The Impact of Child Quantity on Mothers' Labour Market Outcomes in New Zealand

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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.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material to which a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

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Disclaimer

The results in this paper are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand.

The opinions, findings, recommendations, and conclusions expressed in this paper are those of the authors, not Statistics NZ.

Access to the anonymized data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorized by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this paper have been confidentialized to protect these groups from identification and to keep their data safe.

Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats. govt.nz.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

Chapter 1 Introduction

The dramatic increase of female participation in the labour force is one of the prominent trends in labour markets in the developed world, higher levels which are central to economic growth and development in many countries, (Galor & Weil, 1996). In New Zealand, from 1994 to 2014, female labour force participation - a measure of the number female activity in the labour market - increased by 8 percent for women aged 25-49. Specifically, labour force participation has increased by 23 percent for all mothers and 7.8 percent for partnered mothers, (Flynn & Harris, 2015). Meanwhile, this increase in labour force participation was accompanied by a significant decrease in fertility to sub-replacement levels of fertility, (Statistics New Zealand, 2021).[1] Fertility levels and longer life expectancies are leading to rapid ageing in the population of several countries, and many are concerned about how that may affect public policy and standards of living. A persistence of sub-replacement fertility rates may create fiscal pressures for governments resulting in adjustments to public programs and the retirement age, (Lee, 2001; Lee & Mason, 2014). Increased levels of female education (Black et al, 2008; McCrary & Royer, 2011), declining use of child labour (Becker 1960), access to birth control (Bailey, 2010; Goldin & Katz, 2002) and increased female labour force participation (Adsera, 2005) are all linked to the changes in child quantity in the last half-century.[2]

Female labour force participation and income are negatively correlated with family size, (Aliaga, 2005, as cited by Moschion, 2013). In addition, female labour force participation is lower than male labour force participation. Labour force participation for women with children is lower than those without children or those whose children no longer reside in the same household, (Adsera, 2005; Gronau, 1973; Leibowtiz et al, 1992). Having children may introduce restrictions on the labour market participation for women. Conversely, women who are less inclined to work may have more children than those with a stronger inclination to participate in the labour market, (Karbownik & Myck, 2016). This implies self-selection into larger families and that the correlation between child quantity and lower employment could be biased, (Blundell & Macurdy, 1999). In this case, Ordinary Least Squares estimates (OLS) will exaggerate the effect of child quantity on female labour participation. Whereas, if strong labour market attachment results in the decision to have children (i.e., a positive correlation), OLS will understate the effect of child quantity on female labour participation, (Karbownik & Myck, 2016). To address this issue more complex measures are used to estimate the effect of childbearing on female participation in the labour market.

[1] Fertility is the actual level of reproduction. Fertility is measured for women of childbearing age 15-44.
[2] For the purpose of simplicity, I use child quantity interchangeably with family size.

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

subsequent child. Further, 2SLS analysis on the employment and earnings of the partners provides no evidence that the father of these children increases their wages or employment when having additional children.

The dissertation is organised as follows: Chapter 2 provides a discussion of the relevant theoretical models and literature. Chapter 3 details the empirical strategy used and its validity, and Chapter 4 describes the data and sample construction. Chapter 5 presents the main results along with additional subsample analyses and robustness checks; followed by a discussion of policy implications in Chapter 6. Finally, Chapter 7 concludes.

Chapter 2 Background and Motivation

2.1 The Quantity-Quality Framework

Since the early 1960s economists have been invested in the economics of fertility and its effect on household decisions and choices. The decision to have children and the number of children involve trade-offs that have implications for labour market participation, household production and consumption, (Bagozzi & Van Loo, 1978). The purchase of market-based inputs, such as contraceptives, food, children's clothes, and childcare are all attached to the decision to have children. Fertility decisions are part of joint household consumption optimization: children provide parents utility, but raising them is costly, and the home-based childcare limits labour market participation for caregivers. Researchers like Willis (1973) have suggested that the decision to have children is a consumption decision.

Becker and his co-authors (Becker, 1960; Becker & Lewis, 1973; Becker & Tomes, 1986) proposed that children should be viewed as an economic good, depending on whether their parents received direct utility from them. Most importantly, parents increase their utility through increasing child quality and child quantity, where child quality refers to the child's quality of life. Becker refers to children who have more invested in them as "high quality" (p. 211). Increasing parents' income increases the amount spent on each child, thereby increasing the parents' satisfaction. Much like Willis (1973), Becker and Lewis (1973) assume that parents view child quantity and child quality as substitutes. The quantity-quality trade-off assumes that the parents will maximise their joint utility (1), subject to an income restraint (2).

$$U = U(n, q, y) \tag{1}$$

$$I = \pi nq + \pi_y y \tag{2}$$

Where n represents the number of children, q denotes child quality, π represents the price of nq, y is the rate of consumption of all other goods, π_y the price of y and I represents parental income. Becker and Lewis (1973) assume that child quality is the same for each child.[3] Additionally, they assume that parents will make a joint decision on the demand for children at one point.

[3] Recent studies, both theoretical (Aizer & Cunha, 2012) and empirical (Brinch et al., 2019; Rosenzweig & Zhang, 2009) relax this assumption.

Parents maximise their utility denoted in (1) subject to the constraint (2), the first order conditions of this maximisation are:

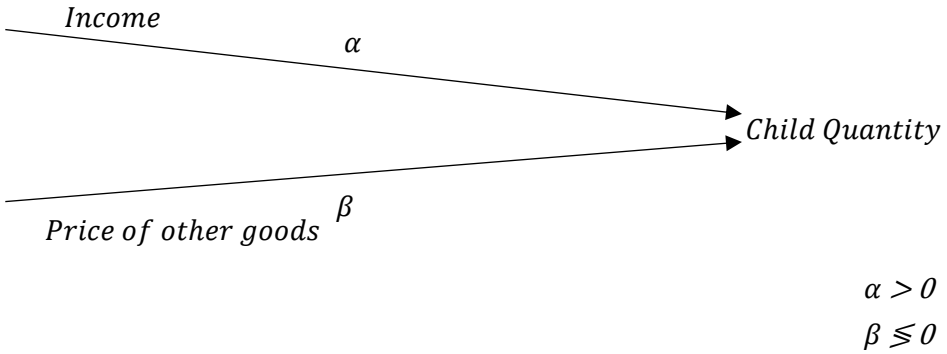
$$MU_n = \lambda q\pi = \lambda p_n$$

$$MU_q = \lambda \pi n = \lambda p_q$$

$$MU_y = \lambda \pi_y = \lambda p_y$$

$MU_n, MU_q,$ and MU_y represents the marginal utilities for the number of children, child quality and consumption, respectively. p_n, p_q and p_y denotes the shadow prices or marginal costs of the number of children, child quantity and consumption. λ is a representation of the Lagrangian multiplier and the marginal utility of income. The important distinction to make is that the shadow price of the child quantity is positively related to child quality, and the shadow price of child quality is positively related to the number of children. Becker and Lewis' (1973) economic interpretation of these shadow prices are that increasing child quality is "more expensive" (p. 82) with higher quantities of children; likewise, increasing child quantity is more expensive with "high quality" (p. 82) children. Bagozzi and Frances van Loo's (1978) diagram summarising the theoretical model of Becker (1960) is shown in Figure 1. Each arrow in this diagram represents a hypothesized causal relationship of the explanatory variables on child quantity.

