

The labour supply of Indigenous Australian females: the effects of fertility and interactions with the justice system

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Abstract Indigenous females are among the most disadvantaged groups in Australia; Furthermore outcomes for Indigenous Australians compare unfavourably with those for similar First Nations around the world. There appears to be a demographic transition under way in Indigenous Australia whereby declines in fertility and mortality are likely to lead to an increase in the number of Indigenous people supplying their labour in the near future. This paper examines the determinants of Indigenous female labour force participation with a particular focus on the role of fertility and interaction with the justice system. The analysis controls for the standard determinants of labour supply, but its main contribution is in taking into account the endogeneity of these potential interruptions to labour market participation. These findings are also important because Indigenous Australian females are 22 times more likely to be in prison than other Australian females and hence the analysis has crucial implications for the ability of policy makers to ‘close the gaps’ between Indigenous and other Australians. Once endogeneity of fertility with labour supply is taken into account, there is no significant independent effect on labour force participation and hence policy should focus on the other factors including education and training.

Keywords Indigenous females · Fertility · Crime · Labour supply · Australia

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Introduction

Aboriginal and Torres Strait Islander Australians (hereafter referred to as Indigenous Australians) account for only 2 % of the Australian population but on most of the indicators of economic and social well-being, they make up a significantly larger proportion of those who are disadvantaged. Employment, income and education levels are lower; child mortality rates and morbidity rates are higher. The life expectancy at birth of Indigenous males is 11.5 years lower and of Indigenous females, 9.7 years lower than that estimated for their other Australian counterparts (SCRGSP 2009). Addressing Indigenous disadvantage has become a major focus of governments at all levels. The Council of Australian Governments (COAG) has a stated goal of closing the measured gaps in key indicators within specified time frames.

Economic engagement, usually measured in the mainstream Australian community by labour force participation and employment, is an important indicator of disadvantage with implications for individual, family and household incomes. Active labour force participation is also recognized to have beneficial effects for mental and physical health and to improve wider family and community outcomes. There is a specific COAG goal of halving the employment gap between Indigenous and other Australians by 2018.

A demographic transition has been identified among Indigenous Australians whereby long-run reductions in mortality (especially infant mortality) and more recent declines in fertility are likely to lead to substantial changes in the age composition of the population with a large number of Indigenous people entering the working age group in the near future (Taylor 2003, 2010). These changes are likely to increase the number of people involved in Indigenous labour but labour force participation rates could be left unaffected. The demographic transition will only lead to an increase in the labour force participation rate if the young people newly entering the working-age population are more likely to supply their labour than historically evident in the Indigenous population.

Hence it is crucial to understand the processes that determine labour supply in order to appreciate the policy prospects for closing economic gaps.

Earlier studies have found human capital variables, age and location of residence, to be important determinants of labour force participation. (Daly 1995; Hunter 2004). While several publications examine the relationship between the interaction with the justice system and labour force status for Indigenous Australians (Borland and Hunter 2000; Stephens 2010; SCRGSP 2011), this paper extends the earlier analysis by simultaneously considering the effects of both fertility and arrest on female labour supply.

Aggregate data for measuring outcomes for Indigenous Australians are limited; the five-yearly Census of Population conducted by the Australian Bureau of Statistics (ABS) is the most comprehensive source of information. There is no formal recognition and identification of Indigenous Australians related to treaty obligations as in the US, but for most official purposes, identification is a matter of individual choice. In official statistics there are no gradations of indigeneity. Since 1971, respondents to the Census have been given the option to identify themselves

as either Aboriginal or Torres Strait Islanders (since 1996 it is possible to identify as both). An important issue in interpreting changes over time in the Census data has therefore been the increasing propensity for individuals to self-identify as Indigenous Australians.

Census data have clear limitations for analysing social factors associated with labour supply. Several ABS surveys offer a rich source of data on Indigenous Australians, but the ability to compare outcomes with those of other Australians is limited by the Indigenous-specific nature of much information covered (e.g. ABS 1995, 2004). The estimates reported in this paper are taken from data collected by ABS as part of the National Aboriginal and Torres Strait Islander Social Survey (NATSISS) in 2002.¹ The main reason for focusing on these data is that other similar surveys do not include adequate measures of all the determinants of Indigenous labour supply we seek to analyse, especially the simultaneous provision of information on both fertility and arrest. For example fertility data are missing from the most recent NATSISS collected in late 2008 and early 2009 (see Johnstone and Evans 2012).

On standard labour market indicators, Indigenous Australians are among the most disadvantaged First Nations in developed countries. They have lower labour force participation rates than similar groups in other settler societies (see Table 1). The unemployment rates for the First Nations were about twice those of other peoples in these countries; the relative employment-to-population ratios were particularly low for Indigenous Australians (see Table 1).

