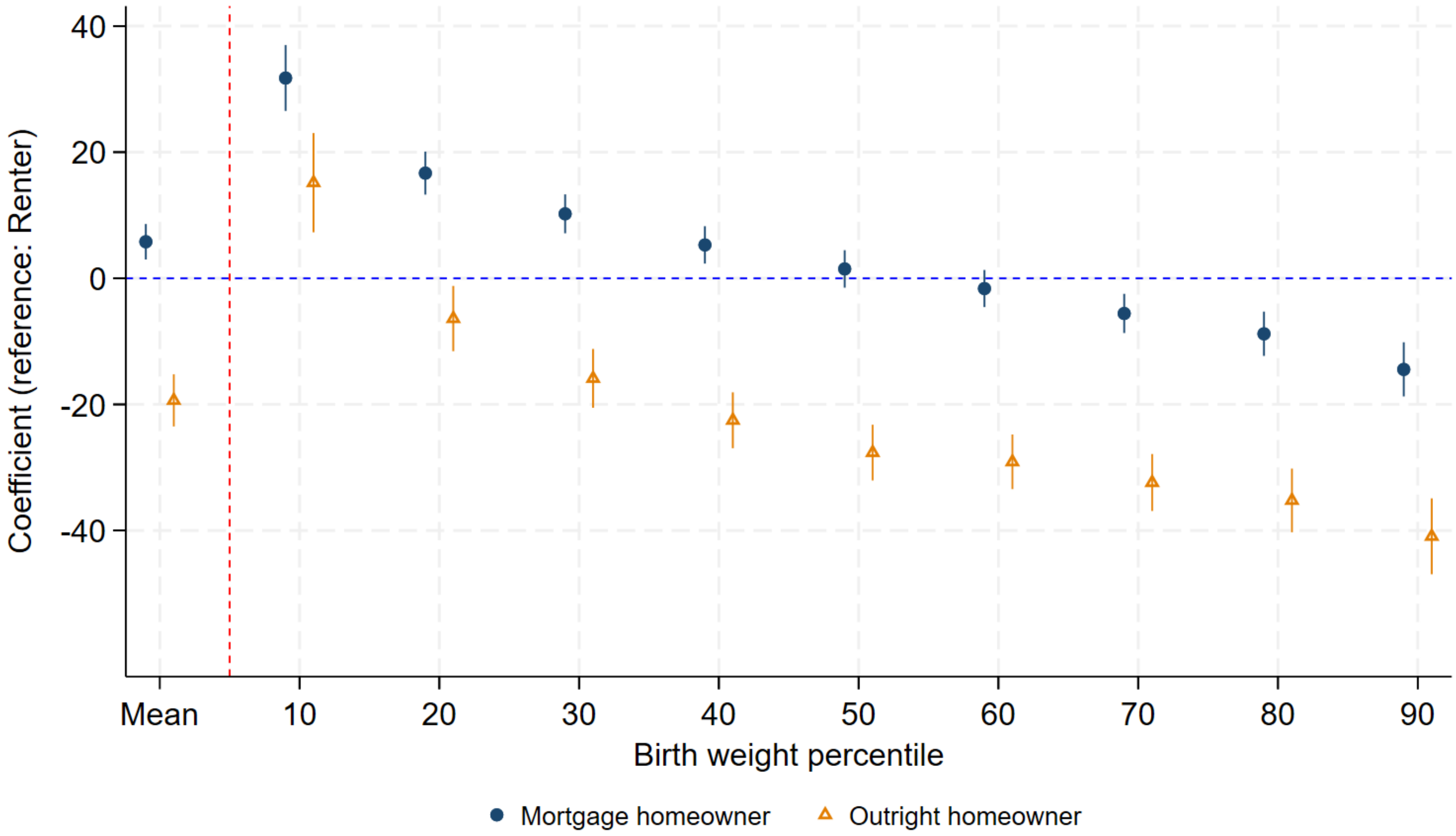
Notes: This figure presents estimates and corresponding 95% confidence intervals (shown as whiskers) for maternal and paternal education categories (with "Year 11 or below" as the reference group for both variables). Estimates at the mean are obtained from OLS regressions, and those at selected percentiles are derived from unconditional quantile regressions (UQR). In addition to other socioeconomic variables, covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Full regression results are reported in Table 2 and Appendix Table A2.

Figure 2: Associations between family income and child birth weight at the mean and selected percentiles