Figure 1: Becker's (1960) Theoretical Model for Fertility as Constructed by Bagozzi and Van Loo (1978)



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

Mincer (1962, 1963) contributes to the neoclassical model of fertility with two additions. First, the permanent income, not current, influences childbearing decisions. This alteration updates the concept that accounts for how income changes with experience and education. Second, costs regarding raising children not only consist of market-priced goods and services, but the opportunity cost of foregone earnings. The effects of these opportunity costs are hypothesised to influence childbearing decisions negatively and positively. That is if a mother's potential earnings increase then the cost of her time increases. Alternatively, if potential earnings increase then the family may afford more children.

Much of the analysis in the family size literature focuses on child quality, using education, health and delinquency as measures for a child's quality. There is inconclusive evidence that health or education is affected by family size in developed countries, (Black et al, 2005; Dasgupta & Solomon, 2018). However, in developing countries family size has negative effects on children's future human capital outcomes, (Glick et al., 2007; Rosenzweig & Zhang, 2009). Relatively fewer papers discuss how child quantity affects parental outcomes including their labour force participation. Participation in the labour force may result in the purchase of market-based inputs that improve child quality.

2.2 The Role of Parental Time and Specialisation

Standard economic theory regarding consumption states that, like any price, a higher shadow price of child quality should reduce child quantity. Ermisch (2003) states that "the factors affecting this cost are closely associated with the key role of parental time, especially the mothers" (p.114). Contributions from Becker (1965) and Lancaster (1966, 1971), model that households combine time and market goods to produce commodities such as, health, education, and children. These contributions build upon Mincer's (1963) earlier models which conceptualise allocating time between the market and home production.

Building on the work of Mincer (1963) and Becker (1965), Willis (1973) introduces a model which treats households not just as utility maximisers as with in Becker and Lewis (1973), but also as producing units. In this model, families maximise utility (3) subject to the family's budget constraint (4) and the mothers' time constraint (5), given the production functions in (6) and (7).

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

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

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

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

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

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).*

Angrist and Evans (1996), provide an alternative approach, incorporating aspects of the quality-quantity model into Gronau's (1977) model for home production. Families can maximise their utility through children and leisure, with an option to buy or produce an input that increases their utility from children. Both parents can spend their time in the labour market, or by raising their children or through time spent in leisure. And time spent raising children is solely determined by child quantity, real wages (with childcare costs as a numeraire) and the marginal productivity of home production. Generally, increasing child quantity increases home production, which comes at the expense of either their leisure time or time spent in work. In this model, if wages are high enough or childcare is cheap enough, time spent in home production can be negligible for both parents. If the mother and father's leisure time are substitutes, then husbands can take less leisure to compensate for their wife's decline in earnings from increasing their time raising children. Increasing the number of young children therefore may prompt men to increase their labour hours per year, while their partners work substantially fewer hours, (Smith, 1973). This behaviour, where one parent compensates as a reaction to the decline in work/leisure hours of the other, is called the 'Specialisation Effect'. Becker (1981, 1985) proposes that the commodities that households produce are more efficiently done so if the parents with comparative advantages specialise in the labour market or home production. If the mother chooses to specialise in home production the father will increase his work involvement, (Becker et al., 1977). Conversely, Lundberg and Rose (2002) propose that men and women reduce their hours and spend more time at home as a result of an increase in the number of children. Both effects suggest that we should see a decrease in maternal labour market involvement as a result of an increase in child quantity. The expected outcome for men is more ambiguous, since for men these two effects work in the opposite direction, (Frenette, 2011).

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.

In the same year, Rosenzweig and Wolpin (1980b) use 87 twin pairs to estimate labour supply effects of family size in the United States, using survey data from Department of Health, Education and Welfare. The authors restrict the analysis to first births to avoid the aforementioned parity issue, and so the 'twins first' method was conceived. Bronars and Grogger (1994) use the 1970 Public Use Microdata Samples (PUMS) and Census data to analyse the effects of multiple births on labour force participation and earned income of married women in two ways, 'twins first' and 'twins second'. Using an indicator of multiple births at the first and second birth positions resulted in decreases in mothers' labour force participation and earnings, with the twins at the second birth exhibiting a larger decrease. Angrist and Evans (1998), use a much larger five percent 1980 and 1990 PUMS sample and exploit twin presence at the second birth to estimate child quantity effects on parental labour outcomes. They found a similar effect on the women's labour force participation; in particular, Angrist and Evans (1998) look at the child quantity effects on labour market outcomes of all women. Using the same five percent 1980 PUMS, Cáceres-Delpiano (2006) specifically uses multiple births as a source of variation in child quantity on the second or higher birth parity. The author shows that mothers with two or more children exhibit a five-percentage point decrease in labour force participation when increasing child quantity. Additionally, he observes a similar decrease for mothers with three or more children.

In another seminal study, Angrist and Evans (1998) introduced the use of gender mix of the two firstborn children as a source of exogenous variation in family size. This strategy exploits the preference that US parents have for mixed gender composition of their children and parents whose first two children are of the same sex are more likely to have another child. Due to the random assignment of child gender, gender mix meets the requirement for a source of exogenous variation in family size for mothers with at least two children, (Moschion, 2013). In their analysis, Angrist and Evans (1998) found that having more than two children, when instrumented with twin presence at the second birth and gender composition of the first two children, resulted in a reduction in female labour force participation, hours per week and annual labour income. Angrist and Evans find that the magnitude of the reduction is larger when instrumented using gender composition than when instrumented using twinning in the second birth as shown in Table 1. Unlike other studies that use the gender-mix instrument, Cools et al. (2017) estimate the long-term labour effects of having an additional child using Norwegian administrative data. They find that having an additional child reduces the labour supply an effect that fades as the children reach adulthood.

Table 1 summarise the main empirical findings.

Using gender mix and 'twins second' as instruments, studies in Canada (Frenette, 2011), France (Fontaine, 2017; Moschion, 2009 as cited in Moschion, 2013) and Australia (Moschion, 2013)

find that having more than two children had a negative effect on the labour market outcomes of mothers. In an alternative approach, to reduce the disparity caused in the estimates using 'twins second' and gender composition as instruments due to the possible heterogeneity in the treatment effect, Moschion (2013) used both instruments together, yielding a weighted average of the two estimates. Using both instruments, Moschion found that the likelihood of labour market participation was reduced by 19 percentage points for French mothers using Labour Force Surveys from 1990-2002 (Moschion, 2009, as cited in Moschion, 2013), and by 12 percentage points for Australian mothers using the 2006 Australian Census, (Moschion, 2013). Fontaine (2017) adopted this same approach using French Census data, finding that having an additional child decreases female labour participation by 8 percent.

