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20 December 2010

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The Australian baby bonus offering parents $3,000 on the birth of a new child was announced on May 11 2004. The availability of five years of birth data following the introduction of the baby bonus allows for a more comprehensive analysis of the policy implications than is current in the literature. The focus of this paper is to identify if there is a positive fertility choice response to the introduction of the Australian baby bonus policy and if this response is sustained over time. To do this 19 years of birth and macroeconomic data, beginning 1990, is analysed using an unobservable components model. The results indicate a significant increase in birth numbers ten months following the announcement of the baby bonus, and this overall increase was sustained up to the end of the observed period. A cumulative growth in birth numbers which commenced in January 2006 slows in 2008 and 2009. It is suggested that the initial increase in births, identified in March 2005, is a direct fertility response to the introduction of the policy and that the subsequent change in the growth of birth numbers may be the result of a delayed effect working through a number of channels. It is estimated that approximately 119,000 births are attributable to the baby bonus over the period, at an approximate cost of $39000 per extra child.

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1) Introduction and background

Declining fertility levels are a major concern for many developed economies as they are associated with higher dependency ratios (McDonald and Kippen, 2001). Australia is no exception - the fertility rate in 2003, prior to the introduction of the baby bonus, was 1.75 which is considerably lower than the estimated replacement level of 2.1 children per female.

In response to low fertility levels, the Australian Government announced the introduction of the Baby Bonus in May 2004, a policy specifically designed to increase fertility levels. There have been a number of adjustments to the policy since its inception. Initially the federal government pledged each mother a lump sum payment of $3,000 for each child born after 30th June 2004. This amount was subsequently increased in July 2006 and July 2008 to $4000 and $5000 respectively[1]. There are no studies to date that have considered whether the baby bonus has had a sustained effect on the national fertility rate, nor any that have attempted to gauge the impact of macroeconomic influences on the fertility rate in Australia over the same period. By using a structural time series model (Harvey 1991) we examine the impact of the baby bonus policy on fertility in Australia until September 2009. In particular the number of births per 1000 women of child bearing age is modeled with a view to determine whether the baby bonus has had a temporary or sustained effect on fertility levels. Economic determinants are also controlled for. Thus, this investigation goes some way to addressing the apparent gaps in the literature.

A temporary fertility effect may take two forms. First, a *short term policy introduction* effect exists if couples are sufficiently motivated to have children as a result of the publicity surrounding the announcement of the policy. Given such an effect, the number of births would temporarily increase approximately 9 months following the announcement before returning to their long run path after a short period of time. The second type of temporary effect is a *compression* effect. This is the case when the timing of births is brought forward as a result of the policy. If a compression effect occurs the fertility rate would temporarily

[1] A significant change also occurred on the 1 January 2009. Specifically the Baby bonus was means tested and payable in 13 equal installments if the total family income equaled $75,000 or less, in the first 6 months following the birth of the child. It is difficult however to determine what effects this might have had given that not enough data following this policy change is available at this point in time.

increase and then decrease relative to the long run path. Importantly the decrease would be sufficiently large enough to offset the increase thus having a net effect of zero on fertility levels.

A priori, however, there is no reason to assume that the baby bonus will have only a temporary effect on fertility, as the initial fertility response may be maintained, or even magnified, over time. Endogenous social norm effects may act to influence the fertility choices of women who were not initially directly affected by the subsidy itself. An individual's fertility decision making may change not only because of a change in government payments but also because of the behaviour of their peers.

Furthermore, a delayed fertility response may emerge, due to resource constraints and policy information lags. Individuals and couples may need to acquire additional financial resources and put in place social and medical supports before they have children[2]. This may be particularly relevant for couples engaging in Assisted Reproductive Technology (ART) procedures, (i,e., IVF) which have become increasingly popular in recent years[3]. Therefore although decisions to have a child may be made in a timely fashion, the actual fertility response may take longer to occur.