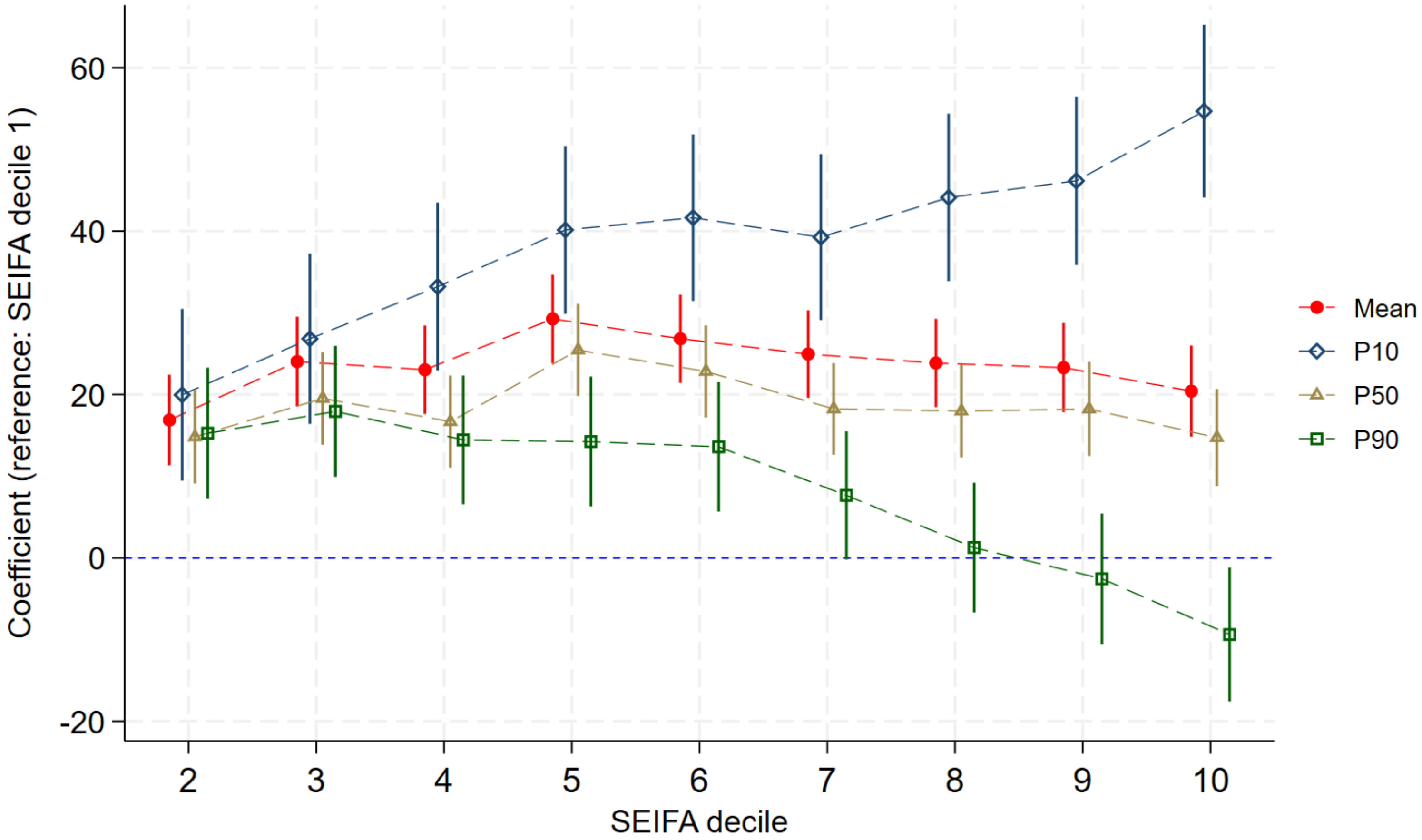
Notes: This figure presents estimates and corresponding 95% confidence intervals (shown as whiskers) for family income categories (with "Under $26,000 per year" as the reference group). Estimates at the mean are obtained from OLS regressions, and those at selected percentiles are derived from unconditional quantile regressions (UQR). In addition to other socioeconomic variables, covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Full regression results are reported in Table 2 and Appendix Table A2.

Figure 3: Associations between home ownership status and child birth weight at the mean and selected percentiles



