Abstract

Since the 1960s, the total fertility rate in New Zealand, much like in other developed countries, has declined, while the female labour market participation has increased. The link between labour supply and child quantity may explain increases in the female labour market participation rate if low child quantity results in higher labour force attachment. Previous New Zealand studies on the effects of childbearing on female labour supply suffer from a lack of reliable micro-data. Furthermore, past NZ-specific analyses also fail to account for a likely endogenous determination of child quantity, which can bias estimation of the main causal mechanisms of interest. In this dissertation, I estimate the causal effect of child quantity on maternal labour market outcomes. Following the empirical methodology adopted in the previous family size literature, I use twin births and parental preferences for mixed-sex siblings as plausible sources of exogenous variation in child quantity. I use population-based administrative data from Statistics New Zealand's Integrated data infrastructure for my empirical analysis. Focusing on mothers of childbearing age (aged 18-45), the empirical analysis incorporates a two-stage least squared (2SLS) estimation strategy. I find that when using sources of exogenous variation, having additional children results in a reduction in labour market earnings and employment propensity. This negative effect is further substantiated by a decrease in the proportion of months worked and full-time employment propensity. Furthermore, using fixed effects regression, I also find that the probability of employment in a paid job (and level of labour market earnings) declines with each successive child. If having additional children results in increased time spent raising children, it is likely at the expense of leisure time as having an additional child has no effect on the labour outcomes of partners of mothers in this sample.

Empirical evidence shows that childbearing has a negative effect on employment and work hours when addressing the potential endogeneity in child quantity in several western countries, (Angrist & Evans, 1998; Frenette, 2011; Moschion, 2013). While there have been numerous studies of female labour force participation in New Zealand, they rely either on regional aggregates for employment and family size or the assumption that family size is exogenous, (Brooks, 1991; Hyman, 1979; Poot & Siegers, 1992; Ross, 1987). At the time of their studies, individual-level unit record data was unavailable, and so they relied on regional aggregates of fertility and labour force participation.

I contribute to the existing evidence on the effects of child quantity on parental labour market employment by answering the following research question: *What causal effect does child quantity have on the employment and earnings of mothers in New Zealand?*

This dissertation contributes to the existing New Zealand family size literature in three ways. First, it is the first to estimate the effect of child quantity on parental labour market outcomes using population-wide administrative data from Statistics New Zealand's Integrated Data Infrastructure. Second, it addresses potential endogeneity by allowing for exogenous variation in child quantity through multiple births and the parental preference for a mixed-gender composition of their children. Third, it also considers the birth order effects through mothers' fixed effects regression analysis that control for individual-level time-invariant unobserved influences.

I use parental preferences for mixed-sex children and multiple births as sources of exogenous variation (instrumental variables) in child quantity to address potential endogeneity. Consistent with international studies that also use two-stage least squared (2SLS) and the same instruments, having additional children results in a decrease in earnings and employment.

My main findings are as follows. Increasing child quantity decreases the proportion of mothers employed and those employed in full-time work. Mothers reduce their labour supply regardless of their education level or age. Most of the 2SLS estimates are smaller than the OLS estimates, suggesting that OLS exaggerates the causal effect of childbearing. Compared to other countries these effects are small. France, Australia and the United States all experienced larger decreases in the proportion of women employed. Only Argentina and Mexico observe smaller declines in employment using preferences for mixed-sex children. Additionally, I analyse the labour market effects by birth for mothers controlling for mother specific characteristics. I do this by running a fixed effects regression on mothers who had their first child between 2010 and 2015. I find that the probability of maternal employment and a mother's monthly salary declines with each

$$U = U(n, q, S) \tag{3}$$

$$Y = H + wL = px \tag{4}$$

$$T = t + L \tag{5}$$

$$q = f\left(\frac{t_c}{n}, \frac{x_c}{n}\right) \tag{6}$$

$$S = g(t_s, x_s) \tag{7}$$

Like the quantity-quality model a family's utility function is comprised of the number of children n, the quality per child, q, and in the place of consumption of other goods, S represents the satisfaction from other sources. The purchase of aggregate goods x, at price p, is limited by the family's lifetime income Y, which is determined by the husband's lifetime earnings, H, the wife's hourly wage, w, and her hours worked over the course of the marriage L. A wife's total time after marriage is denoted by T, the time spent in home production t is divided into time spent on children, t_c, and time spent devoted to satisfaction, t_s. There are two types of good, goods allocated to one's children, x_c, and those allocated to one's satisfaction, x_s. This model assumes that the husband and wife contribute to family income and that only the wife's time is productive at home.

