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NATURAL CONTRACEPTIVE USE IN A MODERN POPULATION:

CORRELATES, FERTILITY TIMING AND EFFICACY AMONG USERS IN MOLDOVA

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Abstract

This thesis investigates the dynamics of natural contraceptive method use in a low fertility setting in contemporary Eastern Europe. Natural contraception was one of the key drivers of European fertility transition and still accounts for a large proportion of current method use in the developing world as well as in the Eastern Europe. Nonetheless, little systematic research on natural method use exists in contemporary demographic literature. This thesis focuses on the post-Socialist republic of Moldova- the poorest country in Europe. The Moldovan contraceptive regime, as observed elsewhere in Eastern Europe, is characterised by limited uptake of modern contraception and widespread use of induced abortion. Under the Moldovan Socialist government, social pressures including the requirement of children to obtain housing led to an almost homogenous pattern of early low fertility. In examining natural method use in the Moldova, this thesis addresses not only the limited understanding of natural method use in contemporary societies, but also contributes to unravelling the potential interaction between contraception and abortion in a low fertility setting.

The main aims of this thesis are to: (i) provide a quantitative evaluation of the dynamics of natural contraceptive use in a low fertility setting and (ii) explore the changing fertility situation in Moldova. These aims are accomplished using data from the first ever Demographic and Health Survey (DHS) conducted in Moldova during 2005. The thesis comprises four research chapters as well as an introduction and conclusion.

The introduction chapter examines the significance of natural methods in historical and contemporary societies, and provides context on the Moldovan demographic and socio-economic context. The second chapter examines the factors influencing the use of natural contraceptive methods. Specifically, the effect of economic hardship on the persistence of natural contraceptive use is examined. The analysis also evaluates the impact of FP programmes designed to reduce reliance on natural methods at a regional level. It contributes direct policy relevance by improving understanding of the efficacy of reproductive health interventions. In particular, the

chapter identifies an impact of uneven coverage of health infrastructure on contraceptive choice and switching patterns. The second and third chapters evaluate the fertility timing patterns associated with natural method use – specifically the effect of contraceptive confidence on the interval between marriage and first birth and all subsequent birth intervals. These analyses also expand the understanding of contraceptive confidence by examining the interaction between natural method use and induced abortion. The fourth chapter tests the hypothesis that natural method use is in fact less effective than modern method use. This is pertinent to the peculiar demographic situation in Moldova, where low fertility occurs concurrently with a high prevalence of natural method use. The analysis evaluates the determinants of contraceptive discontinuation using the contraceptive histories recorded in the DHS contraceptive calendar. Key results are the high failure rates of natural contraceptives, and the high propensity of modern reversible method users to abandon use- hence exposing them to unwanted pregnancy. The final chapter summarises the key findings from each paper and addresses the policy implications as well as limitations of the thesis. Areas for future research are also identified.

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Declaration of authorship

I, Mark James Lyons-Amos, declare that the thesis entitled 'Natural contraceptive use in a modern population: correlates fertility timing and efficiency among users in Moldova' and the work presented in the thesis are both my own, and have been generated by me as a result of my own original research. I confirm that:

- This work was conducted wholly while in candidature for a research degree at this university
- Where any part of this thesis has been previously been submitted for a degree or any other qualification at this University of any other institution, this has been clearly stated
- Where I have consulted the published work of others, this is always clearly attributed
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- I have acknowledged all main sources of help
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Signed: …….

Date: …….

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List of abbreviations

CEE – Central and Eastern Europe

CIS – Commonwealth of Independent States

FP – Family Planning

LAM – Lactational Amenorrheic Method

MCMC - Markov Chain Monte Carlo

MDHS- Moldova Demographic and Health Survey

MQL- Marginal Quasi Likelihood

MRHS- Moldova Reproductive and Health Survey

NPAIDS- National Program for combating HIV/AIDS

NPRH - National Program in Family Planning and Protection for Reproductive Health for the years 1999-2003

PQL - Penalised Quasi Likelihood

TFR – Total Fertility Rate

Chapter 1: Introduction

1.1 Motivation and research problem

The dynamics and underlying influence of natural contraceptives in family planning and reproductive health are not well researched in demographic studies. This thesis addresses this problem by systematically investigating the patterns and influence of natural method use illustrated by the case of Moldova, a poor post-Socialist state in Eastern Europe.