Previous studies suggest that a pronatalist policy can have a positive effect on fertility, although the cost tends to be high. For example Gauthier and Hatzius (1997) simultaneously consider cash benefits and maternity leave. The dependent variable they used is the log of total fertility using data from 22 industrialized countries from 1970-1990. Their results found the decision to bear a child was affected by "its direct cost which is lowered by the government subsidy, but not by the opportunity costs involved in taking time off work" (Gauthier and Hazius 1997 pg 300). They also found that increasing assistance for the first child had a greater effect on fertility than for subsequent children. The economic control

[2] A recent study by the Australian Institute for Family Studies (Gray et al 2008) suggests that individuals, on average want to have more children than the replacement fertility level of 2.1, however due to financial constraints, as well as work related issues and partnership issues, have no plans to do so.

[3] Increasing from 6792 live births in 2004 to 10633 live births in 2008 Table 35, page 43, Assisted reproductive technology in Australia and New Zealand 2008, AIHW, ASSISTED REPRODUCTION TECHNOLOGY SERIES Number 14

variables they used include unemployment, men's wages, women's wages, and the change in the unemployment rate.

Counter to theoretical expectation they found men’s wages positive yet insignificant and women's wages negative and only significant at the 10% level. The change in the unemployment rate was found to be highly significant. In addition differences were noted between subgroups - no evidence was found that cash benefits affect fertility in the Anglo Saxon countries; however benefits had a large and consistent effect in the Scandinavian countries, with continental and southern Europe in between. (Gauthier and Hazius 1997).

A policy implemented in the province of Quebec that paid families up to $8,000 for having a child[4] provides a natural experiment in fertility choice and as such has stimulated some interesting studies. Milligan (2005) found evidence that the policy achieved its goal of increased fertility and attributed 93,000 births to the policy over the ten year period of the policy. Milligan (2005) also found that higher income was associated with a larger fertility effect for cash payments[5].

Preceding Milligan (2005), Duclos, Lefebvre and Merrigan (2001) used a difference in difference estimator to identify the impact of the Quebec baby bonus scheme. They found that generous family benefits do have an effect on fertility rates, in particular providing strong incentive to give birth to a third child in Quebec.

The Australian baby bonus scheme has also received significant research attention since its inception in 2004. Much of the economic analysis on the Australian baby bonus has been focused on distortionary birth timing effects, fertility intentions, or state specific impacts.

For example, Gans and Leigh (2006) have analysed the short term birth timing effects of the introduction of the policy. They used daily birth numbers from 1975-2004 focusing on the days immediately preceding and following July 1 of each year. Using standard regression techniques they conclude that up to 1,000 births (primarily discretionary caesareans) may

[4] The Allowance for Newborn Children, gave a payment of $500 for a first child and up to $8,000 for a third.

[5] This is consistent with experience of the baby bonus in Western Australia (see Lane, 2010, discussed below)

have been moved as a result of the introduction of the baby bonus. Based on similar analysis of the 2006 baby bonus increase, they conclude approximately 600 births were moved in this instance (Gans and Leigh 2007).

Drago et al (2009) make use of HILDA[6] household panel data to assess if the baby bonus increased fertility *intentions* and thereby births, and if the effects were temporary or sustained. They investigate whether the effects were concentrated among particular income groups and those women who already had children. A simultaneous equations approach was used, with fertility intentions treated as endogenous in a model predicting births, thus testing the effect of the baby bonus on fertility intentions. Their analysis included variables that capture the opportunity cost of birth such as labour force status, education and income. They found that fertility intentions rose after the announcement of the Baby Bonus, and the birth rate was estimated to have risen modestly as a result. Their results that are largely consistent with the opportunity cost approach.

Lain et al (2009) use a Poisson regression analysis of New south Wales (NSW) birth numbers and Australian Bureau of Statistics (ABS) Population estimates to assess the effect of the baby bonus on birth rates. They analysed the change in the birth rates in 2005 and 2006 relative to the trend before the introduction of the bonus and find that birth rates increased, especially in those women having their second or subsequent child.