Parents increase their utility by having more children, investing more time and resources to improve their children's quality, or investing in their own satisfaction. Of course, if they are investing time into childrearing or satisfaction, this is at the expense of time spent in the labour market. The Willis model provides reasoning that the interaction between the decision to have children and income is negative in what Willis (1987) describes as the "female cost of time hypothesis" (p.69). Willis (1987) summarizes this hypothesis as follows:

> *The cost of time hypothesis follows from the assumption that childrearing is relatively more intensive in the use of mother's time than are non-child-related household production activities. When a wife does not engage in market work, ... the shadow value of her time, and hence the marginal cost of children, is an increasing function of husband's income and when women do participate in the market, the cost of time is determined by her (marginal) wage rate. Since the wife's time allocation is endogenous, the model also provides an explanation for the negative correlation between the presence of young children and female labor supply (p. 69).*

2.3 Relevant Literature

2.3.1 International Literature

Estimating the effects of fertility on labour market outcomes is not without its methodological challenges. Economists like Becker (1981) suggest that labour force participation, marriage and fertility decisions are all jointly determined/endogenous. Women may often consider their income, employment and hours worked in their decision to have children, (Browning et al., 2011). Mothers may also consider their children in their decision to enter the labour market or work more hours. Regressing labour market participation on child quantity may then create biased estimates as labour force participation and child quantity are endogenously determined.

To address the endogeneity concern in family size, economists often use the incidence of multiple births and the sex of the first two children as sources for exogenous variation (instrumental variables). In a seminal contribution, Rosenzweig and Wolpin (1980a) introduce multiple births (or twins) as a source of exogenous shock (instrumental variable) to child quantity. This instrument exploits the occurrence of twins to estimate the effect of an unanticipated increase in child quantity. Rosenzweig and Wolpin (1980a) state that the twin's variable finds a way around the simultaneity bias due to the randomness of having a multiple birth.

Following Rosenzweig and Wolpin (1980a), a number of studies have made use of a twin birth variable as an instrument for an unexpected increase in family size. There has since been significant variation in the use of the twins as exogenous variation in family size: 'twins' ratio' Rosenzweig and Wolpin (1980a); 'twins first' by Rosenzweig and Wolpin (1980b); 'twin presence' by Dasgupta and Solomon (2018); and the 'twins second' approach by Bronars and Grogger (1994).

Rosenzweig and Wolpin (1980a) use 25 twin pairs to estimate the effect of family size on child educational outcomes in India. They use data of families with married women from the Additional Rural Incomes survey, collected between 1969 and 1971. Rosenzweig and Wolpin (1980a) do not simply use the presence of twins as an instrument due to concern about the correlation of twins with parity; women who give birth to more children are more likely to have twins, (Mittler, 1971, as cited by Rosenzweig & Wolpin, 1980a).[4] They instead use the twins' ratio, which is the number of twin births divided by the number of pregnancies. This approach standardizes parity and in part, accounts for the potential non-randomness of twin birth occurrences.

[4] This is also evident in New Zealand data, where the probability of twins increases with birth parity.

Chapter 3 Empirical Strategy

3.1 Ordinary Least Squares

The objective of this dissertation is to examine the effect that child quantity plays on a mother's labour market outcomes. I begin with an Ordinary Least Squares regression (OLS), which can be represented by:

$$Y_i = \beta_0 + \beta_1 Childquantity_i + \beta_2 X_i + \epsilon_i \quad (8)$$

I regress a measure of mother i's labour market outcomes Y_i, which are measured by the outcome variables described in detail in Table 2 in Chapter 4, on the number of children $Childquantity_i$ and a vector of mother-specific controls X_i. The vector X_i includes the mother's ethnicity, age (and age^2), age at first birth (and age at first birth^2), education, partnership status, and family income[5]. However, child quantity might be endogenously determined by individual characteristics, including unobserved parental preferences. As such, the OLS estimates are likely to be inconsistent and biased. Specifically, the endogeneity concern is as follows. Having children may affect a mother's decision to participate in the labour market, but on the other hand, participating in the labour market may affect her decision to have children. The result is a correlation with the error term, ϵ_i , and a bias in the estimates.

3.2 Instrumental Variables Approach

To address for the aforementioned endogeneity concerns, I use the instrumental variable method (IV). Standard IV estimation proceeds as follows. In the first stage, I model the effect of the instruments' variation in child quantity. In the second stage, I estimate the effect of maternal labour market outcomes using predicted $Childquantity_i$ values obtained from the first stage. The two-stage least squares model can be represented by the following two equations:

The first stage:

$$Childquantity_i = \sigma_0 Xi + \sigma_1 IV_i + \omega_i \quad (9)$$

[5] While there are concerns of endogeneity by including family income, there is no significant differences in regression estimates when including this control.

The second stage:

$$Y_i = \alpha_0 + \alpha_1 \widehat{Child quantity}_i + \alpha_2 X_i + \epsilon_i \quad (10)$$

The mothers' specific characteristics denoted by vector X_i are similar to the variables in equation (8) and IV_i represents one of two binary variables I use as instruments. The two IV's I use in my analysis are twin presence in the second birth '*Twin-2*' and the '*same-sex*' instrument. In the regression using sex composition of children as the instrumental variable, the variable IV_i is set to 1 for mothers whose first two children are of the same sex and 0 otherwise. In the *same-sex* regression I use only mothers of singletons – to remove influences in family size caused by multiple births. As specified in the international literature section in Chapter 2 the twinning instrument is used in various ways. For my analysis, I will use multiple birth presence in the second birth as my instrument.[6] In the regression where I use twinning as my instrument, I use an indicator that is equal to 1 if there is a presence of a multiple birth in the second birth and 0 otherwise. Additionally, I exclude mothers with multiple births in all other parities, such that the comparable group incorporates mothers of singletons only. I prefer to use twin presence in the second birth for my main analysis as it provides a good comparison with the *same-sex* instrument as the analysis is restricted to families with two or more children.