Implementation of these instruments is not restricted to developed countries only. In a study on the effects of child quantity on maternal labour market outcomes in Iran, Majbouri (2019) used multiple birth presence as a sole instrument to find a reduction in female labour force participation for less educated mothers of young children. Majbouri (2019) does not use gender mix preference since parents in less developed economies are likely to have a strong gender preference for children in favour of sons. In contrast to Azimi (2015), Majbouri (2019), argues against the use of a son preference instrument as families with a son preference may affect female labour force participation through other channels. For instance, families that favour sons may have a preference against the participation of women in the labour market.

While the hypothesized 'fatherhood premium' has been analysed using fixed and random effects analysis, (Killewald, 2013; Loh, 1996), very few studies focus on instrumental variable strategies to study the effect of exogenous variation in child quantity on paternal or husband labour market outcomes. In this context, both Angrist and Evans (1998) and Frenette (2011), explore the effects of child quantity on the husbands' and biological fathers' labour market outcomes, respectively. Frenette (2011) found that mothers' labour supply decreases with additional children and that fathers' labour supply response is minimal. In Frenette's analysis, fathers' work hours marginally decline when family size is instrumented using the gender mix, and father unpaid weekly childcare and unpaid housework hours increases. The result is that both parents experience an increase in their overall workload (paid work and unpaid household production). In Angrist and Evans' (1998) study, the labour supply effects of increasing child quantity of husbands are also negligible across both the 1980 and 1990 PUMS. Where Angrist and Evans (1998) and Frenette (2011) differ is that US husbands in families with more than two children will work on average an additional week and earn more when instrument by each of the two IV's.

Table 1. Summary of Main Findings

Authors	Country	Data	Instruments used	Results	
				Labour market participation IV	Hours per week IV
Rosenzweig and Wolpin (1980b)	United states	Pooled demographic surveys	Twins First	Short term estimate	-
				Long term estimate	-
Bronars and Grogger (1994)	United States	1970 and 1980 PUMS	Twins 1^R Twins 2^R	Twins 1: -0.036 (0.036) -0.035 (0.017)	-
				Twins 2: -0.123 (0.033)	-
Angrist and Evans (1998)	United States	1980 PUMS	Twins 2 Gender Mix	Twins 2: -0.079 (0.013)	-
				Gender Mix: -0.125 (0.026)	
Frenette (2011)	Canada	2006 Census	Twins 2 Gender Mix	Twins 2: -0.062 (0.022)	Twins 2: -3.091 (0.267)
				Gender Mix: -0.118 (0.057)	Gender Mix: -5.475 (1.046)
Moschion (2009, as cited in Moschion, 2013)	France	Labour Force Surveys (1990-2002)	Gender Mix*Twins 2	-0.188 (0.057)	-2.27 (0.90)
Moschion (2013)	Australia	Census 2006	Gender Mix*Twins 2	Gender Mix*Twins 2: -0.119 (0.027)	-3.04 (0.90)
Cruces and Galiani (2007)	Argentina and Mexico	Censuses: Argentina (1991), Mexico (2000)	Gender Mix	Gender Mix A: -0.082 (0.032) Gender Mix M: -0.063 (0.307)	-

Note: These are estimates from aforementioned studies. Regression outputs; se in parenthesis.
^{R}. Refers to the reduced form estimates.

2.3.2 New Zealand Literature

Much of the New Zealand literature on child quantity and parental labour market outcomes is limited by data. With reference to the specific literature focusing on determinants of female labour market conditions, Hyman (1979) provides one of the earliest evidences on the inter-urban variation in female labour force participation in 1971. The analysis was limited to 24 observations for each of New Zealand's main urban areas using the 1971 census of population data. Subsequent research of female labour force participation includes studies by Ross (1987), who uses a Society for Research on Women in New Zealand Inc's 1967/1968 random survey of working-age women in the four main urban areas; Brooks (1991) who uses the Labour department's Quarterly

Employment Survey data; and Harris and Raney (1991, as cited by Poot & Siegers, 1992) who created a synthetic dataset using a cross-section of 1986 census data. Using ordinary least squares regression, Ross (1987), found women with several children of preschool age earn and work significantly less than women with no children, ceteris paribus. However, Ross (1987) and the other aforementioned New Zealand studies do not account for endogenous determination of child quantity.

Poot and Siegers (1992) were the first to acknowledge these empirical concerns by pooling the regional data of three censuses and treating both the presence of children and female labour force participation as jointly determined. In their model, female labour force participation and child quantity are dependent on earnings, the proportion of those with post-secondary school education, the degree of urbanisation and the religious composition of the region. Both child quantity and female labour force participation are overidentified and estimated using weighted least squares approach using the square root of the region's population as the weights and with three-stage least squares. Female labour force participation was found to have a positive effect on child quantity, however, the effect of child quantity on female labour force participation was insignificant. Despite pooling data from three censuses, Poot and Siegers' analysis still relies on regional aggregation, which has several weaknesses due to norms or disturbances particular to a region, (Grimes, 1981, as cited by Brooks, 1991). Poot and Siegers (1992) conclude that there is a need for analysis at the micro-level in New Zealand, using census unit record data, which at the time was not provided by the department of statistics.

Sin et al. (2018) use administrative data from the Integrated Data Infrastructure to analyse the effect of parenthood on the labour market outcomes of men and women. This study compares the labour market outcomes from 2006 to 2015 of non-parents and parents who had their first child between 2003 to 2010. The authors find upon becoming mothers, women experience a decrease in hours, earnings, and employment. Men, in contrast, experience no labour market penalty to parenthood. Much like several New Zealand-based studies before it, Sin et al's (2018) study does not account for the potential endogeneity in childbearing.

This study departs from much of the previous New Zealand-based literature on child quantity and female labour force participation in three ways. First, it uses individual-level administrative data of the New Zealand population provided by Statistics New Zealand. Second, it considers the endogeneity of child quantity by allowing for exogenous variation motivated by the unanticipated incidence of multiple births and the random assignment of child gender. Third, it also considers the birth order effects through mothers' fixed effects regression analysis that controls for individual-level time-invariant unobserved influences.

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.

instrument can be qualitatively argued to satisfy the excludability assumption of an instrumental variable. However, Rosenzweig and Wolpin (2000) argue that there are economies of scale in having children of the same sex – these include, sharing of resources (e.g., rooms and clothes).[7] Consequently, this may generate income effects that can affect parental labour market outcomes. Specifically, mothers with same-sex children may have an advantage over mothers with mixed-sex children. While I cannot directly test the exclusion restriction, I do so indirectly in Chapter 5 - where I run supplemental analysis to test the empirical validity of the child gender mix instrument.