A further study by Lain (2010) has evaluated the impact of the baby bonus on New South Wales (NSW) health services and they estimate an additional 11,283 births per year in NSW due to the baby bonus, at a cost to the health care system of an additional $60 million in 2008 (Lain et al 2010) [7]. An analysis of the policy impact in Western Australia was conducted by Langridge et al (2010), and using similar statistical techniques to Lain et al, they found a positive increase in fertility particular in women residing in higher socioeconomic areas.

[6] Refer to Wooden and Watson (2007) for a detailed description of the Household, Income and Labour dynamics in Australia Survey (HILDA)

[7] Negative binominial regression was used on data from 1998 – 2004 to generate a predicted number of births in 2008. The predicted number was then compared with observed numbers to identify a deviation from the pre baby bonus trend.

2. Theoretical background

Much of the economic theory of fertility within the rational choice framework originates from the works of Gary Becker (1960) and Harvey Leibenstein (1957). It is assumed that fertility is a conscious decision and the essence of the model is that families balance the benefit against cost of an additional child, given that children are assumed to be a normal good[8]. Therefore, fertility behaviour can be analysed within a choice theoretic framework wherein family size (given preferences) is the result of variations in income and the "costs" inclusive of the opportunity cost of children (Hotz et al 1993). The "cost" variable incorporates the theory of the allocation of time, the concepts of household production theory and human capital investment theory. Given that the rearing of children is considered time intensive relative to other household production, the cost of child bearing (and rearing) is in the most part a function of the mother's time. The interaction of these variables is complex in the context of fertility choice, for example rising female labour participation rates, less gender specialisation, and higher human capital investment and wages for women represents rising family incomes yet a higher opportunity cost to childbearing. Therefore the relative strength of the income and substitution effects is of significance when assessing the influence of changing family policy on fertility. Ultimately a universal subsidy to lower the cost or "price" of children would be expected to increase the demand for children and this would be reflected in higher birth numbers.

Recent developments in the family economics literature have also highlighted the role of the social climate and social interactions on fertility choice. The rational choice model of fertility has been extended to include social interaction, on the basis that individuals use the situational information available to them. Becker and Murphy (2003), suggest that "the number and education of children are affected by the behaviour of friends, peers and neighbours…… births within a group could respond sharply to small changes in explanatory variables because the social multiplier magnifies the responses of the members of the same social group" (Becker and Murphy 2003 page 21). Economic models have been developed for the study of "socially embedded" fertility behaviour such as that of Kohler (1997). Durlauf and Walker (1999) suggest that endogenous social effects generate social multipliers which exist when the total effect of an individual's decision on the overall population behaviour is larger than the initial direct effect of her choice. For example a couple may respond directly to the financial incentive of the policy, yet may communicate positive experiences of childbearing to friends, colleagues etc. and through social learning induce other couples to consider child bearing.

Kuziemko (2006) explores one aspect of social interaction by using micro level data to test if fertility peer effects exist. It was found that the probability of having a child rises by 15% in the two years following the birth of a niece or nephew. The effect is strongest when it is a sister that has a child and when cost saving from co-ordination is most likely.[9]

While this paper will not investigate the fertility impact of the baby bonus by utilising these behavioural models, these models may be useful in offering potential explanations for patterns in the macro-level data considered in this paper.

3. Methodology

In this section the results of two applications of the structural time series models are presented. The first examines monthly fertility rates and the second quarterly fertility rates to enable key economic variables to be taken into account. In both instances the fertility rate is defined as the number of babies born per 1000 women of child bearing age. The paper uses monthly ABS Australian birth data from January 1990-September 2009.

Figure 1 presents the fertility rate beginning in 1990 up until September 2009. The shaded area corresponds to March 2005 to September 2009 identifying the period in which the policy could have had an effect, given the nature of the reproductive cycle. The date at which the policy was introduced is also identified.