3.2.1 Instrument Validity

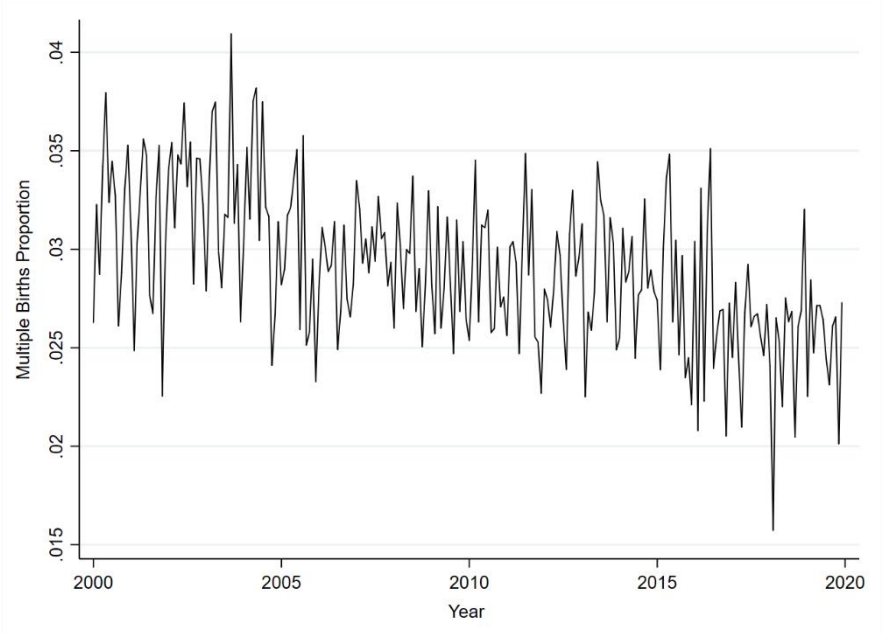
To address the potential endogeneity of child quantity, instruments must satisfy three assumptions. First, they must be exogenous, meaning that they are as good as being randomly assigned, in the sense that the IV is uncorrelated with omitted variables, (Angrist & Piscke, 2015; Wooldridge, 2016). Second, they must have a causal effect on child quantity. Finally, the two groups must be similar in all aspects that affect their labour market outcomes, (Diaz & Fiel, 2020). This final assumption is known as the exclusion restriction which Angrist and Piecke (2015) describe as: "single channel through which the instrument affects outcomes" (p. 106).

Much like parents from other Western countries, New Zealanders are more likely to have an additional child if all their children are of the same sex, (Angrist & Evans, 1998; Gray & Evans, 2005; Hank & Kohler, 2000; Statistics New Zealand, 2017). Genders are virtually randomly assigned and therefore plausibly uncorrelated with the error term in the main estimating equation that may include unobserved individual characteristics. Therefore, the child gender-mix

[6] I also estimate instrumental variable regression considering indicators of the presence of a twin birth across different birth parity as further robustness checks. See section 5.2 of Chapter 5.

proportion of twin births has declined since the introduction of single embryo transfer in 2004, (King, 2004). An effect that is illustrated in Figure 2.

Figure 2: Multiple Births as Proportion of Total Births between 2000 and 2020



Source: Authors calculations using IDI Birth Registry Data.

The decline in the proportion of twin births also coincides declining in twin births through ART procedures as these procedures have become more advanced. In 2004, 16% of the babies born through ART in Australia and New Zealand were twins or higher-order births, which has since declined to 3.2% as of 2018, (Newman et al., 2018; Wang et al., 2004).

Diaz and Fiel (2020) state that women who received ART in the US are expected to belong to higher socio-economic groups and have a stronger preference for children, causing the instrument to be biased upward. In New Zealand, this is less of a concern as ART is subsidized for women who meet age and health requirements, (Auckland District Health Board, n.d.). Most of these women will not be in the analysis as I use twinning in the second birth - most women who receive ART have not had any successful births, (Centers for Disease Control and Prevention, 2007).

the time of the census and for the twelve-month period succeeding the Census month (i.e., March 2013). I link the birth registry data with my spine merging the 'parent ID' of children onto the unique identifiers of the census mothers in the spine. Merging Census and Birth data provides a full catalogue of the mothers in my sample and their children. From this data, I generate variables for the number of children, the sex composition of the first two births, and the occurrence and birth position of multiple births. For the purpose of my analysis, I apply further restrictions to my sample of census-based mothers to reduce biases that may arise from confounding influences of unobserved heterogeneities. First, I restrict the sample to mothers with live births only. Excluding these mothers can alleviate the possibilities of changes in mothers' labour market decisions due to negative health shocks. More specifically, mothers may experience psychological trauma and stress that affects their motivation to participate in the labour market. Second, women with any missing information on multiple births are also dropped from the dataset for the same reasons. Third, I restrict my sample to women who were at least 16 at the time of their first childbirth. Finally, only mothers who are part of cisgender/binary couples are kept in the data set. This is because same-sex couples can only conceive a child through Artificial Reproductive Treatments (ART) like In vitro fertilisation (IVF). Furthermore, the family formation decisions might be driven by unobserved individual preferences that might also be correlated with individuals' labour market activities. It is important to note that we cannot completely control for IVF births in the data, as the IDI does not explicitly provide information on child adoption or indicators of whether childbirth resulted from artificial fertility-based treatment. Nonetheless, to reduce the likely prevalence of IVF all same-sex couples are dropped from the sample. Finally, I restrict the sample to mothers of two or more children. The final sample consists of 204,057 mothers.