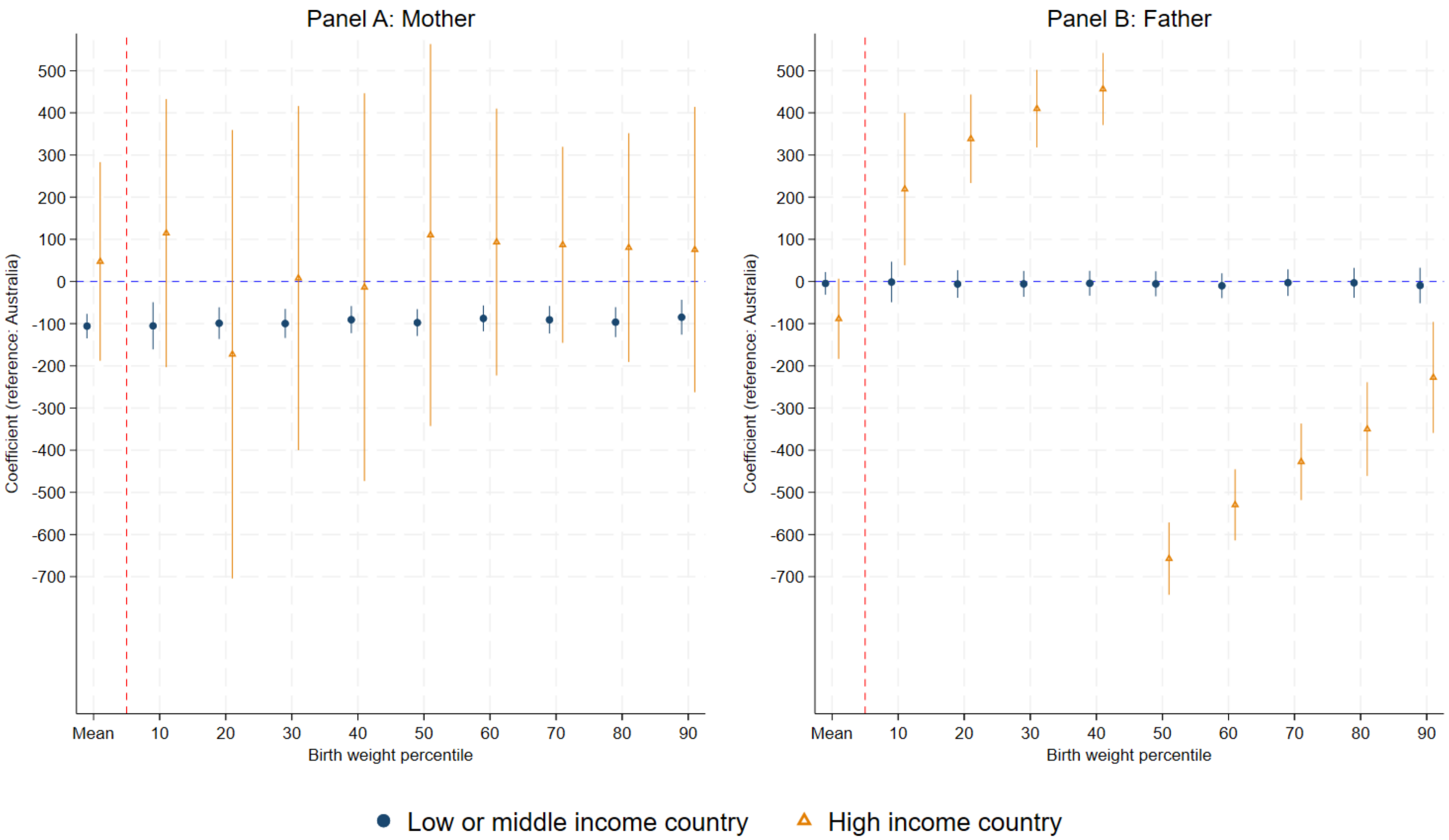
Notes: This figure presents estimates and corresponding 95% confidence intervals (shown as whiskers) for home ownership status (with "Renter" as the reference category). Estimates at the mean are obtained from OLS regressions, and those at selected percentiles are derived from unconditional quantile regressions (UQR). In addition to other socioeconomic variables, covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Full regression results are reported in Table 2 and Appendix Table A2.

Figure 4: Associations between local socioeconomic conditions and child birth weight at the mean and selected percentiles



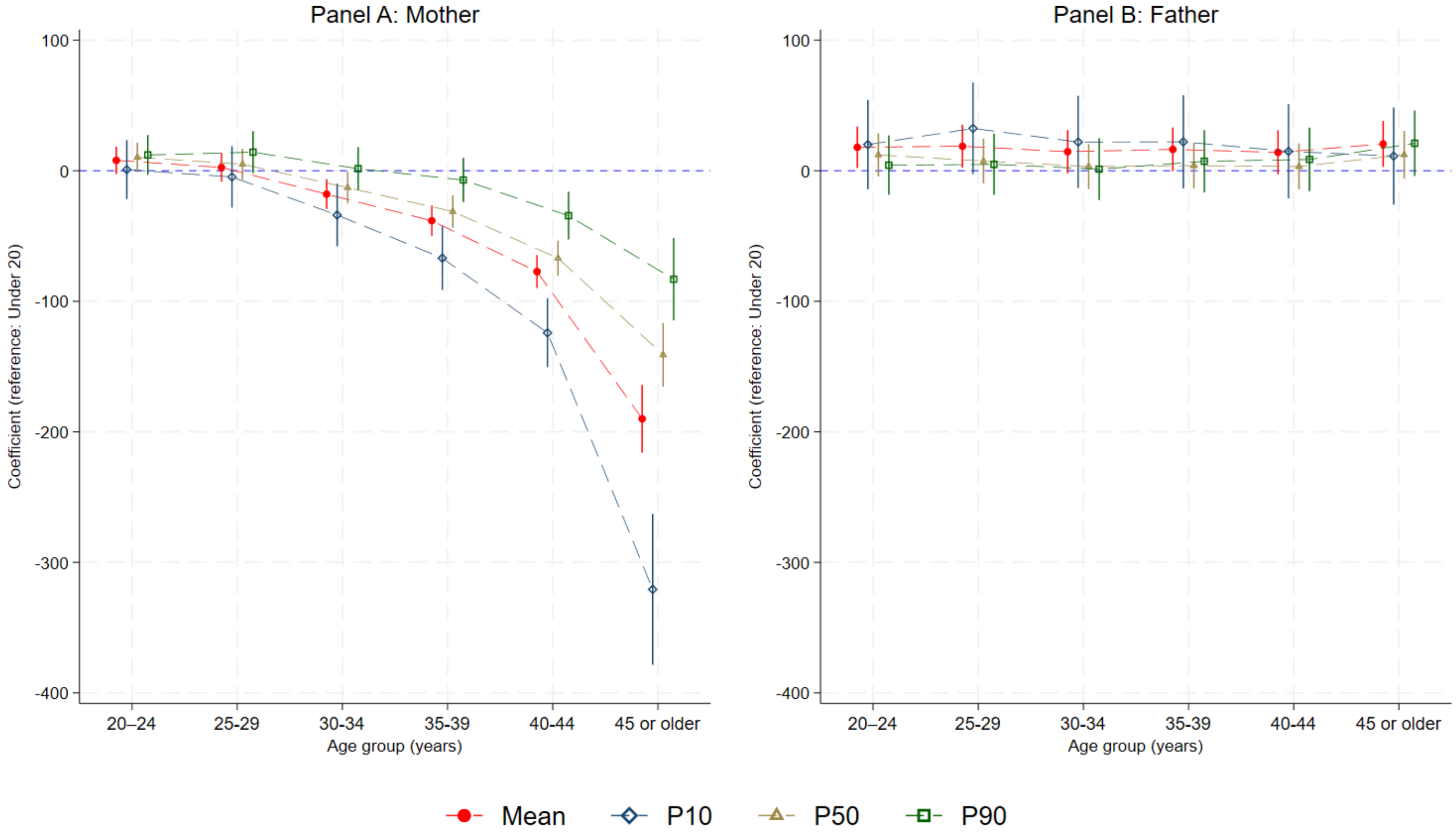
Notes: This figure presents estimates and corresponding 95% confidence intervals (shown as whiskers) for local socioeconomic conditions, measured using SEIFA deciles (with "SEIFA decile 1" as the reference category). Estimates at the mean are obtained from OLS regressions, and those at selected percentiles are derived from unconditional quantile regressions (UQR). In addition to other socioeconomic variables, covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Full regression results are reported in Table 2 and Appendix Table A2.