Indigenous Australian females have a relatively low rate of labour force participation (Hunter 2004; Daly 1995); while it has risen gradually over time, it remains substantially below that of other Australian females. According to the Population Census, between 1971 and 2006 the labour force participation rate of Indigenous females doubled to 49 %. This was well below the 58 % of other Australian females who participated in the labour force in 2006 and 20 % below the participation rate for Indigenous males. Participation rates for Indigenous females were substantially lower in remote Australia than in the major cities; 46 % compared with 56 % in 2006.²

These figures relate to engagement in the mainstream labour market. An important issue in analysing active economic engagement among Indigenous Australians is the extent to which the labour force participation rate reflects all the economic activities of Indigenous people. Around one quarter of the people who identify themselves as Indigenous in the Population Census live in remote and very remote Australia where the mainstream labour market barely exists. In these areas, as in more settled locations, traditional hunting and gathering supplement money income received from other sources such as the welfare system (Altman et al. 2006).

¹ For a fuller discussion of the results of this survey see Hunter (2007). For a survey of the major indicators and a comparison with results for non-Indigenous Australians see Altman et al. (2009).

² The distribution of the Indigenous population is less urbanized than the Australian population as a whole. In 2006, just under one-third of Indigenous people lived in major cities (31.8 %), with a substantial number living in inner or outer regional areas (42.8 %) and over one-quarter residing in remote or very remote locations (25.4 %). See ABS (2010) for further details about labour force and estimated residential population statistics derived from the 2006 Census.

Table 1 International comparison of Indigenous arrests and labour market outcomes 2000/01

	Unemployment rate	Employment/ population ratio	Labour force participation rate	No. of offences/arrests per 1000 adults
Indigenous Australians	20.0 (2.7)	40.3 (0.7)	50.4 (0.8)	243.6 (11.5) ^a
Canadian aboriginal	19.1 (2.6)	49.7 (0.8)	61.4 (0.9)	25 (8.0) ^b
New Zealand Maori	16.8 (2.2)	56.3 (0.9)	67.7 (1.0)	87.9 (4.8) ^c
American Indian	7.4 (2.0)	53.8 (0.9)	61.4 (0.9)	89 (2.0) ^d

Sources Australia: ABS census of Population and Housing, 2001; ABS Demography Unit Canberra, Unpublished data; The reported crime statistics are for NSW and based on the number of individuals who commit offences (adjusted using Hunter and Ayyar 2011 data on the Indigenous undercount in Indigenous offender estimates); Canada: Statistics Canada 2001 Census, Statistics Canada Adult Correctional Services in Canada 2000/01; New Zealand: Statistics New Zealand 2001 Census, Ministry of Maori Development 2000; United States of America: US Census Bureau 2000 Census, FBI Uniform Crime Report for 2001 available on the web at http://www.fbi.gov/ucr/cius_01/01crime4.pdf

The ratio of Indigenous to non-Indigenous outcomes is indicated in brackets

^a There are no national data on arrest/offender rates in Australia and the above reports the NSW data from Local Court, which is broken down by Indigenous status. Loh and Ferrante (2003) estimate that the number of Indigenous individuals arrested in Western Australia was 206.8 per 1,000 adults (18+) in 2001 with a corresponding Indigenous to non-Indigenous ratio of 11.9. The higher (absolute) rate of arrest compared to the offence rate reported above may simply reflect the fact that arrest is a rather amorphous concept; for example, arrest is a jurisdictional-specific concept that depends on police implementation of the law and the availability of alternative sanctions. Many people who may consider they have been arrested never have the matter brought before the courts. Note that the ratio of Indigenous to non-Indigenous outcomes is remarkably similar in these two Australian states despite the different measures of interactions with the criminal justice system. Given the conceptual difficulty in measuring rates of arrest/offending, readers should focus on the relative outcomes for Indigenous and non-Indigenous populations (in parenthesis)

^b The Canadian statistics relate to custodial admissions

^c The New Zealand data relate to 1998 for prosecution rates per 1,000 population

^d US data relate to 1998 for prosecution rates per 1,000 adult population

People living on a remote outstation are unlikely to satisfy the criteria for active labour force participation as applied by the ABS, but they may still be engaged in activities which make an important contribution to their well-being and that of their community. While there are only limited aggregate data on involvement in this customary non-market economy, the component of the 2002 NATSISS that sampled discrete remote Indigenous communities showed that 82 % of respondents had engaged in fishing or hunting activities in a group in the preceding 3 months (Altman et al. 2006). Unfortunately, the 2002 NATSISS did not collect data on gathering activities so the role of Indigenous females in the customary economy is likely to be understated (Altman et al. 2006).