Tables 2 provides the means and descriptions of the outcome variables in this dissertation, while Table 3 provides the sample means and a detailed description of the controls. For a full list of descriptive statistics of all women aged 18-45 consult Table A1 and Table A2 in Appendix A. Additional descriptive statistics by ethnicity are also available in Appendix B in Table B1 and B2.

Table 2. List of Outcome Variables

Variable	Description	Means		
		All mothers	Mothers with two or more children	Non-mothers
Created using 2013 Census				
Employment	Employment at the time of the census is captured by a binary indicator, which equals 1 if the mother reports that she is employed in the 2013 census, 0 otherwise.	0.60	0.58	0.65
Full-time	Full time employment during the Census is captured by a binary indicator, which equals 1 if the individual works full time, and 0 otherwise	0.35	0.30	0.52
Created Using IRD data				
Employment	Employment at the time of the census is captured by a binary indicator, which equals 1 if the mother has at least one job holding in March 2013, and 0 otherwise.	0.52	0.49	0.59
Proportion of months employed	A 0-1 value, representing the proportion of months employed in the year subsequent to the 2013 Census	0.50	0.48	0.57
Total annual earnings	The continuous measure of Total Annual earnings is the aggregate of earnings from employment in the post census period. Annual earnings are reported in NZ dollars and are adjusted for inflation by using the consumer price index of the first quarter of 2013 as the reference base period. [A]	21728.10	20118.90	27586.60
Average monthly earnings	The average monthly earnings are estimated by dividing the annual aggregate annual earnings in the post census period by the number of months employed over this period. [B]	2073.10	1899.30	2532.90

Note: Detailed descriptive statistics are found in Table A1 Appendix A.

[A] All women with no earnings are assigned salary of $0.

[B] This is conditional on if the mothers make more than $0 in wages and salaries in the postcensus period i.e., Mothers with 0 earnings are treated as missing.

Source: Author calculations based on data in the IDI.

the 2013 census. The negative effect is quantified by a 4.5 and 13 percentage point decrease in the proportion of months worked when instrumented by the multiple births in the second parity and gender-mix, respectively. Furthermore, child quantity has a negative effect on the earnings of mothers in the 12-month period subsequent to the 2013 census, both annual and monthly. Average monthly earnings decrease by $187 when instrumented with the incidence of multiple births in the second birth; this result is insignificant when instrumented with gender-mix. 2SLS estimates are mostly smaller than the OLS estimates, suggesting an upward bias in OLS estimates.[10]

Similar to Angrist and Evans (1998) and Frenette (2011), using the gender-mix instrument produces a larger negative effect in labour market outcomes than the twinning instrument. Angrist and Evans (1998) note two reasons for the discrepancy in the size of the estimates across the two instruments. First, the additional child is who is a twin is generally older in comparison to the additional child whose first two siblings were of the same sex. Younger children may require more attention; this may explain the large discrepancy in some of the estimates. Second, having multiple births may have a positive return to scale in the production of childcare. Finally, Black et al., (2010) suggest that the disparity in estimates could be a result of two different treatments – an expected and unexpected arrival of a child – which have different interpretations.

[10] This is with exception to full-time work which when instrumented with the gender-mix instrument yields a larger estimate.

seven (IRD) percentage points. This is comparatively larger than the decreases in employment when instrumented using multiple birth presence in the second parity. This might be explained by the relationship observed by Angrist and Evans (1998) and Bronars and Grogger (1994). They state that age differences between twin parities might explain the difference in maternal labour participation. Angrist and Evans (1998) and Bronars and Grogger (1994) found twins in the second parity were younger on average than those in the first parity. Younger children may require more attention from mothers and so mothers will allocate their time away from the labour market.

The estimates of the labour market effect of child quantity on the partners of mothers in this sample in March 2013 are displayed in Table 9. OLS shows the partners of the mothers also experience a decline in the likelihood of employment by an average of 2 percentage points. This is consistent with Lundberg and Rose (2002) who theorised that both parents will reduce their time spent in the labour market to raise their children. However, if child quantity is endogenous then the OLS estimates are inconsistent. There is no empirical evidence in this analysis of a specialisation effect when allowing for exogenous variation in child quantity.

Table 7. 2SLS Estimates of the Impact of an Additional Child on Labour Market Outcomes by Using Gender-Specific Instruments.