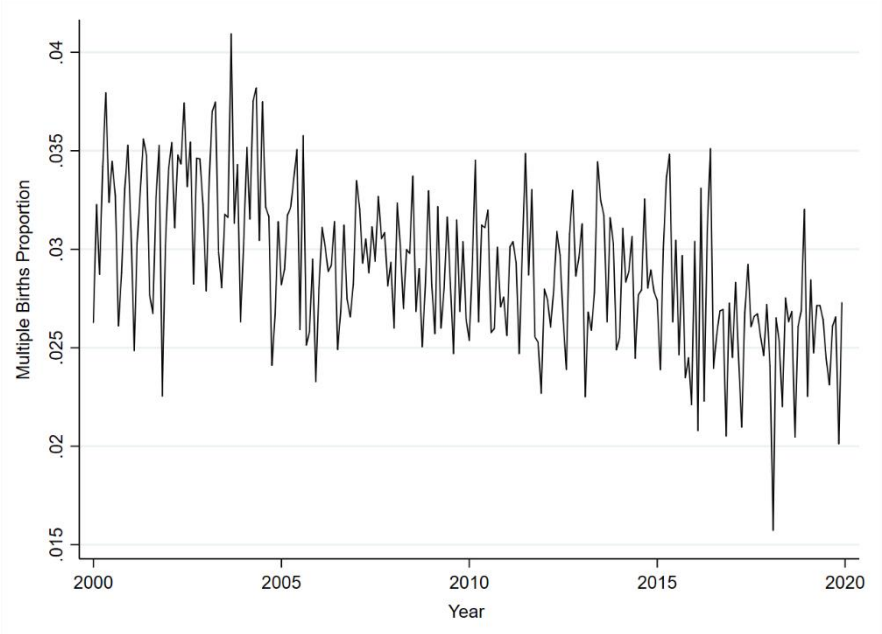
The concerns regarding the twinning instrument are that it may potentially violate the exclusion restriction and may not satisfy the instrument exogeneity requirement. Previous literature has shown that older women, those with a family history of twins or African American mothers are more likely to have twins, (Bortolus et al., 1999; Bulmer 1970; Lichtenstein et al., 1996). For that reason, I control for the mother's demographic characteristics, including age and ethnicity. Evidence in fertility samples in the United States shows that the likelihood of multiple births increases with parity, (Rosenzweig & Wolpin, 1980a). To address this concern, I look at multiple births in the second birth in my main analysis exclusively – this also allows for a good comparison with the gender-mix analysis. Bhalotra and Clarke (2019) find that maternal health, health-related behaviour, and prenatal environment are positively associated with multiple births. This relationship holds even across richer and poorer countries - and holds for women who do not use Artificial Reproductive Treatments (ART). Uggla and Mace (2016) find that children of older and healthier mothers are more likely to receive investments. Bhalotra and Clarke (2020) state that if mothers that choose to invest in their health through healthy diets or limited alcohol consumption and also invest in their child post pregnancy, then the twin-IV is inconsistent.

There are some factors that influence the likelihood of twins that I cannot control. ART procedures, such as In Vitro Fertilization can increase the incidence of multiple births, (Pison & D'Addato, 2006; Pison et al., 2015; Schieve et al., 1999). Higher-order births are especially common with assisted fertility procedures, (Kulkarni et al., 2013). In the United States, an increase in the occurrence of multiple births coincided with increases in fertility treatments; the multiple-birth rate, however, later declined, as medical professionals began to limit the transfer of multiple embryos, (Practice Committee of the American Society for Reproductive Medicine, 2013 as cited by Diaz & Fiel, 2020). In New Zealand, we have seen a similar effect as the

[7] I test this in a robustness check. I find that having two boys and two girls as the first-born children has no significant effect on the labour market outcomes of mothers compared to mixed-gender children. Results are available upon request.

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).

Chapter 4 Data and Descriptive Statistics

To analyse the causal effect of child quantity, which I use as an indicator for family size, on a mother's labour market outcomes, I use data from Statistics New Zealand's Integrated Data Infrastructure (IDI). The IDI contains administrative microdata about individuals, households, and organisations. Administrative data is data sourced from various government and non-government agencies for the purpose of registration, transactions and delivering services, such as tax payments or a health service, (Statistics New Zealand, 2014). The IDI allows for the linking of individuals across datasets using unique confidentialised identifiers.

The three datasets that I use in my analysis include – the Department of Internal Affairs' birth registry, the 2013 Census and Inland Revenue (IR) tax data that incorporates monthly labour market information of the working-age population. The birth registry contains birth records of all people born in New Zealand. The birth registry contains partially digitized birth records from 1840, which later became fully digitised in 1998. Each birth record includes information about the child and their parents, including parents age, birth date, an indicator of stillbirths, sex of the child and multiple birth status. The 2013 New Zealand Census was conducted by Statistics New Zealand based on the population who were residing in New Zealand on March 5th, 2013. The Census 2013 incorporates a wide range of demographic, labour market and socio-economic information on all individuals and households, including ethnicity, partnership status, education level and family income. Additionally, the 2013 census does provide a measure for employment and individual income level. However, the income level in the census is not continuous. The monthly tax records from the Inland Revenue includes information about employment status (i.e., an indicator of being in a paid job) and earnings from wages and salaries on a monthly level. The advantage to using this data is that it provides a more objective measure of employment and monthly earnings unlike with self-reported census records, and so measurement errors caused by self-reporting (Pavlopoulos et al., 2012) are not of any concern. Using both sources for employment also allows us to validate self-reported measures with more precise administrative information.

I begin with 375,678 women who were of childbearing age between 18 and 45 during the Census period and have at least one child at the time of the 2013 Census. The selection of the mothers' age group is consistent with prior studies in the related literature, (Angrist & Evans, 1998; Karbownik & Myck, 2016; Moschion, 2013;). These mothers from the census form the sample spine for my analysis. Using Statistics New Zealand's unique identifiers, I link the aforementioned census-based mothers to the IR data that captures labour market information at

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.