Figure 5: Associations between maternal and paternal country-of-origin income group and child birth weight at the mean and selected percentiles



Notes: This figure presents estimates and corresponding 95% confidence intervals (shown as whiskers) for maternal and paternal country-of-origin income group categorical variables (with "Australian-born" as the reference category for both variables). Estimates at the mean are obtained from OLS regressions, and those at selected percentiles are derived from unconditional quantile regressions (UQR). In addition to other socioeconomic variables, covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Full regression results are reported in Table 2 and Appendix Table A2.

Figure 6: Associations between maternal and paternal age and child birth weight at the mean and selected percentiles



Notes: This figure presents estimates and corresponding 95% confidence intervals (shown as whiskers) for maternal and paternal age group categories (with "Under 20" as the reference category for both variables). Estimates at the mean are obtained from OLS regressions, and those at selected percentiles are derived from unconditional quantile regressions (UQR). In addition to other socioeconomic variables, covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Full regression results are reported in Table 2 and Appendix Table A2.

Online Appendixes

For refereeing purposes and to be published online

Appendix Table A1: Estimates of socioeconomic gradients in low birth weight and across remaining selected percentiles

Regression at:	Low birth weight	P20	P40	P60	P80
	(1)	(2)	(3)	(4)	(5)
Mother education: Year 12 [(a)]	-1.13***	52.59***	41.99***	36.89***	34.43***
	(0.07)	(2.30)	(1.97)	(1.93)	(2.29)
Mother education: Certificate [(a)]	-0.82***	38.40***	33.81***	31.32***	27.35***
	(0.08)	(2.64)	(2.26)	(2.23)	(2.64)
Mother education: Diploma [(a)]	-1.15***	53.03***	40.15***	33.83***	30.91***
	(0.09)	(2.92)	(2.51)	(2.48)	(2.94)
Mother education: Bachelor degree or higher [(a)]	-1.44***	70.52***	59.13***	52.77***	48.60***
	(0.08)	(2.55)	(2.20)	(2.17)	(2.59)
Mother migrant – Low or middle income country [(b)]	1.49***	-98.85***	-90.49***	-87.48***	-96.27***
	(0.50)	(19.14)	(16.36)	(15.65)	(18.12)
Mother migrant – High income country [(b)]	2.55	-172.36	-13.44	93.55	80.56
	(6.08)	(271.30)	(234.63)	(161.42)	(138.37)
Father education: Year 12 [(a)]	-0.84***	35.26***	24.06***	18.54***	15.54***
	(0.07)	(2.41)	(2.06)	(2.03)	(2.41)
Father education: Certificate [(a)]	-0.82***	31.78***	21.35***	16.79***	14.21***
	(0.07)	(2.21)	(1.89)	(1.87)	(2.23)
Father education: Diploma [(a)]	-1.04***	40.28***	26.88***	18.55***	11.55***
	(0.09)	(3.11)	(2.70)	(2.68)	(3.20)
Father education: Bachelor degree or higher [(a)]	-1.17***	42.76***	28.79***	18.16***	11.79***
	(0.08)	(2.62)	(2.27)	(2.25)	(2.68)
Father migrant – Low or middle income country [(b)]	-0.37	-5.80	-4.17	-10.03	-3.03
	(0.43)	(16.69)	(15.06)	(15.03)	(18.08)
Father migrant – High income country [(b)]	-3.72**	338.50***	456.49***	-529.50***	-349.99***
	(1.82)	(53.53)	(43.62)	(43.04)	(56.61)