[9] Refer to Durlauf and Walker (1999) for a survey of empirical evidence on fertility transitions relevant to the social interactions model.

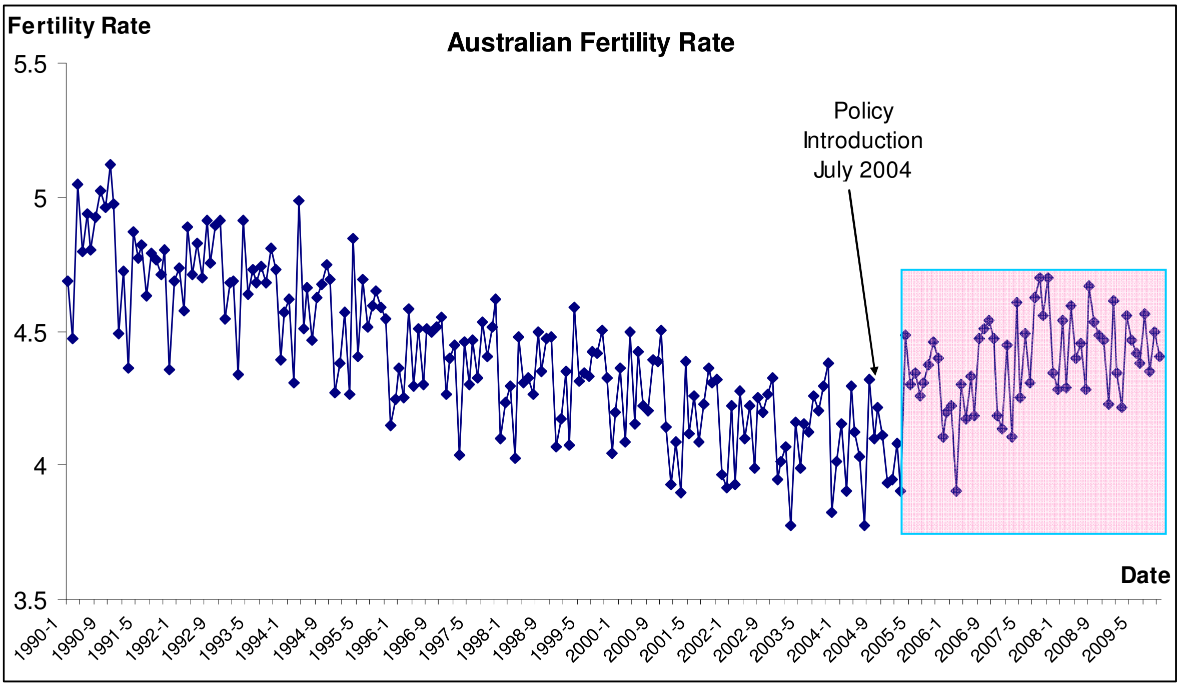

Figure 1 Australian Fertility Rates Calculated using Australian Bureau of Statistics Data cat. no. 3301 3201.0,

Fertility rates illustrated in Figure 1 changed noticeably after March 2005, approximately 10 months following the announcement of the baby bonus. All other things equal, this suggests that the policy may have had an impact on fertility rates. To formally test whether this change in pattern is significant a structural time series model is fitted to the data. Using y_t denote the fertility rate at time t, the model has the form:

$$y_t = \mu_t + \gamma_t + \Theta X_t + \Phi Z_t + \varepsilon_t \ , \ \varepsilon_t \sim \text{NID}(0, \sigma_\varepsilon^2), \qquad (1)$$

where μ_t , γ_t, X_t and Z_t denote the trend, seasonal, explanatory and policy intervention variables at time t. The coefficients Θ and Φ measure the direction and size of the explanatory and policy intervention variables respectively.