A further factor influencing the measured labour force participation of Indigenous Australians has been the work-based welfare scheme, the Community Development Employment Projects (CDEP) scheme. Under this scheme,

Indigenous communities have had the option of pooling their welfare entitlements and receiving some supplementary government funding to undertake projects of a developmental nature in these communities, mainly located in rural and remote areas.³ Participants are paid their welfare entitlements usually in exchange for working on a part-time basis. The scheme began in 1977 and since then there has been an extended debate about whether CDEP participation constitutes employment or not. It is a significant issue in discussions of Indigenous employment as over a quarter of the total employment of Indigenous Australians, about 13 % of the working-age population, was under the scheme at the time of the 2002 NATSISS (Gray and Chapman 2006; Hunter 2002).

CDEP participation was counted as employment in the NATSISS data used in this study; and the determinants of this type of employment are likely to be quite different from the determinants of mainstream employment. For example, a female sole parent receiving income support from the government can also be required to work part-time on the CDEP scheme to receive this benefit. However, her work might involve child care that would otherwise take place outside the market, but has been integrated into the CDEP scheme. An identical sole parent receiving income support but not living in a community with a CDEP scheme would not be counted as participating in the labour force.

The net effect of the customary economy and CDEP schemes in Indigenous communities may be that labour force participation measured by ABS data could either understate, overstate, or even not affect the true level of economic engagement of Indigenous females. The results presented below therefore partly reflect data limitations and the difficulties of measuring economic engagement for this marginally attached group.

The determinants of Indigenous female labour supply

The economic theory of the determinants of labour supply is well developed (Killingsworth 1983; Killingsworth and Heckman 1986; Pencavel 1986). The decision to supply labour to the market will depend upon a number of factors including the level of unemployment benefits, macro-economic conditions, the level of labour demand in the local labour market as well as the social and economic conditions facing individuals and their families. For example, for mothers, the age of their children is likely to be very important as the balance changes between paid work and childbearing and rearing responsibilities (Hersch and Stratton 1994).

In models of family labour supply, individuals make choices on labour force participation with the aim of maximizing the welfare of the whole family unit. Therefore individuals' decisions to search for work will depend on the opportunity cost of their non-market work (for example, child care and housework), their expected wage, their human capital endowments (health, schooling and labour market experience), the income of other members of the household and their preferences for paid employment. The interaction of demand and supply in the

³ In the Australian context, welfare includes income support for the unemployed and sole parents.

relevant labour market will decide whether or not the individual is employed. In labour markets where there are few opportunities available, individuals may be discouraged from seeking work and cease to participate in the labour market (Hunter and Gray 2001).

There is a standard group of variables typically included in empirical estimates of labour supply. These include human capital, as measured by years of schooling or educational qualifications, and on-the-job training, as measured by years of labour market experience. The accurate measure of labour market experience is particularly difficult for groups such as Indigenous Australians who experience intermittent attachment to the labour market (see Gray and Chapman 2006). Family characteristics are also included, such as marital status and number of children, health, other household income and location of residence, capturing the effects of demand conditions in the relevant labour market. Rather than present a detailed justification for the inclusion of all the standard variables used here, the discussion focuses on particular factors relevant for Indigenous Australians.

In addition to the standard variables included in the analysis of labour force participation, there are some particular factors which are likely to be important in the context of Indigenous Australians. Access to a traditional lifestyle, including hunting and gathering and use of an Indigenous language, is likely to influence an individual's decision about whether or not to participate in the mainstream labour market. A history of social exclusion from mainstream institutions in Australia is also likely to influence the decision to participate in paid work. Hunter and Gray (2001) found that Indigenous-specific cultural factors had a significant negative effect on participation in the mainstream labour market for men and women. The presence of the CDEP scheme in a community may also affect labour supply.

Earlier estimates of labour force participation and employment for Indigenous Australian females show that the presence of children had a negative effect (Borland and Hunter 2000; Daly 1995). Responsibility for child-rearing may have long term effects on the participation decision by reducing the accumulation of work experience and affecting occupation and related employment choices. Expectations about the domestic responsibilities of females also influence their education levels. In the Australian welfare system, the means testing of the benefits received by lone parents can discourage participation where income from employment reduces the level of benefit entitlement. The current study used the number of children ever borne as the measure of fertility. The coefficient on this variable will capture the effect of ever having had children on the current decision to participate. Unfortunately information on the age of children was not available in the data set used for the 2002 NATSISS.

The Royal Commission into Aboriginal Deaths in Custody (RCADC) highlighted the alarming difference between Indigenous and other Australians in arrest and incarceration rates which still continues (Commonwealth of Australia 1991). Recent data from 2008 show that Indigenous males were 17.2 times, and Indigenous females 21.7 times, more likely to be in prison than their non-Indigenous counterparts (SCRGSP 2009).