	Employed (Census)	Employed (Census)	Employed (IRD)	Employed (IRD)	Full-time	Full-time
Instrument used	Boy Boy	Girl Girl	Boy Boy	Girl Girl	Boy Boy	Girl Girl
Child quantity	-0.099**	-0.087*	-0.091*	-0.113*	-0.100*	-0.096
	(0.035)	(0.04)	(0.037)	(0.042)	(0.051)	(0.065)
First Stage						
Instrumental variable	0.068***	0.063***	0.068***	0.063***	0.068***	0.055***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Observations	148,959	143,211	148,959	143,211	87,030	83,832
F statistic	307.01	237.49	307.01	237.49	246.91	151.77

Levels of significance: * ($p<0.05$); ** ($0.005>p>0.001$); *** $p<0.001$.
Notes: Regression outputs; robust se in parenthesis. Controls for this analysis are consistent with that of the main analysis. Boy-Boy is an instrument equal to 1 if the mothers two eldest children are boys, and 0 otherwise. Likewise, Girl-Girl is an instrument equal to 1 for mothers whose two eldest children are girls, and 0 otherwise. Mothers who's eldest two children are girls are excluded from the Boy-Boy analysis. Likewise, mothers who's eldest two children are boys are excluded from the Girl-Girl analysis.
Source: Author calculations based on data in the IDI.

Table 9. Estimates of the Impact of an Additional child on Labour Market Outcome of Partners in March 2013.

	Employed (Census) OLS	Employed (Census) 2SLS	Employed (Census) 2SLS	Employed (IRD) OLS	Employed (IRD) 2SLS	Employed (IRD) 2SLS
Instrument used	-	Twins 2	Same Sex	-	Twins 2	Same Sex
Child quantity	-0.017***	-0.006	-0.006	-0.024***	-0.005	-0.039
	(0.001)	(0.006)	(0.021)	(0.002)	(0.012)	(0.035)
First Stage						
Instrumental variable	-	0.813***	0.066***	-	0.813***	0.066***
		(0.012)	(0.004)		(0.012)	(0.004)
Observations	140,961	140,961	140,526	140,961	140,961	140,526
F statistic	-	4368.24	332.73	-	4368.24	332.73
	Full-time OLS	Full-time 2SLS	Full-time 2SLS	March 2013 earnings OLS	March 2013 earnings 2SLS	March 2013 earnings 2SLS
Instrument used	-	Twins 2	Same Sex	-	Twins 2	Same Sex
Child quantity	-0.001	-0.001	-0.008	-5.495	-278.766	-84.75
	(0.001)	(0.006)	(0.046)	(19.05)	(169.51)	(430.7)
First Stage						
Instrumental variable	-	0.818***	0.066***	-	0.813***	0.066***
		(0.012)	(0.004)		(0.012)	(0.004)
Observations	134,514	134,514	128,607	140,961	140,961	140,526
F statistic	-	4827.37	340.74	-	4368.24	332.73

Levels of significance: * ($p<0.05$); ** ($0.001<p<0.005$); *** $p<0.001$.
Note: Regression outputs; robust se in parenthesis. Controls used are the partners equivalent of the mother controls in our main analysis (e.g., partner age at first birth).
Source: Author calculations based on data in the IDI.

Chapter 7 Conclusion

The effects of child presence on parental labour market outcomes have been discussed since the early 1960s as economists explored the factors that affected female labour market outcomes. One of the major factors is child quantity. Empirical models analysing the effect of child quantity on women's labour supply are not straightforward due to the potential endogeneity concerns in the measure of child quantity. One such method is to allow for exogenous variation in child quantity using instrumental variables. This is particularly relevant in the context of New Zealand, where there is no empirical analysis on the effects of child quantity on maternal labour market outcomes that uses exogenous variations to address the potential endogeneity issue. The aim of this research is to add comprehensive NZ-Specific evidence to the existing international literature that looks at the causal relationship between family size and maternal labour market outcomes. This study uses administrative data from Statistics New Zealand of mothers aged 18-45 at the time of the 2013 Census. Overall, I find a negative effect on maternal labour market outcomes as a result of an increase in child quantity.

Two-stage least squared estimates suggest that mothers having an additional child will decrease employment by four and ten percentage points, using multiple births in the second birth and parental preference for mixed-gender children as an exogenous shock to child quantity, respectively. Compared to other available countries, the New Zealand-based analysis provides the smallest estimates using the twinning instrument. Moreover, my results also suggest that the proportion of months worked, average monthly earnings and annual earnings from wages and salaries, all decrease with an increase in child quantity. The negative relationship consistently holds using both the commonly used instruments. Additionally, ten percent of mothers are found to leave full-time work for part-time work when having more than two children using the gender mix instrument. I find no statistical evidence of partners' labour market outcomes being positively affected by child quantity, otherwise known as the 'specialisation effect', when allowing for exogenous variation.

I conducted longitudinal analysis on mothers, including running a fixed-effects regression to analyse the effect of birth order on maternal labour market outcomes of first-time mothers. These results suggest that reductions in employment and earnings increase in magnitude with each subsequent birth.

The Integrated Data Infrastructure provides a wide range of employment-based measures relative to other large-scale labour force surveys and the census. However, there are still some limitations to data that affect the analysis. The inability to identify natural birth from adoptions and artificially assisted births may prompt some bias to estimations if those events are driven by unobserved individual choices. Additional information, such as occupation and work hours at the monthly level would provide additional context to how parental labour market outcomes are effect by child quantity - this is also outside the scope of the IDI.