Regression at:	Low birth weight	P20	P40	P60	P80
	(1)	(2)	(3)	(4)	(5)
Family income $26,000-$33,799 (c)	-0.42***	19.93***	20.52***	18.23***	14.73***
	(0.13)	(4.33)	(3.56)	(3.42)	(3.97)
Family income $33,800-$41,599 (c)	-0.89***	36.47***	30.21***	24.03***	18.59***
	(0.12)	(4.10)	(3.42)	(3.29)	(3.84)
Family income $41,600-$51,999 (c)	-0.86***	43.72***	37.08***	29.78***	28.48***
	(0.11)	(3.76)	(3.14)	(3.03)	(3.55)
Family income $52,000-$64,999 (c)	-1.28***	53.68***	44.40***	36.78***	34.28***
	(0.11)	(3.75)	(3.14)	(3.06)	(3.59)
Family income $65,000-$77,999 (c)	-1.13***	54.85***	45.63***	39.83***	35.64***
	(0.10)	(3.46)	(2.89)	(2.80)	(3.27)
Family income $78,000-$90,999 (c)	-1.24***	54.34***	43.74***	35.15***	25.50***
	(0.11)	(3.64)	(3.06)	(2.97)	(3.46)
Family income $91,000-$103,999 (c)	-1.38***	59.18***	44.06***	35.35***	23.88***
	(0.11)	(3.68)	(3.11)	(3.03)	(3.54)
Family income $104,000-$129,999 (c)	-1.15***	50.45***	36.17***	26.07***	17.82***
	(0.12)	(4.06)	(3.45)	(3.37)	(3.93)
Family income $130,000-$207,999 (c)	-1.00***	42.13***	26.29***	15.32***	4.31
	(0.12)	(4.06)	(3.44)	(3.34)	(3.88)
Family income $208,000 or more (c)	-0.81***	41.07***	34.13***	30.14***	19.34***
	(0.13)	(4.38)	(3.68)	(3.58)	(4.19)
Mortgage homeowner (d)	-0.59***	16.68***	5.29***	-1.62	-8.80***
	(0.05)	(1.74)	(1.51)	(1.50)	(1.79)
Outright homeowner (d)	-0.44***	-6.39**	-22.52***	-29.12***	-35.23***
	(0.08)	(2.64)	(2.26)	(2.21)	(2.57)
SEIFA decile 2 (e)	-0.28***	13.90***	14.66***	16.80***	16.64***

Regression at:	Low birth weight	P20	P40	P60	P80
	(1)	(2)	(3)	(4)	(5)
	(0.10)	(3.47)	(2.93)	(2.86)	(3.37)
SEIFA decile 3 [(e)]	-0.55***	23.36***	21.49***	17.36***	17.96***
	(0.10)	(3.45)	(2.91)	(2.84)	(3.36)
SEIFA decile 4 [(e)]	-0.58***	23.59***	17.54***	18.00***	17.35***
	(0.10)	(3.41)	(2.89)	(2.82)	(3.32)
SEIFA decile 5 [(e)]	-0.63***	32.14***	28.66***	23.58***	16.83***
	(0.10)	(3.40)	(2.89)	(2.83)	(3.34)
SEIFA decile 6 [(e)]	-0.68***	31.20***	25.84***	20.01***	17.10***
	(0.10)	(3.39)	(2.89)	(2.83)	(3.34)
SEIFA decile 7 [(e)]	-0.75***	30.45***	21.17***	17.05***	10.81***
	(0.10)	(3.38)	(2.88)	(2.81)	(3.30)
SEIFA decile 8 [(e)]	-0.76***	32.90***	21.34***	16.60***	8.41**
	(0.10)	(3.42)	(2.92)	(2.86)	(3.35)
SEIFA decile 9 [(e)]	-0.88***	32.85***	22.39***	15.41***	6.20*
	(0.10)	(3.45)	(2.95)	(2.89)	(3.38)
SEIFA decile 10 [(e)]	-0.98***	33.43***	20.80***	10.32***	-0.79
	(0.10)	(3.54)	(3.04)	(2.97)	(3.48)
Observations	1,294,185	1,294,185	1,294,185	1,294,185	1,294,185
R-squared	0.130	0.111	0.077	0.055	0.035
Mean dependent variable	0.05	3010.00	3310.00	3560.00	3850.00

Notes: Estimates in each column are derived from Ordinary Least Squares (OLS) models for mean regressions and from unconditional quantile regression models at selected percentiles. For the low birth weight outcome (birth weight < 2,500 g), coefficients and standard errors are multiplied by 100 for presentation purposes. [(a)], [(b)], [(c)], [(d)], and [(e)] denotes the reference categories: "Year 11 or below", "Australian-born", "Under $26,000", "Renter", and "SEIFA decile 1", respectively. Additional covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Robust standard errors clustered at the family level are reported in parentheses. The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.