International comparisons also highlight the overrepresentation of Indigenous Australians in the justice system. It is difficult to get international crime data measured in a comparable way across countries that also enables a comparison

between Indigenous and non-Indigenous people. The data presented in Table 1 use different measures in each country, but they enable a comparison of the relative position between Indigenous and non-Indigenous people in each country. Table 1 shows that in 2000/01, Indigenous Australians had a rate of interaction with the justice system that was 11.5 times higher than non-Indigenous Australians and well above the relative rates for US Indians and New Zealand Maori. The rate of custodial admissions of Canadian Aborigines was also particularly high relative to other Canadians. The evidence shows a strong negative effect of involvement with the justice system on employment status so the high rates of involvement for Indigenous Australian are likely to be detrimental for labour market outcomes.

Subsequent research has shown the implications of these differences for the employment status of Indigenous Australians. Borland and Hunter (2000) estimate on the basis of 1994 ABS data from the NATSIS, that having been arrested reduced the probability of employment for Indigenous males by between 10 and 20 % and Indigenous females by between 7 and 17 %. Hunter's (2001) analysis of the 1994 NATSIS data emphasized the role of sex, age, labour force status, alcohol consumption, education, and whether a person had been physically attacked or verbally threatened in determining the likelihood of arrest (see Dodson and Hunter 2006a; Hunter 2001). The cumulative and multiple disadvantages that arise from historical circumstances are likely to be particularly pronounced for Indigenous people. One such Indigenous-specific factor is the effect for some Indigenous children of belonging to the 'stolen generation' who were taken from their families as part of government policy which continued into the early 1970s. Whatever one's position on the official justification for taking children away, the phenomenon is associated with a high level of social disruption that is likely to have intergenerational effects on interactions with the justice system (Dodson and Hunter 2006b).

The significance of arrest in explaining employment rates raises the possibility that interruptions to labour market experience and human capital formation are adversely affecting the labour supply of Indigenous females.

The potential importance of a criminal record in explaining labour market outcomes for Indigenous Australians is further highlighted by the results from a series of American studies based on surveys of employers. Holzer et al. (2006) asked employers about their views on employing members of a number of disadvantaged groups including the long-term unemployed, welfare recipients, participants in government training programs and those with a criminal record. While over 90 % of employers said they were willing to hire welfare recipients or people without a high school diploma, 59 % said they would hire employees with a broken employment history and 83 % said they would hire someone who had been unemployed for over a year, only 38 % said they would hire an ex-offender. Other results presented by these authors and by Pager (2003) show that black American ex-offenders were the group least likely to be offered employment. Pager found that the combination of employers' rejection of job applicants with a criminal record and racial prejudice meant that black non-offenders were less likely to be offered entry-level jobs than whites with a criminal record and black offenders faced a 64 % reduction in employment opportunities compared with whites without a criminal record.

Arrest is likely to affect labour force participation and employment for a number of reasons. On the demand side of the labour market, it may be used by employers as a screening device. Employers may shy away from potential employees with a history of interaction with the justice system. In addition there are some types of work where individuals with a criminal record are explicitly excluded, for example work with children. However this screening effect will not be important for participation in the CDEP scheme. Further, businesses may avoid geographic areas with high levels of criminal activity, thereby reducing the number of job opportunities (e.g. Dale 1976; Finn and Fontaine 1985; Schwartz and Skolnick 1962). Stoll et al. (2000) present evidence from the US that employment growth in inner cities, where disadvantaged minorities were more concentrated, was slower than in the suburbs, making access more difficult to the employment opportunities that do exist for low-skilled workers. This observation is also likely to be relevant for Indigenous Australians living in remote and regional areas where employment growth has been rather slow over the long run.⁴

On the supply side, a history of arrest may reduce an individual's motivation to work and acquire labour market skills (Borland and Hunter 2000; Hunter and Gray 2001). Another possibility is that a person's labour force status will affect the likelihood of being arrested. For example, a response to being unable to obtain employment may be to engage in drinking which increases the probability of being arrested for offences relating to drunkenness (Freeman 1988). Evidence from the 1994 NATSIS shows a strong positive relationship between alcohol consumption and arrest, so a history of arrest may indicate other individual characteristics that may have a negative effect on labour supply (Borland and Hunter 2000). The importance of work-related characteristics such as punctuality, motivation and reliability have been emphasized in studies of successful transitions into employment even for low-skilled workers (Farkas 2003; Heckman et al. 2006).

Arrest is also correlated with unemployment although the relationship tends to be in the opposite direction to that for employment (Office of Evaluation and Audit 1997; Hunter and Gray 2001). However, the effect of arrest on unemployment is much less than its effect on employment, especially for females (Hunter and Gray 2001). While arrest may shuffle people from employment into unemployment, it may also increase the number of discouraged workers by causing some people to leave the workforce entirely. The net effect of arrest on labour force participation is probably driven by the lack of motivation of individual jobseekers to look for work after arrest has reduced their prospects of employment. Individuals' appraisals of their employment prospects are not always entirely realistic, and the psychological dynamics of negative experiences and attitudes of people who have been arrested may be a factor in the low levels of labour force participation.