Using this specification, the individual behaviour of each component such as the trend and seasonal component can be explicitly modelled. Following on from equation (1), the expanded form of the model fitted to the data is:

$$y_t = \mu_t + \gamma_t + \Theta X_t + \varepsilon_t, \qquad \varepsilon_t \sim \text{NID}(0,\sigma_\varepsilon^2), \qquad (2)$$

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \qquad \eta_t \sim \text{NID}(0,\sigma_\eta^2), \qquad (2a)$$

$$\beta_t = \beta_{t-1} + \varsigma_t, \qquad \varsigma_t \sim \text{NID}(0,\sigma_\varsigma^2), \qquad (2b)$$

$$\gamma_t = \sum_{j=1}^{s/2} \gamma_{j,t},$$

$$\begin{bmatrix} \gamma_{j,t} \\ \gamma_{j,t}^* \end{bmatrix} = \begin{bmatrix} \cos\lambda_j & \sin\lambda_j \\ -\sin\lambda_j & \cos\lambda_j \end{bmatrix} \begin{bmatrix} \gamma_{j,t-1} \\ \gamma_{j,t-1}^* \end{bmatrix} + \begin{bmatrix} \varpi_{j,t} \\ \varpi_{j,t}^* \end{bmatrix}, \quad \varpi_t \sim \text{NID}(0,\sigma_\varpi^2). \qquad (2c)$$

Equation (2) is commonly referred to as the observation equation. Equations (2a) to (2c) represent the state/component equations. Equation (2a) captures the trend and is made up of μ_{t-1} and β_{t-1}, where β_t captures the growth rate in the series and μ_{t-1} the level.

While this paper will focus on implications for the baby bonus on fertility rather than discretionary birth timing, the Gans and Leigh (GL) birth timing effect can be used as an example to illustrate how the policy intervention effects are captured,. The GL effect corresponds to two impulse intervention variables, one to capture the abnormal decrease in June 2004 and the other to capture the abnormal increase in July 1 2004. Specifically by modifying equation (1) such that:

$$y_t = \mu_t + \gamma_t + \phi_1 d_{2004,6} + \phi_2 d_{2004,7} + \varepsilon_t, \qquad (3)$$

the GL effect can be determined. Specifically if the baby bonus had a significant birth timing effect, then the coefficient ϕ_1 should be negative and significantly different from zero and ϕ_2 should be positive and significantly different from zero (assuming the variable was behaving consistent with its historical time path).

4. Results

In the first instance monthly fertility rates are modelled[10]. The specification of the first model determines whether a fertility effect, as well as the *birth timing* effects identified by (Gans and Leigh 2009) are evident in the monthly fertility rate data. In terms of the fertility effect, a change in the pattern of the data is tested corresponding to the date March 2005, 10 months

[10] Full reports of the model fit is available upon request from the authors

following the announcement of the introduction of the baby bonus. In particular a change in the mean is tested.

Table 1 Selected model estimates for Model 1

Type	Month	Coefficient	P-value
Outlier	2004(6)	-0.252	0.003
Outlier	2004(7)	0.146	0.079
Outlier	2006(6)	-0.062	0.455
Outlier	2006(7)	0.052	0.527
Outlier	2008(6)	-0.090	0.276
Outlier	2008(7)	0.143	0.084
Outlier	2008(12)	0.345	<0.00
Outlier	2009(1)	-0.066	0.425
Level break	2005(3)	0.216	<0. 00

The results in Table 1 suggest that birth numbers changed significantly approximately nine months after the introduction of the baby bonus. Specifically, an additional .216 babies per 1000 woman of child bearing age, or approximately 1,100 additional babies have been born each month since March 2005.

In addition to this fertility change the *birth timing* effect identified by Gans and Leigh (2009) was also tested. Specifically, was there a short term shift in the number of births corresponding to the introduction of the baby bonus in 2004? The results in Table 1 concur with the Gans and Leigh (2009) finding. However, they do not support their subsequent findings regarding a birth timing effect in 2006 as the result of the increased value of the baby bonus (Gans and Leigh, 2006). This point's to the problem of confounding intervention estimate effects with trend effects if only short term data is considered.