Appendix Table A2: Determinants of birth weight – Remaining results

Regression at:	Mean	Low birth weight	P10	P20	P30	P40
	(1)	(2)	(3)	(4)	(5)	(6)
Male	123.78***	-0.91***	89.50***	104.47***	117.02***	125.27***
	(0.95)	(0.04)	(1.95)	(1.26)	(1.12)	(1.07)
First time mother	-101.32***	1.96***	-133.44***	-104.53***	-99.37***	-95.65***
	(1.09)	(0.05)	(2.31)	(1.46)	(1.28)	(1.21)
Multi births	-1,034.89***	46.23***	-2,432.84***	-1,304.29***	-959.22***	-760.20***
	(4.00)	(0.31)	(10.90)	(3.83)	(2.30)	(1.66)
Number of all co-residing children	14.85***	-0.21***	11.59***	9.45***	10.30***	11.24***
	(0.67)	(0.02)	(1.25)	(0.80)	(0.71)	(0.68)
Mother age: 20–24 [(a)]	7.98	-0.14	0.85	3.59	1.80	6.48
	(5.37)	(0.23)	(11.49)	(7.20)	(6.26)	(5.83)
Mother age: 25–29 [(a)]	2.58	0.03	-4.75	-5.04	-6.68	-0.37
	(5.67)	(0.23)	(11.98)	(7.54)	(6.57)	(6.13)
Mother age: 30–34 [(a)]	-17.89***	0.56**	-33.89***	-27.49***	-26.60***	-19.80***
	(5.82)	(0.24)	(12.24)	(7.71)	(6.73)	(6.28)
Mother age: 35–39 [(a)]	-38.26***	1.12***	-66.90***	-51.10***	-48.49***	-40.38***
	(5.97)	(0.24)	(12.49)	(7.88)	(6.88)	(6.43)
Mother age: 40–44 [(a)]	-77.24***	2.12***	-124.16***	-97.71***	-89.89***	-77.66***
	(6.45)	(0.27)	(13.49)	(8.49)	(7.42)	(6.93)
Mother age: 45 or older [(a)]	-190.00***	6.04***	-320.67***	-238.99***	-199.10***	-170.97***
	(13.26)	(0.65)	(29.46)	(17.23)	(14.31)	(12.92)
Father age: 20–24 [(a)]	17.97**	-0.10	20.04	19.61*	20.14**	18.84**
	(8.08)	(0.35)	(17.47)	(10.76)	(9.33)	(8.63)
Father age: 25–29 [(a)]	18.78**	-0.32	32.46*	20.79*	20.36**	15.87*
	(8.36)	(0.36)	(17.91)	(11.08)	(9.60)	(8.89)
Father age: 30–34 [(a)]	14.64*	-0.18	22.01	14.22	14.17	10.09
	(8.46)	(0.36)	(18.07)	(11.18)	(9.70)	(8.99)
Father age: 35–39 [(a)]	16.38*	-0.22	22.10	14.95	13.02	9.60
	(8.53)	(0.36)	(18.19)	(11.27)	(9.78)	(9.06)
Father age: 40–44 [(a)]	14.07	-0.05	14.86	11.90	12.00	9.21
	(8.66)	(0.37)	(18.43)	(11.43)	(9.92)	(9.20)
Father age: 45 or older [(a)]	20.54**	0.11	11.25	18.77	18.34*	17.36*
	(8.95)	(0.38)	(18.99)	(11.78)	(10.24)	(9.50)
Constant	3,279.61***	7.34***	2,610.42***	2,890.69***	3,063.90***	3,202.85***
	(8.23)	(0.35)	(17.44)	(10.82)	(9.40)	(8.72)
Observations	1,294,185	1,294,185	1,294,185	1,294,185	1,294,185	1,294,185
R-squared	0.133	0.130	0.138	0.111	0.091	0.077

Notes: Estimates in each column are derived from Ordinary Least Squares (OLS) models for mean regressions and from unconditional quantile regression models at selected percentiles (P10–P90). For the low birth weight outcome (birth weight < 2,500 g), coefficients and standard errors are multiplied by 100 for presentation purposes. [(a)] denotes "Under 20" as the reference category. Additional covariates include socioeconomic variables (with results reported in Table 2 and Appendix Table A1), state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Robust standard errors clustered at the family level are reported in parentheses. The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.

Appendix Table A2: Determinants of birth weight – Remaining results (continued)

Regression at:	P50	P60	P70	P80	P90
	(7)	(8)	(9)	(10)	(11)
Male	133.14***	133.24***	138.72***	148.95***	153.00***
	(1.06)	(1.04)	(1.10)	(1.25)	(1.54)
First time mother	-93.87***	-89.89***	-88.38***	-91.06***	-86.46***
	(1.20)	(1.17)	(1.23)	(1.39)	(1.72)
Multi births	-630.84***	-516.07***	-441.15***	-386.68***	-322.14***
	(1.40)	(1.21)	(1.18)	(1.23)	(1.39)
Number of all co-residing children	12.45***	12.37***	14.65***	15.42***	18.08***
	(0.68)	(0.67)	(0.71)	(0.81)	(1.00)
Mother age: 20–24 [(a)]	10.29*	15.39***	14.36**	2.95	12.10
	(5.74)	(5.56)	(5.79)	(6.53)	(7.79)
Mother age: 25–29 [(a)]	5.05	13.30**	12.84**	3.24	14.25*
	(6.03)	(5.83)	(6.08)	(6.85)	(8.18)
Mother age: 30–34 [(a)]	-12.95**	-4.14	-3.70	-13.09*	1.60
	(6.18)	(5.99)	(6.25)	(7.03)	(8.41)
Mother age: 35–39 [(a)]	-31.22***	-19.64***	-17.21***	-24.92***	-7.09
	(6.33)	(6.14)	(6.40)	(7.21)	(8.63)
Mother age: 40–44 [(a)]	-66.97***	-50.52***	-47.40***	-51.67***	-34.40***
	(6.83)	(6.62)	(6.91)	(7.77)	(9.33)
Mother age: 45 or older [(a)]	-141.01***	-128.20***	-114.12***	-112.46***	-83.06***
	(12.44)	(11.85)	(12.09)	(13.33)	(16.11)
Father age: 20–24 [(a)]	12.11	14.42*	15.06*	14.90	4.24
	(8.45)	(8.18)	(8.51)	(9.60)	(11.60)
Father age: 25–29 [(a)]	7.44	7.33	7.90	11.66	4.89
	(8.71)	(8.43)	(8.79)	(9.88)	(11.93)
Father age: 30–34 [(a)]	3.26	4.73	4.98	9.81	1.26
	(8.81)	(8.53)	(8.89)	(10.01)	(12.08)
Father age: 35–39 [(a)]	3.92	6.18	8.19	13.63	7.28
	(8.89)	(8.61)	(8.98)	(10.10)	(12.19)
Father age: 40–44 [(a)]	3.28	5.82	8.69	12.45	8.67
	(9.02)	(8.75)	(9.12)	(10.26)	(12.40)
Father age: 45 or older [(a)]	12.29	17.36*	19.29**	24.26**	21.04
	(9.32)	(9.03)	(9.42)	(10.59)	(12.80)
Constant	3,333.11***	3,444.94***	3,572.42***	3,741.59***	3,959.63***
	(8.55)	(8.26)	(8.57)	(9.63)	(11.68)
Observations	1,294,185	1,294,185	1,294,185	1,294,185	1,294,185
R-squared	0.065	0.055	0.045	0.035	0.022