The negative effects of the combination of racial discrimination and interaction with the justice system are also likely to have an impact on the employment prospects of Indigenous Australians. Holzer et al. (2006) argue that employers may apply statistical discrimination against distinct groups rather than undertake

⁴ The recent mining boom has enhanced growth in some areas, but such effects are localized. In any case, the vast majority of the growth in mining employment has occurred since 2002.

background checks for a criminal record. Where this occurs, groups such as black Americans and Indigenous Australians who have had no involvement with the justice system will find it difficult to get employment as they are treated as if they have a criminal record. This problem will be less pronounced where employers undertake background checks although it may reduce the employment prospects of individuals with a criminal record.

In summary, the potential effects of criminal activity and arrests on labour force participation of Indigenous Australians are of interest for a number of reasons. First, the large disparity in arrest rates may explain part of the difference in employment rates between Indigenous and other Australians, which in turn perpetuates exclusion of Indigenous Australians from the labour market. Second, understanding the relation between an individual's arrest record and employment outcome provides an insight into the social costs of contact with the criminal justice system for Indigenous Australians. This seems particularly important where there is a possibility that much of the contact of Indigenous Australians with the criminal justice system arises through differences in treatment of Indigenous and non-Indigenous Australians under that system rather than differences in behaviour.⁵

Modelling labour force participation

The estimation used in this study is based on that developed by Borland and Hunter (2000). Labour force participation is estimated as a function of exogenous explanatory variables (X_i s) and potentially endogenous explanatory factors (Y_i), for example, fertility and an individual's history of arrest in the past 5 years.⁶ These endogenous factors can be estimated as a function of exogenous explanatory variables and valid instruments (Z_i s):

$$\text{LFP}_i = \alpha X_i + \delta Y_i + u_i \quad (1)$$

$$Y_i = \beta Z_i + v_i \quad (2)$$

where u_i and v_i , are normally distributed error terms.

The purpose of estimating these equations was to address the potential issue of simultaneity bias in the estimated coefficients for the effect of both arrest and fertility on labour supply. This bias may arise from the presence of some unobserved underlying factor that is important in determining labour force status, fertility and arrest history, so the error terms are correlated, or by direct causation in both directions

⁵ Broadhurst (1997, p.417) argues that there is '...clear statistical support for the proposition that "race" or Aboriginality increases the risk of arrest'. However, he also cautions that '...Aboriginality may be a factor or variable that catches a number of stigmatizing characteristics (such as truancy, unemployment, substance abuse) and in this sense operates as a shorthand "predictive" model for police...'

⁶ Concerns have been expressed that individuals are likely to underreport their number of arrests. Borland and Hunter (2000) were able to compare estimates of the proportion of Indigenous people in Western Australia who had been arrested in the past 4 years according to the 1994 NATSIS and West Australian police records. They found that the proportions were very similar, 25.4 % according to the NATSIS and 24.6 % according to official records. This finding increases confidence in the survey results on arrest history.

between arrests and labour force participation on the one hand and fertility and labour force participation on the other. In order to address this issue, a sequential two-stage process of estimation is used. The first stage is to estimate a probit equation for whether an individual had been arrested in the preceding 5 years or whether a female ever had a child. In order to identify the equation, variables were included in the Z_{it} s that were not included in the participation equation. Generalized residuals were then calculated from this equation and used with the arrest history variable in the participation equation.⁷ If the null hypothesis of a zero coefficient on the generalized residuals is accepted, the participation equation can be re-estimated as a single equation model excluding the generalized residual term (Vella 1993).

If the generalized residual test indicates some endogeneity, then it is tempting to argue that the coefficient on the endogenous variable indicates the true effect controlling for this simultaneity bias. Unfortunately, this assertion is contestable if the explanatory variable is endogenous and hence the reported results use Conditional Maximum Likelihood estimators to control for the possibility of endogeneity between Eqs. 1 and 2 (Rivers and Vuong 1988). Specifically, if endogeneity is demonstrated to be a significant issue using the generalized residual test, the formal analysis would then use an Instrumental Variable (IV) Probit estimator to provide the consistent (unbiased) estimates and standard errors (using the statistical package Stata). In effect this means that the first-stage regression predicts the number of arrests or the number of children ever born, which is then used as an instrument in the second-stage regression of labour force participation.

Data

The 2002 NATSISS used in this study is the second major nationwide survey conducted by ABS specifically targeted to collect a large amount of information on Indigenous Australians. Carried out between August 2002 and April 2003, it collected information from 9,359 individuals aged 15 years and over from 5,887 households. The sample excluded people in non-private dwellings such as prisons, hospitals, and hostels.

The survey was conducted by personal interview and included a wide range of questions on demographic, cultural and language, education, employment, income, financial stress, health, housing, transport, information technology and crime and justice topics. The study reported here is based on 3,972 female respondents aged between 25 and 64 years for whom there was complete information on all the data required to measure the factors underlying labour force participation.