Motivations for mitigating the negative female labour market effects caused by increasing family size include addressing an ageing population. Introducing additional subsidies to childcare, especially for economically vulnerable groups and those with multiple children may reduce mothers' home-based commitments, thereby increasing their capacity for labour market participation. Such policies may also motivate families to have more children if the costs associated with raising them are less severe. Results of this study could be used to assess the scope for effective policy changes that ease the economic burden for families and at the same time ease mothers' parental commitment such that mothers can increase their involvement labour market activities.

Reference List

Adema, W., del Carmen Huerta, M., Panzera, A., Thevenon, O., & Pearson, M. (2009). The OECD family database: Developing a cross-national tool for assessing family policies and outcomes. *Child Indicators Research, 2*(4), 437.

Adsera, A. (2005). Vanishing children: From high unemployment to low fertility in developed countries. *American Economic Review, 95*(2), 189-193.

Aizer, A., & Cunha, F. (2012). *The production of human capital: Endowments, investments and fertility* (No. w18429). National Bureau of Economic Research.

Angrist, J. D., & Evans, W. N. (1996). Children and their parents' labor supply: Evidence from exogenous variation in family size (No. w5778). National bureau of economic research.

Angrist, J. D., & Evans, W. N. (1998). Children and Their Parents' Labor Supply: Evidence.

Angrist, J. D., & Pischke, J. S. (2015). *The path from cause to effect: mastering'metrics* (No. 442). Centre for Economic Performance, LSE.

Auckland District Health Board (n.d.). Public Funding. Retrieved 28, March, 2021 from: https://nationalwomenshealth.adhb.govt.nz/our-services/fertility/public-funding/

Azimi, E. (2015). The effect of children on female labor force participation in urban Iran. *IZA Journal of Labor & Development, 4*(1), 5.

Bagozzi, R. P., & Van Loo, M. F. (1978). Fertility as consumption: Theories from the behavioral sciences. *Journal of Consumer Research, 4*(4), 199-228.

Bailey, M. J. (2010). " Momma's got the pill": how Anthony Comstock and Griswold v. Connecticut shaped US childbearing. *American economic review, 100*(1), 98-129.

Becker, G. S. (1960). An economic analysis of fertility. *In Demographic and economic change in developed countries* (pp. 209-240). Columbia University Press.

Becker, G. S. (1965). A Theory of the Allocation of Time. *The economic journal, 75*(299), 493-517.

Becker, G. S. (1981). Altruism in the Family and Selfishness in the Market Place. *Economica, 48*(189), 1-15

Becker, G. S. (1985). Human capital, effort, and the sexual division of labor. *Journal of labor economics, 3*(1, Part 2), S33-S58.

Becker, G. S., Landes, E. M., & Michael, R. T. (1977). An economic analysis of marital instability. *Journal of political Economy, 85*(6), 1141-1187.

Becker, G. S., & Lewis, H. G. (1973). On the Interaction between the Quantity and Quality of Children. *Journal of political Economy, 81*(2, Part 2), S279-S288.

Becker, G. S., & Tomes, N. (1986). Human capital and the rise and fall of families. *Journal of labor economics, 4*(3, Part 2), S1-S39.

Moschion, J. (2010). Reconciling work and family life: The effect of the French paid parental leave. *Annals of Economics and Statistics/Annales d'Économie et de Statistique*, 217-246.

Moschion, J. (2013). The Impact of Fertility on Mothers' Labour Supply in Australia: Evidence from Exogenous Variation in Family Size. *Economic Record, 89*(286), 319-338.

Newman, J.E. Paul,R.C. & Chambers, G.M. (2020). *Assisted reproductive technology in Australia and New Zealand 2018*. UNSW Sydney

OECD (2021), Net childcare costs (indicator). doi: 10.1787/e328a9ee-en

Pavlopoulos, D., Muffels, R., & Vermunt, J. K. (2012). How real is mobility between low pay, high pay and non-employment. *Journal of Royal Statistical Society, Series A, 175* (3), 749-773

Pison, G., & D'Addato, A. V. (2006). Frequency of twin births in developed countries. *Twin Research and Human Genetics, 9*(2), 250-259.

Pison, G., Monden, C., & Smits, J. (2015). Twinning rates in developed countries: trends and explanations. *Population and Development Review, 41*(4), 629-649.

Poot, J., & Siegers, J. J. (1992). An economic analysis of fertility and female labour force participation in New Zealand. *New Zealand Economic Papers, 26*(2), 219-248.

Rosenzweig, M. R., & Wolpin, K. I. (1980a). Testing the quantity-quality fertility model: The use of twins as a natural experiment. *Econometrica: journal of the Econometric Society*, 227-240.

Rosenzweig, M. R., & Wolpin, K. I. (1980b). Life-cycle labor supply and fertility: Causal inferences from household models. *Journal of Political economy*, 88(2), 328-348.

Rosenzweig, M. R., & Wolpin, K. I. (2000). Natural" natural experiments" in economics. *Journal of Economic Literature, 38*(4), 827-874.

Rosenzweig, M. R., & Zhang, J. (2009). Do population control policies induce more human capital investment? Twins, birth weight and China's "one-child" policy. *The Review of Economic Studies, 76*(3), 1149-1174.