Notes: Estimates in each column are derived from Ordinary Least Squares (OLS) models for mean regressions and from unconditional quantile regression models at selected percentiles (P10–P90). For the low birth weight outcome (birth weight < 2,500 g), coefficients and standard errors are multiplied by 100 for presentation purposes. [(a)] denotes "Under 20" as the reference category. Additional covariates include socioeconomic variables (with results reported in Table 2 and Appendix Table A1), state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. Robust standard errors clustered at the family level are reported in parentheses. The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.

Appendix Table A3: Robustness checks - Separate inclusion of socioeconomic variables and sample of children born from 2012

	Baseline	Separate inclusion of socioeconomic variables	Sample of children born from 2012
	(1)	(2)	(3)
Mother education: Year 12 [(a)]	46.57***	56.33***	34.91***
	(1.88)	(1.84)	(2.63)
Mother education: Certificate [(a)]	36.32***	46.46***	20.79***
	(2.17)	(2.14)	(3.16)
Mother education: Diploma [(a)]	44.41***	57.85***	26.29***
	(2.37)	(2.31)	(3.65)
Mother education: Bachelor degree or higher [(a)]	62.93***	78.99***	45.74***
	(2.08)	(1.90)	(3.19)
Mother migrant – Low or middle income country [(b)]	-105.65***	-97.16***	-128.66***
	(14.84)	(14.87)	(22.24)
Mother migrant – High income country [(b)]	47.62	74.53	142.40
	(120.18)	(124.93)	(215.60)
Father education: Year 12 [(a)]	27.31***	42.16***	20.52***
	(1.97)	(1.94)	(2.69)
Father education: Certificate [(a)]	24.78***	40.08***	21.00***
	(1.82)	(1.78)	(2.65)
Father education: Diploma [(a)]	28.13***	50.08***	18.73***
	(2.53)	(2.47)	(3.93)
Father education: Bachelor degree or higher [(a)]	30.40***	59.01***	15.91***
	(2.14)	(1.94)	(3.20)
Father migrant – Low or middle income country [(b)]	-4.45	2.98	20.49
	(13.65)	(13.66)	(20.68)
Father migrant – High income country [(b)]	-88.48*	-68.75	-219.48***
	(48.54)	(48.25)	(18.03)
Family income $26,000-$33,799 [(c)]	19.97***	23.77***	24.18***
	(3.44)	(3.46)	(4.83)
Family income $33,800-$41,599 [(c)]	30.98***	39.33***	34.04***
	(3.28)	(3.28)	(4.67)
Family income $41,600-$51,999 [(c)]	37.33***	48.98***	37.30***
	(3.02)	(3.02)	(4.35)
Family income $52,000-$64,999 [(c)]	46.69***	62.22***	43.39***
	(3.02)	(3.00)	(4.40)
Family income $65,000-$77,999 [(c)]	47.97***	68.09***	44.24***
	(2.77)	(2.72)	(3.97)
Family income $78,000-$90,999 [(c)]	42.77***	67.63***	37.63***

	Baseline	Separate inclusion of socioeconomic variables	Sample of children born from 2012
	(1)	(2)	(3)
	(2.91)	(2.84)	(4.16)
Family income \$91,000-\$103,999 (c)	45.51***	72.99***	38.45***
	(2.95)	(2.84)	(4.31)
Family income \$104,000-\$129,999 (c)	35.43***	66.11***	36.72***
	(3.24)	(3.12)	(4.68)
Family income \$130,000-\$207,999 (c)	25.77***	58.40***	23.97***
	(3.23)	(3.06)	(4.52)
Family income \$208,000 or more (c)	31.73***	50.03***	34.16***
	(3.53)	(3.49)	(4.76)
Mortgage homeowner (d)	5.80***	21.84***	5.99***
	(1.44)	(1.38)	(2.10)
Outright homeowner (d)	-19.36***	-4.06*	-26.01***
	(2.11)	(2.08)	(2.90)
SEIFA decile 2 (e)	16.88***	20.27***	22.56***
	(2.83)	(2.84)	(3.97)
SEIFA decile 3 (e)	24.04***	29.56***	28.11***
	(2.80)	(2.81)	(3.94)
SEIFA decile 4 (e)	23.03***	31.58***	26.64***
	(2.76)	(2.76)	(3.90)
SEIFA decile 5 (e)	29.26***	39.16***	31.99***
	(2.77)	(2.76)	(3.91)
SEIFA decile 6 (e)	26.83***	39.41***	32.25***
	(2.76)	(2.75)	(3.93)
SEIFA decile 7 (e)	24.95***	39.39***	31.57***
	(2.74)	(2.72)	(3.90)
SEIFA decile 8 (e)	23.86***	40.24***	26.91***
	(2.76)	(2.74)	(3.96)
SEIFA decile 9 (e)	23.29***	41.56***	29.80***
	(2.78)	(2.74)	(4.02)
SEIFA decile 10 (e)	20.41***	40.52***	32.56***
	(2.85)	(2.77)	(4.14)
Observations	1,294,185	1,294,185	550,184
R-squared	0.133	[0.130; 0.131]	0.122