⁷ Borland and Hunter (2000) estimated the generalized residuals as:

$$\hat{\varepsilon}_{it} = \{[\text{ARR}_{it} - \Phi(Z_{it}\hat{\beta})]\phi(Z_{it}\hat{\beta})\} \{ (1 - \Phi(Z_{it}\hat{\beta}))\Phi(Z_{it}\hat{\beta}) \}^{-1} \quad (3)$$

Where Φ and ϕ are the cumulative distribution function and probability density function of the standard normal distribution, Z is the set of explanatory variables included in Eq. (2), and β is the probit estimate of coefficients on the explanatory variables in Eq. (2). In order to identify the arrest equation from the employment status equation, it is necessary that the arrest equation vector of explanatory variables should include some variables not included in the employment status equation.

The variables used in the analysis are described in Appendix. Eighty-two per cent of the females had given birth to at least one child and almost a third of those surveyed had given birth to four or more children. Ten per cent of the females had been arrested, below half the arrest rate for males. The category of residence with the largest share of Indigenous females is remote Northern Territory areas (over 22 % of respondents).

Following Borland and Hunter's (2000) lead, the variable that indicates whether a respondent was taken from his or her natural family is used as the instrument for arrest; it is not correlated with labour force status but is strongly correlated with the incidence of arrest.

The instruments for fertility are more difficult to find. Several variables are correlated with ever having had children and the number born, but are not directly correlated with labour force participation. This paper argues that the number of a woman's children who died is strongly correlated with the number of children ever born, but is not related to current labour supply. Why should we expect this to be the case? Females whose children die might want to fill the void in their family life, especially if they anticipated some sort of ideal family size. It is also highly unlikely that a death in the family, possibly sometime in the past, is going to be functionally related to current labour force participation. These expectations are borne out by the facts as the number of children who died is the strongest predictor of the number of children born to a woman, but is not directly correlated with labour force participation. In technical terms, it is both a valid and identified instrument. Hunter and Daly (2008) also used several other instruments (living in a multifamily household and being charged with a criminal offence at an early age) which effectively produced the same results as the following analysis. However, in this paper the instrument for fertility is the number of children who died before the survey.

Results

Endogeneity tests of arrest and fertility and labour force participation

This section reports the generalized residual test suggested by Vella (1993) to test the endogeneity of arrest and fertility. This involves a probit model of recent arrest and whether a female ever bore a child. The generalized residual from the first stage regressions of arrest and fertility are calculated and used in a probit model of labour force participation, and the t-statistics for the coefficient on the residual can be interpreted as a test of endogeneity of fertility on labour force participation.

The regressions that are used to estimate the generalized residual test for endogeneity are presented in Hunter and Daly (2008). Table 2 indicates the participation model that includes an arrest dummy, and the associated generalized residual shows that the hypothesis of a coefficient of zero on this residual can be accepted at the conventional levels: hence arrest can be treated as exogenous with respect to labour supply. Accordingly, the preferred specification uses the arrest variable only, not instrumented arrest. Note that the finding that arrest is exogenous with respect to female labour supply is not sensitive to the inclusion of a measure of fertility in the participation equation.

Table 2 Endogeneity tests of arrest and fertility using generalized residuals

	Arrest and fertility	Arrest only
Arrest generalized residual	-0.209 (0.213)	-0.112 (0.209)
Fertility generalized residual***	1.718 (0.200)	

Source Hunter and Daly (2008)

Standard errors of the coefficients are listed in brackets. The instrument for arrest is whether taken from natural family. For fertility it is charged as a minor and lived in a multifamily household. The endogeneity test for fertility is the t-statistic on generalized residual from the probit regression of whether a female had ever borne a child which is significant at the conventional levels (i.e. with a t-statistic of 8.5)

*** Indicates significance at the 1 % levels respectively

The results for the initial test of endogeneity for fertility are also presented in Table 2 and show that fertility cannot be taken as an exogenous variable with respect to labour force participation. The results also show that when the endogeneity of fertility is controlled for, there is no longer a significant effect of having had children on labour force participation. That is, once other explanatory factors and simultaneity bias are controlled for, the effect of fertility on labour supply is not evident, at least when fertility is measured as ever having had children. The next section explores endogenous fertility (measured by the number of children ever born) with respect to labour force participation using an IV Probit estimator.

Factors associated with labour supply of Indigenous females

Table 3 presents the estimates of the marginal effects of factors associated with labour force participation of Indigenous females after controlling for the endogeneity of fertility, as measured by the number of children ever borne and instrumented by the number of those children who died before the survey data were collected.

The largest effects were the increase in participation associated with additional educational qualifications. A university degree increased the probability of participating in the labour force by 43 percentage points compared with a female who had not completed Year 9, holding all other characteristics constant.⁸

Having been arrested in the previous 5 years is the second most important explanation after education as it is associated with a 16 percentage point lower probability of being in the labour force.