Table 3. List of Explanatory Variables

Variable	Description	Means		
		All mothers	Mothers with two or more children	Non-mothers
Age	Age of the women in years at the time of the 2013 Census	34.63	35.27	29.46
Age at first birth	Age of the mother at the time of her first birth	27.10	26.36	-
Number of children	A mother's total number of children under 18 at the time of the Census	1.87	2.48	-
Partnered	Partnership status is captured with an indicator variable that is 1 if an individual is married, in a civil union or a de facto partnership, and 0 otherwise. In New Zealand, all couples, whether married, in de-facto partnerships or a civil union enjoy the same rights and obligations.	0.76	0.80	0.42
Education				
Level 1-4	Attainment of Level 1-4 schooling is indicated by 1, and 0 otherwise.	0.47	0.46	0.46
Level 5-6	Attainment of Level 5-6 schooling is indicated by 1, and 0 otherwise	0.10	0.10	0.08
Bachelor	Attainment of bachelors' degree is captured with an indicator variable that is 1 if the mother has a bachelor's degree, and 0 otherwise.	0.20	0.20	0.21
Postgraduate	Attainment of postgraduate degree is captured with an indicator variable that is 1 if the mother has a postgraduate degree, and 0 otherwise.	0.07	0.07	0.08
Family Income				
Family income of 0-25 thousand	1 if the mother's family income is between 0-25 thousand New Zealand Dollars, and 0 otherwise	0.12	0.11	0.05
Family income of 25-50 thousand	1 if the mother's family income is between 25-50 thousand New Zealand Dollars, and 0 otherwise	0.17	0.17	0.09
Family income of 50-100 thousand	1 if the mother's family income is between 50-100 thousand New Zealand Dollars, and 0 otherwise	0.65	0.68	0.47
Family income of 100-150 thousand	1 if the mother's family income is between 100-150 thousand New Zealand Dollars, and 0 otherwise	0.26	0.27	0.21
Ethnicity				
European	A binary indicator equal to 1 if the individual identifies as European only, 0 otherwise	0.60	0.62	0.59
Maori	A binary indicator equal to 1 if the individual identifies as Maori only, 0 otherwise	0.09	0.09	0.05
Pasifika	A binary indicator equal to 1 if the individual identifies as Pacific Islander only, 0 otherwise	0.06	0.06	0.05
Asian	A binary indicator equal to 1 if the individual identifies as Asian only, 0 otherwise	0.11	0.08	0.19
MELAA	A binary indicator equal to 1 if the individual identifies as either Middle eastern, Latin American, or African, and 0 otherwise	0.01	0.01	0.02

Note: Detailed descriptive statistics are found in Table A2 Appendix A.
Source: Author calculations based on data in the IDI.

Of the 779541 women aged 18-45 at the time of the Census, 425,826 are non-mothers, the remaining 346,920 are mothers[8] with more than half those mothers (204,057) having at least two children. A larger proportion of non-mothers are employed (59) than mothers with at least one child (49) and at least two children (52) using IRD data, as shown in Table 2. The employment proportion is especially low for mothers of more than two children identifying as either MELAA (32) or Maori (40); these groups of mothers also earn between six and seven thousand dollars less in annual earnings respectively than the sample average of mothers with two or more children, these results are available in Table B2. These large discrepancies in labour market measures between mothers of more than two children and non-mothers are also reflected in the proportion of months employed and average earnings.

In terms of their education, a slightly larger proportion of non-mothers (21) have a bachelor's degree when compared to mothers (20) and mothers of more than two children (20), as indicated in Table 3. Minority groups in the sample are less educated, compared to the rest of the sample, mothers with more than two children who are Maori (9), and Pasifika (7) are significantly less likely to have tertiary qualifications, Table B2.

Nearly half (47.7) of mothers with two or more children were mothers whose first two children were of the same sex, Table A2. This proportion is similar to that in Moschion (2013), (50.6), and Angrist and Evans (1998), (50.5). Similar also was the proportion of mothers with twins in the second birth. In this sample, 1.4 percent of mothers with more than two children had multiple births in the second birth parity, Table A2. This proportion is similar to those found in the samples used by Angrist and Evans (1998), (1.2), and Moschion (2013), (1.5). When differentiating by ethnicity, Asian mothers are the least likely to have twins at the second birth (0.8), whilst European mothers are the most likely to (1.5).

[8] Note that most of the same restrictions have been made to these mothers as in our main sample i.e., no stillbirth, cis-gender couples, at least 16 at first birth, and no missing information.

Chapter 5 Results

5.1 Main Findings

The results for the main analysis are presented in Table 4. OLS estimates suggest that an increase in child quantity has a statistically significant and adverse effect on maternal labour market engagement. In particular, we see a decrease in the likelihood of employment by ten and eleven percentage points using Census and IRD measures for employment, respectively. As indicated in column 7 of Table 4, an additional child will lower the proportion of months worked by eleven percentage points. Furthermore, the proportion of full-time workers decrease by 6 percentage points, this indicates that mothers' transition from full-time work to part time work.[9] Having an additional child is adversely related to earnings in wages in salaries; this is quantified by a decrease of $4979 in annual earnings and a decrease in average earnings by $285. However, if child quantity is endogenous determined OLS estimates are likely to be biased.

First stage estimates show that mothers with two first-born children of the same sex are more likely to have an additional child than mothers with first-born children of mixed sexes. This is indicated by the first stage likelihood of having an additional child increasing by six to seven percentage points (Columns 3, 6 and 9). Additionally, in comparison to mothers of singletons, women with multiple births (which are predominantly twins) in the second parity experience an increase in family size by approximately one child (as indicated by a coefficient of 0.82 to 0.85 (Columns 2, 5 and 8 of Table 4). These ranges are consistent with those used in other studies which use the same instruments, (Angrist & Evans, 1998; Frenette, 2011; Moschion, 2013). The empirical validity of both instruments is partially represented by the large F-statistics of both instruments, which are far greater than the threshold of ten as proposed by Stock and Yogo (2005). The F-statistics in the main analysis range between 293 and 6328.

The 2SLS regressions show that an increase in child quantity, when instrumented with multiple births in the second parity has a negative impact on employment propensity. In particular, we see a decrease in the employment likelihood by four percentage points for the census-based indicator and five percentage points for the IRD-based measure. In contrast, when instrumented with gender-mix of the first two children, the negative effect is quantified by nine percentage points for the census-based indicator and ten percentage points for the IRD-based measure. An increase in family size has a negative effect on the proportion of months worked in the year subsequent to

[9] This regression is conditional on the fact that the mother is employed based on the census indicator for employment.

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.

Table 4. Estimates of the Impact of an Additional Child on Labour Market Outcome for Mothers

	(1) Employed (Census) OLS	(2) Employed (Census) 2SLS	(3) Employed (Census) 2SLS	(4) Employed (IRD) OLS	(5) Employed (IRD) 2SLS	(6) Employed (IRD) 2SLS	(7) Proportion of months OLS	(8) Proportion of months 2SLS	(9) Proportion of months 2SLS
Instrument used	-	Twins 2	Same sex	-	Twins 2	Same Sex	-	Twins 2	Same sex
Child quantity	-0.103***	-0.040***	-0.091**	-0.112***	-0.049***	-0.101***	-0.111***	-0.044***	-0.128***
	(0.001)	(0.011)	(0.030)	(0.001)	(0.010)	(0.032)	(0.001)	(0.009)	(0.030)
First Stage									
Instrumental variable	-	0.817***	0.066***	-	0.817***	0.066***	-	0.817***	0.066***
		(0.010)	(0.003)		(0.010)	(0.003)		(0.010)	(0.003)
Observations	204,057	197,571	194,715	204,057	197,571	194,715	204,057	197,571	194,715
F statistic	-	6283.38	413.36	-	6283.38	413.36	-	6283.38	413.36
	Full-time OLS	Full-time 2SLS	Full-time 2SLS	Average monthly earnings OLS	Average monthly earnings 2SLS	Average monthly earnings 2SLS	Total annual earnings OLS	Total annual earnings 2SLS	Total annual earnings 2SLS
Instrument used	-	Twins 2	Same Sex	-	Twins 2	Same Sex	-	Twins 2	Same Sex
Child quantity	-0.06***	-0.021	-0.098**	-285.317***	-137.297*	-82.020	-4979.13***	-2,057.019***	-4625.510*
	(0.002)	(0.015)	(0.046)	(10.09)	(68.32)	(238.423)	(64.74)	(592.097)	(1813.03)
First Stage									
Instrumental variable	-	0.826***	0.062***	-	0.846***	0.061***	-	0.817***	0.066***
		(0.011)	(0.003)		(0.012)	(0.004)		(0.010)	(0.003)
Observations	119,040	115,248	113,652	125,274	121,290	119,589	204,057	197,571	194,715
F statistic	-	5707.37	302.22	-	5240.91	292.78	-	6283.38	413.36