Similarly, the results do not suggest a birth timing effect corresponding to the 2008 increase (assuming α=0.05). However, they do indicate that in December 2008 an abnormally high number of babies were born suggesting the decision to means test families from January 1, 2009 had a significant impact on the timing of births.

The findings in Table 1 are important as they suggest that there has been a significant response in the fertility rate corresponding to the introduction of the baby bonus policy. They also suggest that there has been a short term shift in the number of births as a result of means testing the baby bonus[11]. This reflects a symmetric response broadly consistent with the literature (eg Langridge 2010) that suggests that women residing in higher socioeconomic areas were particularly responsive to the introduction of the baby bonus.

The results in Table 1, however, shed little light on whether there has been a temporary or a sustained fertility response to policy. Figure 2, therefore presents the trend estimate (note the significant intervention effects in Table 1 are included in the trend estimate) for the period January 2003 to September 2009. An increase in the trend in January 2006 is consistent with a delayed fertility response to the introduction of the policy. It should be noted that this increase in the trend takes place before the July 2006 increase in the baby bonus, and therefore potentially reflects a delayed response to the initial introduction of the baby bonus, rather than the impact of additional financial incentives. While subsequent growth in birth numbers appears to have peaked by January 2008, the true magnitude of this delayed effect will become clearer over time as more data becomes available.

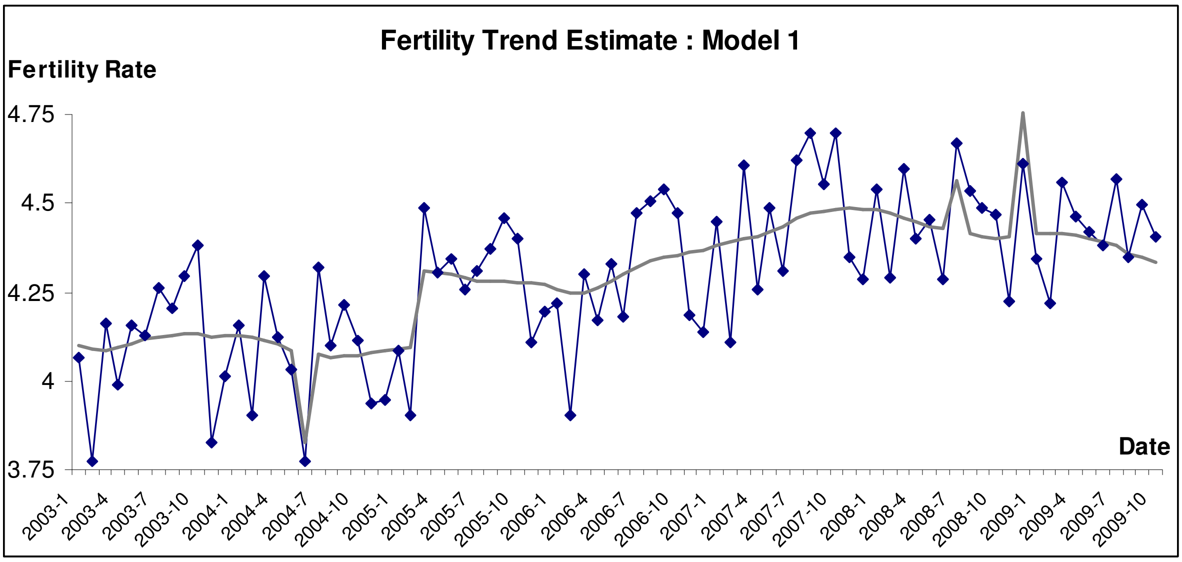

Figure 2 Fertility Rates and trend plus intervention estimates Jan-2003 to Sept-2009

Table 2 presents the results of a refined version of model 1. The major changes being are the elimination of insignificant variables and the inclusion of the slope break intervention effects relating to a delayed reaction. By including the slope breaks it formally tests the delayed effect hypothesis.