Location of residence was also a significant determinant of female labour supply. The finding that the locations with more CDEP are those areas with significantly higher participation rates is consistent with existing literature (Hunter 2002). Such observations provide a reason why the disaggregated geographic controls are required in modelling Indigenous labour supply. Other local institutional factors

⁸ In the Australian education system, Year 12 is the completion of high school.

Table 3 Marginal effects on the probability of labour force participation of Indigenous females aged between 25 and 64 who are not studying full-time, 2002

Description	Marginal effect	SE
Whether arrested in last 5 years***	-0.1618	(0.031)
Number of children ever borne (instrumented fertility)	0.0043	(0.023)
Age***	0.0559	(0.009)
Age squared***	-0.0007	(0.000)
Highest level of educational attainment is a degree or diploma***	0.4309	(0.023)
Highest level of educational attainment is a certificate***	0.2768	(0.030)
Highest level of educational attainment is Year 12***	0.2620	(0.032)
Highest level of educational attainment is Year 10 or 11***	0.1540	(0.027)
Highest level of educational attainment is Year 9***	0.0868	(0.032)
Difficulty in speaking English***	-0.1172	(0.025)
Major City NSW	0.0235	(0.052)
Inner Regional NSW	-0.0683	(0.050)
Outer Regional NSW	-0.0087	(0.046)
Victoria	-0.0667	(0.037)
Major City Queensland	-0.0054	(0.072)
Inner Regional Queensland	-0.0440	(0.076)
Outer Regional Queensland***	-0.0910	(0.040)
Remote Queensland***	0.1173	(0.041)
Non-remote Western Australia	-0.0236	(0.048)
Remote Western Australia***	0.1823	(0.035)
Remote Northern Territory*	0.0597	(0.035)
Remote Balance of Australia***	0.1959	(0.035)
Sole parent***	-0.0817	(0.022)
Ever drank alcohol***	0.1102	(0.020)
Drinks alcohol at high-risk level***	-0.1192	(0.039)
Log of income of other household residents***	0.0724	(0.014)
Both Indigenous and non-Indigenous people living in household***	0.0914	(0.025)
Wald test of exogeneity of fertility instrument $\sim 2(1)$	2.65	
Number of observations	3,377	

The reference person is a 40-year-old non-remote female resident (of balance of Australia) living in an Indigenous-only household with weekly income of \$420 and who has less than 9 years of formal education, who is not a sole parent, drinks alcohol although not at risky level and is in good health. The marginal effects are estimated at the mean value of regressors. Exogeneity of the fertility instrument cannot be rejected at the 10 % level

*, **, and *** Indicate significance at the 10, 5 and 1 % levels respectively

associated with accessibility are also likely to be important here, including access to childcare, informal or otherwise.

The results show that having 'some' alcohol consumption was associated with a higher probability of participation but that high-risk alcohol consumption reduced

participation. This is in line with earlier studies (Terza 2002; MacDonald and Shields 2004).

The income of other household members (family and friends) and living in households that include non-Indigenous people are both associated with significantly higher labour supply. Indigenous households are often intergenerational and non-nuclear with extended families living in one dwelling. Anthropologists developed the concept of 'demand sharing' whereby cultural relationships and value are fostered by providing resources to extended families. Peterson and Taylor (2003) raise the possibility that living in cross-cultural settings can facilitate the ability of families to accumulate wealth and to work within a market system by diminishing the exigencies of demand-sharing requirements. Hence increasing other income in Indigenous households is not associated with any withdrawal from the labour market, but rather is associated with higher labour supply.

Finally the focus in this paper is on the direct role of fertility on labour supply. Once the other explanatory factors are taken into account there is no significant effect of fertility on labour force participation. However, sole-parent families are associated with an 8-percentage-point lower probability of participating. Having children may be associated with lower labour supply of Indigenous females, but it is likely to be picked up by the sole parent dummy. This itself may give an important clue for policy makers as such families are likely to have less support for looking after children to facilitate working or looking for work. Families with more extensive kinship and support networks are more likely to be able to combine children with labour market participation. The net effect is that fertility does not have an adverse effect on labour supply for partnered mothers.

Conclusion: the role of interruptions to the labour supply of Indigenous females

The fact that Indigenous Australian females are less likely to participate in the labour market than other Australian females has been a focus of policy concern. This paper highlights some of the factors that are significant in influencing the poor labour market outcomes for Indigenous females and confirms the findings of earlier research. Variables such as education, difficulty in communicating in English, location of residence and other household income remain important determinants of Indigenous female labour supply. Interaction with the justice system also shows a significant effect on Indigenous female participation. A history of arrest reduces the probability of participating in the labour force. Once the endogeneity of fertility is taken into account, the results show that ever having had a child does not have a significant impact on labour force participation. The results presented here do not control for the current age of the children but they do suggest that having had children at any stage of adult life does not lead to a long-term reduction in labour supply once the level of interaction with the criminal justice system is taken into account.