Levels of significance: * ($p<0.05$); ** ($0.005>p>0.001$); *** $p<0.001$.
Note: Regression outputs; Robust Standard errors (se) in parenthesis.
Source: Author calculations based on data in the IDI.

5.2 Subsample Analyses and Robustness Checks

I re-estimate the main regressions by classifying the mothers' sample by important demographic characteristics. These results are reported in in Tables 5 & 6.[11]

Mothers with higher education may choose to spend more time at home raising their children (i.e., away from the labour market), even though education is positively related to labour market earnings (Cohen et al.,1970; Leibowitz, 1974). However, in our analysis, the negative relationship between child quantity and maternal employment is observed consistently regardless of mothers' qualification level. For instance, when instrumenting child quantity by 'Twins-2' we find a negative impact on the employment propensity when we stratify the mothers by less than bachelor's degree and bachelor's degree or higher. To be specific, I find a decline in the employment propensity for mothers with a bachelor's degree or higher by 4.6 percentage points and 5.3 percentage points for mothers with less than a bachelor's degree. When differentiating by ethnicity, I find that the employment propensity of European mothers, who account for more than half of our mothers, decreases by nine and four percentage points, using gender-mix and 'Twins-2' instruments, respectively. When stratifying by age, younger mothers (5.6) aged 18-35 did not experience a significantly larger decrease in employment propensity than older mothers (4.4) when increasing their number of children. Younger mothers (2275) did experience a larger decrease in annual earnings when compared to older mothers (1892).

Furthermore, I test if the effect on the labour market characteristics varies depending on the gender of the same-sex children. This further allows us to indirectly test if there is a gender preference among New Zealand mothers. These results are found in Table 7. Having two boys has quantitatively similar results for the first stage as well as second stage estimates when compared to having two girls.

Since the incidence of multiple births may vary by parity, we test the labour market effects of exogenous variation generated by multiple births at different birth positions. The effect of the incidence of multiple births at different birth parity is displayed in Table 8. The effect of having an additional child on maternal labour market outcomes is statistically insignificant when allowing for exogenous variation using multiple births in the first parity. However, when instrumented using multiple births in the third parity, employment decreases by six (Census) and

[11] Estimates by ethnicity are mostly statistically insignificant, with exception to European mothers, and can be made available upon request.

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 5. Estimates of the Impact of an Additional Child on Labour Market Outcome for Mothers by Education Level

	Employed (Census)	Employed (Census)	Employed (IRD)	Employed (IRD)	Average monthly earnings	Average monthly earnings	Total annual earnings	Total annual earnings
Less than bachelor's degree								
Instrument used	Twins 2	Same Sex	Twins 2	Same sex	Twins 2	Same sex	Twins 2	Same sex
Child quantity	-0.053***	-0.058	-0.045***	-0.063	-192.667**	-44.950	-2439.480***	-2071.920
	(0.011)	(0.034)	(0.012)	(0.036)	(66.57)	220.14	(546.81)	(1609.20)
First Stage								
Instrumental variable	0.835***	0.069***	0.835***	0.069***	0.850***	0.064***	0.835***	0.069***
	(0.013)	(0.004)	(0.013)	(0.004)	(0.015)	(0.005)	(0.013)	(0.004)
Observations	144,333	142,233	144,333	142,233	83,616	82,470	144,333	142,236
F statistic	4020.53	291.80	4020.53	291.80	2979.90	200.14	4020.50	291.80
	Employed (Census)	Employed (Census)	Employed (IRD)	Employed (IRD)	Average monthly earnings	Average monthly earnings	Total annual earnings	Total annual earnings
Bachelor's degree or higher								
Instrument used	Twins 2	Same Sex	Twins 2	Same sex	Twins 2	Same sex	Twins 2	Same sex
Child quantity	-0.046*	-0.187***	-0.032	-0.208***	-46.19	-79.260	-1550.760	-11752.010*
	(0.012)	(0.068)	(0.020)	(0.075)	(82.820)	(653.810)	(1576.740)	(5886.2)
First Stage								
Instrumental variable	0.835***	0.055***	0.835***	0.055***	0.840***	0.053***	0.835***	0.055***
	(0.016)	(0.005)	(0.016)	(0.005)	(0.016)	(0.005)	(0.016)	(0.005)
Observations	53,286	52,479	53,286	52,479	37,671	37,122	53,286	52,479
F statistic	2767.21	129.06	2767.21	129.06	2838.82	96.72	2263.23	127.89

Levels of significance: * ($p<0.05$); ** ($0.005>p>0.001$); *** $p<0.001$.
Note: Regression outputs; robust se in parenthesis.
Source: Author calculations based on data in the IDI.

Table 6. 2SLS Estimates of the Impact of an Additional Child on Labour Market Outcome for Mothers by Age.

		Employed (Census)	Employed (Census)	Employed (IRD)	Employed (IRD)	Average Monthly Earnings	Average Monthly Earnings	Total Annual Earnings	Total Annual Earnings
	Instrument used	Twins 2	Same Sex	Twins 2	Same sex	Twins 2	Same sex	Twins 2	Same sex
Age 18-35	Child quantity	-0.056***	-0.031	-0.063***	-0.03	-237.058	-46.198	-2275.370***	-2334.560
		(0.015)	(0.055)	(0.015)	(0.055)	(292.8)	(82.82)	(636.020)	(2272.255)
	First Stage								
	Instrumental variable	0.852***	0.055***	0.852***	0.055***	0.870***	0.054***	0.852***	0.055***
		(0.018)	(0.005)	(0.018)	(0.005)	(0.022)	(0.006)	(0.018)	(0.005)
	Observations	94,347	93,141	94,347	93,141	51,966	52,563	94,350	93,141
	F statistic	2263.23	127.90	2263.23	127.90	91.856	1502.80	2263.20	127.89
		Employed (Census)	Employed (Census)	Employed (IRD)	Employed (IRD)	Average monthly earnings	Average monthly earnings	Total annual earnings	Total annual earnings
	Instrument used	Twins 2	Same Sex	Twins 2	Same sex	Twins 2	Same sex	Twins 2	Same sex
Age 36-45	Child quantity	-0.044***	-0.148***	-0.023	-0.148***	-195.28*	-24.11	-1892.096*	-6246.150*
		(0.013)	(0.039)	(0.014)	(0.039)	(95.053)	(344.270)	(909.150)	(2623.652)
	First Stage								
	Instrumental variable	0.820***	0.075***	0.820***	0.075***	0.836***	0.066***	0.820***	0.075***
		(0.012)	(0.004)	(0.012)	(0.004)	(0.013)	(0.004)	(0.012)	(0.004)
	Observations	103,375	101,574	103,375	101,574	68,727	67,623	103,272	101,574
	F statistic	4296.27	304.16	4296.27	304.16	3977.58	206.33	4296.27	304.16