Ross, R. T. (1987). Disaggregate labour supply functions for married women in New Zealand. *New Zealand Economic Papers, 21*(1), 41-55.

Schieve, L. A., Peterson, H. B., Meikle, S. F., Jeng, G., Danel, I., Burnett, N. M., & Wilcox, L. S. (1999). Live-birth rates and multiple-birth risk using in vitro fertilization. *Jama*, 282(19), 1832-1838.

Sin, I., Dasgupta, K & Pacheco, G. 2018. *Parenthood and labour market outcomes* (Motu Working Paper 18-08). Wellington: Motu Economic and Public Policy Research.

Smith, J. P. (1973). *The life cycle allocation of time in a family context* (Doctoral dissertation, National Technical Information Service, US Department of Commerce).

Stancanelli, E. G. (2008). Evaluating the impact of the French tax credit on the employment rate of women. *Journal of Public Economics, 92*(10-11), 2036-2047.

Statistics New Zealand. (2014). *An overview of progress on the potential use of administrative data for census information in New Zealand: Census Transformation programme.* Retrieved from: https://www.stats.govt.nz/assets/Research/An-overview-of-progress-on-

the-potential-use-of-administrative-data-for-census-information-in-New-Zealand/an-overview-of-progress-on-the-potential-use-of-administrative-data-for-census-information-in-new-zealand.pdf

Statistics New Zealand. (2017). *Is balancing the sex of their children important to New Zealand parents?* Retrieved from: https://www.stats.govt.nz/reports/is-balancing-the-sex-of-their-children-important-to-new-zealand-parents

Statistics New Zealand. (2021). *New Zealand's birth rate lowest on record, deaths drop in 2020.* Retrieved from: https://www.stats.govt.nz/news/new-zealands-birth-rate-lowest-on-record-deaths-drop-in-2020

Stock, J., & Yogo, M. (2005). Testing for Weak Instruments in Linear IV Regression. In D. Andrews & J. Stock (Eds.), *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg* (pp. 80-108). Cambridge: Cambridge University Press.

Uggla, C., & Mace, R. (2016). Parental investment in child health in sub-Saharan Africa: a cross-national study of health-seeking behaviour. *Royal Society open science*, *3*(2), 150460.

Wang, Y. A., Dean, J. H., Grayson, N. & Sullivan, E. A. (2006). *Assisted reproductive technology in Australia and New Zealand 2004*. AIHW.

Willis, R. J. (1973). A new approach to the economic theory of fertility behavior. *Journal of political Economy*, *81*(2, Part 2), S14-S64.

Willis, R. J. (1987). What have we learned from the economics of the family?. *The American Economic Review*, *77*(2), 68-81.

Wooldridge, J. M. (2016). *Introductory econometrics: A modern approach*. Cengage learning.

Appendices

Appendix A Supplementary Descriptive Statistics of Women Aged 18-45

Table A 1. Supplementary Descriptive Statistics of Outcome Variables

Variable	Mothers with At least 2 children	All Mothers	Non-Mothers
Created using 2013 Census			
Employment	0.58	0.60	0.69
	(0.49)	(0.49)	(0.46)
Full time	0.30	0.35	0.52
	(0.46)	(0.48)	(0.50)
Created using IRD Data			
Employment	0.49	0.52	0.65
	(0.50)	(0.50)	(0.48)
Proportion of months employed	0.47	0.50	0.62
	(0.46)	(0.46)	(0.44)
Total annual earnings	20118.90	21728.10	27586.60
	(29479.90)	(29602.80)	(29848.90)
Average monthly salary	1899.30	2073.10	2532.90
	(2682.40)	(2723.70)	(2566.60)
N	204057	346920	425826

Note: Means; sd in parenthesis.
Source: Author calculations based on data in the IDI.

Table A 2. Supplementary Descriptive Statistics of Mother-Specific Characteristics

Variable	Mothers with at least 2 children	All mothers	Non-mothers
Age	35.27	34.63	29.46
	(6.055)	(6.718)	(8.565)
Age at first birth	26.36	27.10	-
	(5.250)	(5.597)	
Number of children	2.484	1.873	-
	(0.823)	(0.965)	
Number of children under five	0.847	0.716	-
	(0.885)	(0.767)	
First two births are of the same sex	0.477	0.280	-
	(0.499)	(0.449)	
First two births are girls	0.224	0.132	-
	(0.417)	(0.338)	
First two births are boys	0.252	0.148	-
	(0.434)	(0.356)	
Has twins	0.046	0.027	-
	(0.209)	(0.162)	
Twins in the second birth	0.014	0.008	-
	(0.119)	(0.091)	
Partnered	0.797	0.760	0.421
	(0.402)	(0.427)	(0.494)
Lives in urban area	0.842	0.858	0.863
	(0.364)	(0.349)	(0.344)
Less than bachelor's degree	0.730	0.729	0.708
	(0.444)	(0.445)	(0.454)
At least bachelor's degree	0.270	0.271	0.292
	(0.444)	(0.445)	(0.454)
Family income between $0 and $25k	0.106	0.119	0.048
	(0.308)	(0.324)	(0.213)
Family income between $25 and $50k	0.166	0.171	0.088
	(0.372)	(0.377)	(0.284)
Family income between $50 and $100k	0.676	0.650	0.473
	(0.468)	(0.477)	(0.499)
Family income is greater than $100k	0.267	0.256	0.214
	(0.442)	(0.436)	(0.410)
Highest attained education level 1-4	0.460	0.465	0.463
	(0.498)	(0.499)	(0.499)
Highest attained education level 5-6	0.010	0.098	0.082
	(0.299)	(0.298)	(0.274)
Has a bachelor's degree	0.200	0.198	0.209
	(0.400)	(0.399)	(0.407)
Has a postgraduate degree	0.070	0.073	0.083
	(0.255)	(0.260)	(0.275)
European	0.623	0.600	0.585
	(0.485)	(0.490)	(0.493)
Maori	0.093	0.086	0.049
	(0.291)	(0.280)	(0.217)
Pasifika	0.063	0.059	0.050
	(0.242)	(0.236)	(0.218)
Asian	0.076	0.109	0.191
	(0.264)	(0.312)	(0.393)
MELAA	0.008	0.010	0.019
	(0.086)	(0.100)	(0.135)
N	204057	346920	425826