High fertility rates among Indigenous females reflect a complex interaction between social and economic factors. One significant underlying determinant may be the high rates of infant mortality in the Australian Indigenous population (Kinfu 2006). Parents may choose to have more children if they expect that some of them will die before

adulthood. The institutional framework of the Australian welfare system may also influence fertility and labour force participation. Benefits are related to the number of dependants and the combination of high fertility rates and low levels of labour market skills creates high replacement ratios of welfare income compared with potential employment income, which may have discouraged participation in the labour force for those with children under the age of 16 years (Daly and Hunter 1999). Even though our model does not directly control for childcare, local access to childcare is also likely to be an important issue for Indigenous females (partly captured in the disaggregated remoteness information modelled in the regression analysis).

The empirical estimates presented here show a large significant negative effect of an arrest history on Indigenous female labour force participation. Earlier studies show a positive correlation between high-risk drinking and arrest so if these two negative effects are combined, there is likely to be a substantial reduction in labour force participation. The results suggest a need for strategies to reduce arrests among Indigenous females. These might include developing alternative ways to deal with potential problems before they reach the stage of interaction with the justice system.

The results also show the importance of location of residence in determining the labour supply of Indigenous women. Biddle and Hunter (2006a, b) found that Indigenous Australians were less likely to move in response to employment opportunities than other Australians, and to be more influenced by social and cultural factors. The important role of CDEP in remote labour markets raises the participation rate in these areas compared with areas where CDEP does not operate. The determinants of participation in this scheme are different from the usual determinants of labour supply as the CDEP scheme is based on welfare eligibility. Participants may be working but they have low incomes and limited ability to transfer into mainstream employment. For these reasons, conditions in the local labour market are particularly important and the development of employment opportunities in the areas in which Indigenous people live may have a particular role to play in generating employment.

Finally the results highlight the importance of education and training in promoting attachment to the labour force. Skill formation, however, needs to be promoted in the context of the local labour markets in which Indigenous people are searching for work. The continuing demographic transitions of Indigenous Australians can be contrasted to the aging of the general population in which a substantial proportion of other Australians will be retiring in the near future. On the surface this will provide an economic opportunity for Indigenous Australians in that workers will become relatively scarce and therefore employment prospects are likely to improve and wages will probably rise, depending on migration and other demographic policy settings. However, these social processes cannot be taken for granted because Indigenous people still need to have the skills that employers demand, which again indicates the importance of getting Indigenous education and training policies right.

This paper focuses on the labour supply decisions of a particularly disadvantaged group, Indigenous Australian females. Indigenous Australians are disadvantaged compared with both other Australians and other First Nations in settler societies. Addressing the problems of low education, high levels of interaction with the justice system and the lack of employment opportunities in remote and regional Australia are all essential to improving the economic outcomes for Indigenous Australian females.

Appendix

Summary statistics for regression analysis

Description	Mean	SD
Dependent variables		
Whether participating in labour force	0.497	(0.500)
Whether arrested in last 5 years	0.096	(0.294)
Whether child ever born to a female (generalized residual test)	0.893	(0.309)
Number of children ever born to a female (IV Probit estimator)	3.133	(1.928)
Independent variables		
Age	40.141	(9.998)
Highest level of educational attainment is a degree or diploma	0.089	(0.285)
Highest level of educational attainment is a certificate	0.098	(0.297)
Highest level of educational attainment is Year 12	0.092	(0.289)
Highest level of educational attainment is Year 10 or 11	0.345	(0.475)
Highest level of educational attainment is Year 9	0.135	(0.342)
Difficulty in speaking English	0.164	(0.371)
Major City resident in NSW	0.036	(0.186)
Inner Regional resident in NSW	0.041	(0.198)
Outer Regional resident in NSW	0.051	(0.220)
Victorian resident	0.086	(0.281)
Major City resident in Queensland	0.017	(0.130)
Inner Regional resident in Queensland	0.016	(0.125)
Outer Regional resident in Queensland	0.081	(0.273)
Remote resident in Queensland	0.083	(0.276)
Non-remote resident in Western Australia	0.047	(0.212)
Remote Western Australia	0.115	(0.319)
Remote resident in Northern Territory	0.136	(0.343)
Remote balance of Australia	0.090	(0.287)
Sole parent	0.334	(0.472)
Ever drank alcohol	0.374	(0.484)
Drinks alcohol at high risk level	0.057	(0.233)
Log of Income of other household residents	6.039	(0.671)
Both Indigenous and non-Indigenous people living in household	0.263	(0.440)
Instruments		
Individual taken from natural family as child	0.092	(0.290)
Number of a female's children who have died	0.130	(0.423)
Number of observations	3,377	

Most variables in this table are binary data except the number of children, age and income variables which are count data or 'continuous' variables

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