Notes: Estimates in each column are derived from Ordinary Least Squares (OLS) models. (a), (b), (c), (d), and (e) denotes the reference categories: “Year 11 or below”, “Australian-born”, “Under \$26,000”, “Renter”, and “SEIFA decile 1”, respectively. Additional covariates include gender, first-time mother status, multiple births, the number of co-residing children, state/territory fixed effects, year-of-birth fixed effects, and maternal and paternal country-of-birth fixed effects. R-squared values reported in Column 2 is the minimum (the first value in the squared brackets) and maximum (the second value) R-squared value from all separate regressions. Robust standard errors clustered at the family level are reported in parentheses. The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.

Appendix Table A4: Robustness check - using a mother fixed effects model

Specification and sample:	OLS – Full sample	Family Fixed Effects model	OLS – Family FE sample
	(1)	(2)	(3)
Male	121.85***	128.92***	122.43***
	(0.75)	(0.88)	(0.87)
First time mother	-114.69***	-87.83***	-105.42***
	(0.76)	(0.97)	(0.91)
Multi births	-1,036.39***	-1,035.07***	-1,049.87***
	(3.10)	(4.88)	(3.14)
Mother age: 20–24 [(a)]	32.29***	-3.31	35.23***
	(3.99)	(4.99)	(4.68)
Mother age: 25–29 [(a)]	44.52***	-5.29	49.76***
	(4.21)	(5.58)	(4.96)
Mother age: 30–34 [(a)]	35.24***	-4.12	45.59***
	(4.31)	(6.03)	(5.10)
Mother age: 35–39 [(a)]	16.53***	-3.76	32.99***
	(4.43)	(6.58)	(5.27)
Mother age: 40–44 [(a)]	-26.73***	-27.93***	0.98
	(4.84)	(7.72)	(5.96)
Mother age: 45 or older [(a)]	-134.54***	-105.48***	-94.25***
	(9.94)	(18.39)	(14.28)
Father age: 20–24 [(a)]	31.98***	10.18	28.82***
	(5.82)	(7.46)	(7.02)
Father age: 25–29 [(a)]	30.72***	9.89	27.49***
	(6.03)	(7.96)	(7.30)
Father age: 30–34 [(a)]	18.71***	15.79*	17.58**
	(6.11)	(8.23)	(7.40)
Father age: 35–39 [(a)]	10.56*	19.27**	13.47*
	(6.17)	(8.53)	(7.47)
Father age: 40–44 [(a)]	0.81	15.99*	4.66
	(6.28)	(9.00)	(7.63)
Father age: 45 or older [(a)]	-8.07	-1.23	-5.98
	(6.53)	(10.05)	(8.05)
SEIFA decile 2 [(b)]	23.63***	1.00	23.03***
	(1.93)	(2.63)	(2.31)
SEIFA decile 3 [(b)]	36.72***	2.82	34.53***
	(1.91)	(2.65)	(2.29)
SEIFA decile 4 [(b)]	42.66***	5.41**	40.82***
	(1.90)	(2.69)	(2.28)
SEIFA decile 5 [(b)]	44.31***	4.01	41.33***
	(1.90)	(2.75)	(2.28)

Specification and sample:	OLS – Full sample	Family Fixed Effects model	OLS – Family FE sample
	(1)	(2)	(3)
SEIFA decile 6 [(b)]	43.15***	2.61	39.28***
	(1.91)	(2.80)	(2.30)
SEIFA decile 7 [(b)]	36.96***	1.67	32.56***
	(1.93)	(2.88)	(2.34)
SEIFA decile 8 [(b)]	40.62***	1.65	34.96***
	(1.97)	(3.05)	(2.39)
SEIFA decile 9 [(b)]	39.72***	-1.07	30.28***
	(2.01)	(3.27)	(2.45)
SEIFA decile 10 [(b)]	36.17***	-2.19	22.99***
	(2.08)	(3.65)	(2.56)
Observations	2,191,937	1,585,056	1,585,056
R-squared	0.116	0.711	0.148

Notes: Estimates in each column are derived from either an Ordinary Least Squares (OLS) model or a mother fixed effects (FE) model. [(a)] and [(b)] denotes "Under 20" and "SEIFA decile 1" as the reference category, respectively. Additional covariates include state/territory fixed effects, and year-of-birth fixed effects. Robust standard errors clustered at the family level are reported in parentheses. The symbol * indicates statistical significance at 10% level, ** at 5% level, and *** at 1% level.