Levels of significance: * (p<0.05); ** (0.005>p>0.001); *** p<0.001.
Note: Regression outputs; robust se in parenthesis.
Source: Author calculations based on data in the IDI.

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 8. 2SLS Estimates of the Impact of an Additional Child on Labour Market Outcomes by Using Twinning at Different Parities.

	Full-time	Full-time	Full-time	Employed (Census)	Employed (Census)	Employed (Census)	Employed (IRD)	Employed (IRD)	Employed (IRD)
Instrument used	Twins 1	Twins 2	Twins 3	Twins 1	Twins 2	Twins 3	Twins 1	Twins 2	Twins 3
Child quantity	-0.018	-0.021	-0.022	.004	-0.049***	-0.063***	.0013	-0.04***	-0.066***
	(0.014)	(0.015)	(0.025)	(0.01)	(0.01)	(0.018)	(0.01)	(0.011)	(0.017)
First Stage									
Instrumental variable	0.635***	0.826***	0.92***	0.651***	0.817***	0.838***	0.651***	0.817***	0.838***
	(0.011)	(0.011)	(0.021)	(0.01)	(0.010)	(0.017)	(0.01)	(0.01)	(0.017)
Observations	206,247	115,248	31,542	342,579	197,571	64,623	342,579	197,571	64,623
F statistic	3503.58	5707.37	1942.89	4422.50	6283.38	2372.40	4422.50	6283.38	2372.40

Levels of significance: * ($p<0.05$); ** ($0.001<p<0.005$); *** $p<0.001$.

Notes: Regression outputs; robust se in parenthesis. Controls are consistent with those used in the main analysis. Twins 1 is the instrument that is equal to 1 if a mother has multiple births in the first parity. This analysis is conducted for women with at least one child. Twins 3 is the instrument that is equal to 1 if a mother has multiple births in the third birth parity. This analysis is conducted for mothers with three or more children. In each of these analyses' mothers with twin birth occurrences in other parities are dropped from the set, such that the comparable group incorporates mothers of singletons only.

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.

5.3 Longitudinal Analyses

The effects of an increase in family size in larger families may differ from the effects observed in smaller families. However, using 2SLS and OLS does not address this potential selection issue, (Dasgupta & Solomon, 2018). To address this issue, I use fixed effects regressions to capture how a mother earnings and employment vary with the arrival of additional children by controlling for mother specific time-invariant characteristics. I capture the effect of each birth on the maternal labour market outcomes of mothers. The sample for this analysis consists of mothers who have their first child between 2010 and 2015. I track each mother's subsequent birth, her monthly earnings from wages and salaries and employment using birth registry and IRD tax data between 2010 and 2017. The purpose of this analysis is to understand the labour effects of family size and capture the by birth effects on earnings and employment of mothers of particularly young children. I use the following equation to estimate these effects:

$$Y_{it} = \alpha + \mu_i + \gamma\{Childbirth\}_{it} + \omega_{it} \quad (10)$$

Where Y_{it} are the labour market outcomes of mother i, employment and monthly earnings. Employment is a binary indicator that equals 1 when mother i has at least one job holding month t and 0 otherwise. Monthly earnings are reported in NZ dollars and are adjusted for inflation by using the consumer price index of the first quarter of 2017 as the reference base period. The variable μ_i represents the mother fixed effect that would control for mothers' time invariant unobserved characteristics such as, motivation, ability, etc. Alternatively, since the family in my sample can be identified by the individual mothers, μ_i also represents the family fixed effects. $Childbirth$ is a discrete variable that represents the child born at different parities of mother i at time t, this variable is equal to 0 if the woman is yet to give birth, 1 after her first birth, 2 after her second birth and so on. For the purpose of our analysis, we exclude mothers with multiple births. The parameter γ captures the effect of having an additional child on maternal labour market outcomes.

Table 10 presents the results of this linear fixed effects regression. The arrival of a child regardless of birth order is adversely related to both mothers' earnings and employment. Controlling for mother specific characteristics, the arrival of the first birth results in an 18-percentage point decrease in the probability of being employed. Likewise, mothers' earnings also decline by $570 per month on average with the arrival of the first child. Subsequent births result in larger declines in employment and earnings. It is important to note the average treatment effects of the fixed effects and IV estimation are not comparable.

Table 10. Effects of Birth Order of Mothers' Labour Market Outcomes

	Fixed effects employment	Fixed effects monthly earnings
1st Birth	-0.18 ***	-569.62***
	(0.001)	(8.24)
2nd Birth	-0.267***	-682.25***
	(0.002)	(13.30)
3rd Birth or higher	-0.34***	-927.04***
	(0.004)	(35.37)
Observations	110,760	98,100

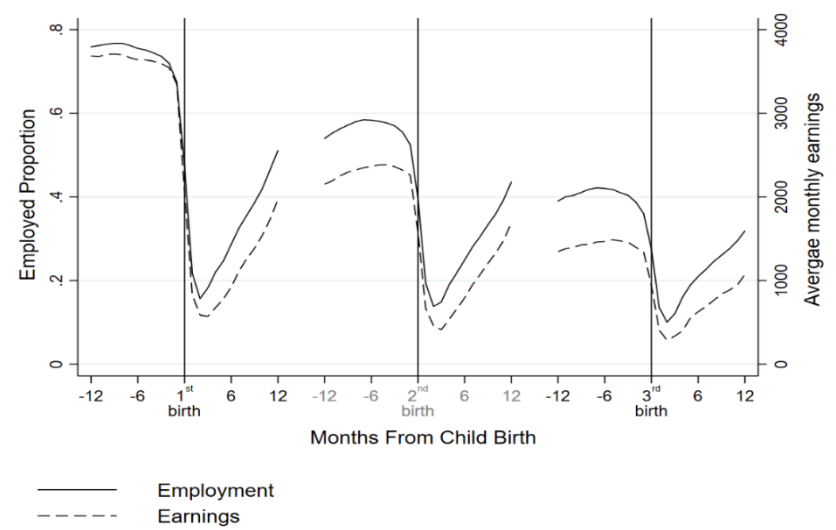
Levels of significance: * (p<0.05); ** (0.005>p>0.001); *** p<0.001.
Note: Regression outputs; se in parenthesis.
Source: Author calculations based on data in the IDI.