[11] The changes to the maternity payment that occurred in 2009 are explained in the introduction

Table 2: Model 2

Type	Month	Coefficient	P-value
Level break	2005(3)	0.225	0.002
Slope break	2006(1)	0.015	<0.00
Slope break	2008(1)	-0.019	<0.00
Outlier	2004(6)	-0.263	<0.00
Outlier	2008(12)	0.347	<0.00

The results in Table 2 support the observations made in relation to Figure 2, and therefore concur with the delay hypothesis. They indicate that at least .225 additional babies have been born per 1000 women of child bearing age, per month, since March 2005,(approximately 1,400 babies) and that this was reinforced by a delayed fertility effect with a cumulative increase of .015 babies per 1000 women per month (approximately 77 babies) every month between January 2006 and December 2007. Importantly the coefficient estimates of the slope break approximately add to zero suggesting that the cumulative delayed increases have been maintained, that is an approximate additional 3,154 babies have been born each month since January 2008.[12] Further, these results suggest that up to June 2009 an estimated 119,000 births can be attributed to the baby bonus policy incentives. The calculated direct cost of each additional birth is in the region of $39,000. [13]

4.1 Controlling for economic influence

In this section intervention effects are re-estimated while controlling for economic factors that could plausibly be associated with changes in fertility. Changes in women's' wages, for example, may influence the opportunity cost of bearing and rearing children, while higher levels of household income may increase the demand for children. Average weekly earnings for females (AWE) and real GDP per capita (RGDPpc) are therefore used in this section as controls to test for the effect of baby bonus on birth rates. As the relevant economic data is recorded quarterly, this section will consider quarterly, rather than monthly, fertility rates.

Table 3 presents the coefficient estimates of the intervention and economic variables. For the period from January 1990 to September 2009 none of the economic determinants of fertility

[12] Calculated as .225 +.36 babies per 1000 women of childbearing age per month

[13] Refer to the Australian Bureau of Statisics -Year book Australia 2009-10 table 9.22 for a total estimated cost of the baby bonus 2004 - 2009

tested statistically significant. This may be a reflection of the relatively stable growth experienced over the observed period. Importantly, although quarterly rather than monthly data was utilised, the intervention effects remain consistent with the findings of the previous section, both in terms of the introduction and the delayed effects.

Table 3 Model Output Economic Effect.

Type	Date	Coefficient	P-Value
Outlier	2004 Q2	-0.310	0.061
Level break	2005 Q1	0.533	<0.000
Slope break	2006 Q1	0.106	0.002
Slope break	2008 Q1	-0.175	0.021
Outlier	2008 Q4	0.175	<0.000
AWE		0.006	0.523
RGDPpc		<0.000	0.131

5. Conclusion

This paper analyses the impact of the Australia baby bonus on Australian births between March 2005 to September 2009 using an unobservable components model. The results indicate a significant increase in birth numbers ten months following the announcement of the baby bonus, and that this initial policy introduction effect were maintained, as were the cumulative delayed increases in births. The existence of a temporary introduction effect and a compression effect are not supported by the data. While the results are consistent with a discretionary birth timing effect as a result of the introduction of the baby bonus, the results do not support the existence of such an effect following the 2006 increase in the value of the baby bonus, in contrast to previous literature.

While this paper has focused on the quantity implications of the baby bonus, both the change in births following the means testing of the payment support and other research suggests that there may be a heterogeneous response to the policy across the population. Given the delayed effects identified in the paper, it may take time for the "quality" implications of the baby bonus (ie the wellbeing of the child and utility of the parents) to be fully revealed. A key future research focus then, is to assess the variability in the response, and delay in response, to the baby bonus across age, cultural background, socio economic status and education. The baby bonus has had a significant and positive effect on fertility rates; however, this effect has not been large enough to increase the fertility rate to the replacement level. Further, the recent change of mean testing the baby bonus may reduce the overall influence. This suggests that more needs to be done to increase the fertility rate in the interest of future long term economic prosperity.

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