Note: Means; sd in parenthesis.
Source: Author calculations based on data the IDI.

Appendix B Supplementary Descriptive Statistics of Women Aged 18-45 by Ethnicity

Table B 1. Supplementary Labour Market Descriptive Statistics of Mothers with More than Two Children by Ethnicity

Variable	European	Maori	Pasifika	Asian	MELAA	Other
Created using 2013 Census						
Employment	0.65	0.41	0.42	0.55	0.40	0.52
	(0.48)	(0.49)	(0.49)	(0.50)	(0.49)	(0.50)
Full-time	0.30	0.26	0.31	0.37	0.24	0.29
	(0.46)	(0.44)	(0.46)	(0.48)	(0.43)	(0.45)
Created using IRD Data						
Employment	0.53	0.40	0.43	0.44	0.32	0.46
	(0.50)	(0.49)	(0.50)	(0.50)	(0.47)	(0.50)
Proportion of months employed	0.51	0.36	0.40	0.43	0.31	0.44
	(0.462)	(0.45)	(0.46)	(0.46)	(0.43)	(0.46)
Total annual earnings	22061.30	13878.80	16805.70	19399.50	13121.30	17856.10
	(31645)	(22125.80)	(22858.50)	(28349.60)	(23730.80)	(26120.30)
N	127065	19050	12753	15408	1524	28260

Note: Means; sd in parenthesis.
Source: Author calculations based on data in the IDI.

Table B 2. Descriptive Statistics of Mother-Specific Characteristics for Mothers with More than Two Children by Ethnicity

Variable	European	Maori	Pasifika	Asian	MELAA	Other
Age	36.29	32.68	33.53	35.17	34.69	33.32
	(5.666)	(6.596)	(6.526)	(5.218)	(5.512)	(6.399)
Number of children	2.383	2.922	2.949	2.210	2.347	2.593
	(0.668)	(1.178)	(1.191)	(0.496)	(0.713)	(0.906)
Mothers age at first Birth	27.46	22.64	24.37	27.49	27.64	24.10
	(4.956)	(4.862)	(4.881)	(4.321)	(4.830)	(5.294)
Number of children under five	0.784	0.928	1.103	0.930	1.137	0.899
	(0.863)	(0.948)	(0.980)	(0.838)	(0.877)	(0.888)
First two children are of the same sex	0.476	0.479	0.478	0.474	0.473	0.477
	(0.499)	(0.500)	(0.500)	(0.499)	(0.499)	(0.499)
First two children are girls	0.224	0.224	0.230	0.229	0.213	0.219
	(0.417)	(0.417)	(0.421)	(0.420)	(0.409)	(0.414)
First two children are boys	0.252	0.255	0.248	0.246	0.261	0.257
	(0.434)	(0.436)	(0.432)	(0.431)	(0.439)	(0.437)
Has twins	0.047	0.044	0.049	0.034	0.053	0.047
	(0.212)	(0.205)	(0.215)	(0.181)	(0.224)	(0.210)
Twins at the second birth	0.015	0.013	0.013	0.008	0.010	0.015
	(0.123)	(0.113)	(0.114)	(0.089)	(0.098)	(0.123)
Partnered	0.859	0.500	0.730	0.918	0.846	0.679
	(0.348)	(0.500)	(0.444)	(0.274)	(0.361)	(0.467)
Has less than a bachelor's degree	0.676	0.912	0.926	0.632	0.675	0.818
	(0.468)	(0.284)	(0.261)	(0.482)	(0.469)	(0.385)
Has a bachelor's degree or a higher	0.324	0.088	0.074	0.368	0.325	0.182
	(0.468)	(0.284)	(0.261)	(0.482)	(0.469)	(0.385)
Lives in an urban region	0.807	0.857	0.984	0.973	0.952	0.850
	(0.394)	(0.350)	(0.125)	(0.163)	(0.214)	(0.357)
N	127065	19050	12753	15408	1524	28260

Note: Means; sd in parenthesis.
Source: Author calculations based on data in the IDI.