The effects of childbirth by parity on the labour market outcomes of mothers is graphically represented in Figure 3. In particular, I show mother labour market outcome trends twelve months before and twelve months after each childbirth. The sample for this analysis consists of mothers who have their first child between 2010 and 2015. I track each subsequent birth the mother has as well as her monthly earnings from wages and salaries and employment between 2008 and 2017. Monthly earnings are adjusted for inflation with consumer price index using the 2017 first quarter as the reference period. I calculate and plot the average earnings and the employment proportion by month before/after childbirth for the first, second and third or greater birth. Figure 3 indicates that employment proportion and earnings drop significantly at childbirth. This Figure indicates that mothers re-enter the workforce around 2 months after childbirth and the employment proportion and earnings slowly increase from thereon. Each subsequent birth is succeeded by a further reduction in the employment proportion and monthly earnings for mothers. The employment rate for these mothers twelve months before their first birth was 76 percent, in contrast, their employment twelve months before their third or higher birth is almost half that.

The effects of childbirth by parity on fathers' earnings and employment are graphically represented in Figure 4. The effects on fathers' labour market outcomes are mixed in comparison to mothers of the same children. Fathers' earnings increase with the arrival of a child, while employment decreases.[12]

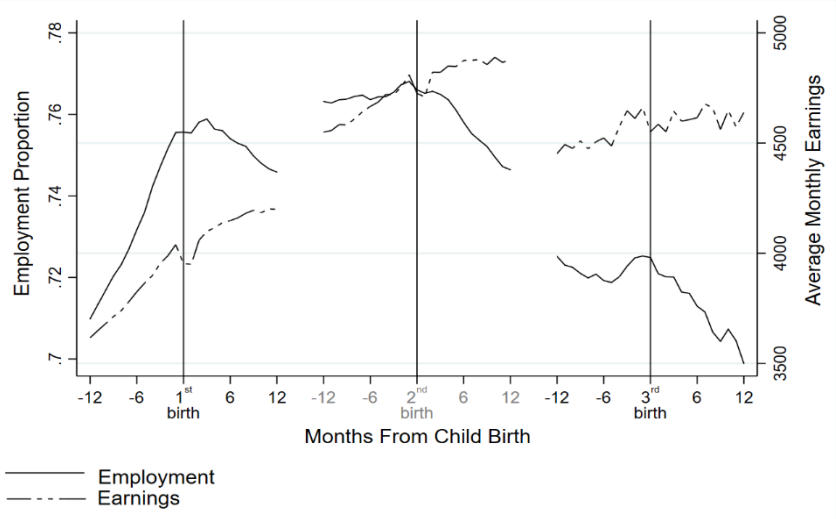
[12] Fathers may increase their monthly earnings by increasing their weekly work hours or by seeking promotion. Neither is observable using IRD tax data.

Figure 4. The Average Monthly Earnings and Employment Proportion of Mothers by Months from Birth.



Source: Author calculations based on data in the IDI.

Figure 3. The Average Monthly Earnings and Employment Proportion of Fathers by Months from Birth.



Source: Author calculations based on data in the IDI.

Chapter 6 Discussion

The results from this analysis on New Zealand mothers conforms to the previous findings in the related international literature. Several studies find statistically significant results when empirically analysing the relationship between maternal labour market outcomes and family size when allowing for exogenous variation. All of which report a similar result where child quantity has an adverse effect on labour market participation, (Angrist & Evans; Cruces & Galiani, 2007; Frenette, 2011; Moschion, 2009, as cited in Moschion, 2013; Moschion, 2013). France observes a particularly large negative impact on labour supply (19). In comparison, New Zealand observes a relatively small decrease in the probability of being employed by 4 to 10 percentage points, depending on the instrument. Several studies also rely on Census and other survey responses as data sources. While sample sizes are large enough to conduct proper, self-reported values for earnings and employment introduce measurement errors and bias, (Pavlopoulos et al., 2012). The advantages to the IDI are that birth and income data are accurately recorded and updated on a monthly basis so self-reporting isn't so much an issue. Furthermore, despite these studies indicating a similar negative effect in maternal labour market outcomes, estimate magnitudes appear to vary by study period and region. Regional variation in estimate magnitudes can be explained due to institutional differences.

Institutional differences in taxation, childcare and other support systems for families may be relevant to understand the impact of child quantity on a mother's employment. Two papers compare the causal estimates of child quantity on maternal labour supply. Both find relationships between family policies and mother labour market participation, (Michaud and Tatsiramos, 2009; Moschion, 2010). For example, in France, the impact of child quantity on labour participation is large and consistent with a long (up to three years) paid parental leave scheme, which until 1994 was only available for mothers with at least three children, (Moschion, 2010; Moschion, 2013). In comparison to other countries, at the time of Moschion's (2009, as cited in Moschion, 2013) study, French childcare was relatively inexpensive, six percent of net family income, (Moschion, 2013). Additionally, the French tax system favours single earning families, giving additional incentives for mothers to leave the labour market. Some other countries do not share such benefits, (Adema et al., 2009).

Policy changes may reduce the economic burden associated with having children, including reducing the costs of early childhood education. In 2012, New Zealand childcare amounted to 38% of the average couples' wage, second among OECD countries, (OECD, 2021). This is puzzling as early childcare is widely available and partially subsidised in New Zealand. In 2007,

the government introduced the 20-hours free childhood education initiative, where the cost for early childhood education can be fully subsidised for up to 6 hours per day, and up to 20 hours per week for three- to five-year-olds. In a comprehensive analysis of the reform, Bouchard et al. (2020) find that decreasing childcare costs results in increased labour force participation for women with two eligible children. This is consistent with theoretical models for family size and parental time allocation, such as Angrist and Evans (1998), whereby parents will reduce their time spent in home production thereby increasing their labour hours when the cost of childcare is reduced. Policies that increase the labour supply of mothers either by further reducing childcare costs could partially help and address the ageing issue countries like New Zealand face, (Burniax et al., 2003). Jaumounte (2003) suggests this approach is far more acceptable than forcing the older population to work longer.

An alternative approach policy makers may take to address population ageing is by increasing fertility rates. Policy makers may do this by creating financial incentives for families to have children. Currently, New Zealand implements child benefits in the form of the Family Tax Credit, this is not a universal payment and is dependent on income and the number of children. Empirical evidence in France shows that implementing tax credits has a negative effect on female labour participation, especially for married women, (Stancanelli, 2008). Implementing an allowance system for families with children has a positive effect on child quantity, (Milligan, 2005), while creating an income effect, reducing the female labour supply, (Jaumotte, 2004). Additionally, policy reforms that reduce childcare costs may increase child quantity also, as shown in a Mork et al., (2013).

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.

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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.