Rogow and Horowitz (1995) identified a lack of research on natural contraception and natural methods continue to be underrepresented in demographic literature. A search conducted in three online academic archives[1] produced only 128 articles with key words "traditional contraception" or "natural contraception," while "modern contraception" returned 1402 articles for the post-2000 period. Studies examining the trends and determinants of contraceptive use often ignore natural methods- for example Westoff (2005), Swar-Eldahab (1993) and Pariani *et al.* (1991) define contraception in terms of modern method use. In contrast, the role of natural contraceptives is rarely acknowledged and often without any explicit investigation (for example, Magadi and Curtis 2003). Where natural methods are the explicit focus of research, the analyses are either dated (Ní Bhrolchaín 1988, 1986a, 1986b) or have a qualitative focus (Johnson-Hanks 2002, Pitkänen 2003). Despite this research neglect, natural methods account for 24% of contraceptive use globally since 2000 (author's calculations, data from Measure DHS 2012).

Moldova presents an interesting case for detailed investigation for several reasons. Following independence, Moldova has undergone a traumatic transition from State Socialism, with widespread deterioration in economic, health and living standards. Modern method use is limited, yet the country managed to achieve a sub-

[1] JStor, Pubmed and Popline, 29.03.2011

replacement level fertility for over a decade. Poor economic conditions and out-migration of young men especially to Romania, Russia and elsewhere in Europe offer some explanation of the low fertility trends. Population indicators in Moldova have responded through alterations in short term behaviour coupled with longer term trends toward a Westernised demographic regime (Sobotka 2003). While there has been considerable demographic research into central Asian (Agadjanian 2002, Westoff 2000, 2005) and central European post-Socialist republics (Witte and Wagner 1995), research on Moldova has so far been limited to macro level descriptions of demographic trends (Sobotka 2003).

The remainder of this chapter is structured as follows. The research objectives are considered in detail in section 1.2. The research questions resulting from these research objectives are specified in section 1.3. Section 1.4 provides an overview of natural method use in historical and modern contexts, while section 1.5 presents background on the Moldova demographic context. The policy relevance of the thesis is considered in section 1.6, and the structure of the remainder of the thesis.

1.2 Research objectives

The overarching objective of this thesis is to undertake a quantitative examination of the dynamics of natural method use in low fertility settings, with a focus on Moldova. Specifically, the thesis explores the underlying relationship between natural contraception and induced abortion within the context of changing fertility and reproductive behaviours, which is not systematically explored in demographic literature (Agadjanian 2002, Westoff 2005).

The changing fertility situation in Moldova is poorly understood and under explored (Sobotka 2003) – primarily due to lack of reliable data (Sobotka 2003, Livi-Bacci 1993. In this context, the Moldovan Demographic and Health Survey (MDHS), conducted in 2005, provides a rich source of demographic data including reproductive health and family planning information. This thesis will make use of this dataset considering

statistical techniques appropriate for dealing with complex retrospective survey data.

1.3 Research questions

Three research questions are addressed in this thesis:

1. *What are the correlates of natural method use in Moldova?*

This question will determine the key factors determining contraceptive choices and in particular the influences which tend to differentiate the choice between a modern and a natural method. The analysis will focus on the effect of economic status on method choices and assess the impact of National Family Planning (FP) and Reproductive Health (RH) programmes in Moldova.

2. *How does method choice influence women's reproductive strategies, and how does this relate to other influences?*

The research question will determine whether the reproductive strategies of natural method users are systematically different to those of modern method users, due to effects such as contraceptive confidence (Keyfitz 1980, Ní Bhrolchaín 1988). Two distinct external influences are relevant in the Moldova context: the importance of induced abortion - which is closely associated with natural method use (Agadjanian 2002, Westoff 2005) – but also external economic and social influences (Sobotka 2003, Witte and Wagner 1995).

3. *How effective is natural method use in Moldova, and what are the determinants of contraceptive discontinuation?*

This research question will identify the failure rate of natural contraception comparing other (modern) methods. The analysis will determine whether the contraceptive failure rates of natural methods are higher than those of modern methods in a low fertility context. More broadly, this research question will examine the rates of method abandonment and switching (as well as failure).

1.4 Natural contraception in historical and contemporary societies

The significance of natural contraceptive methods derives from widespread historical prevalence, as well as continued and renewed importance in the wake of recommendations at the International Conference on Population and Development (ICPD) in Cairo in 1994. The most commonly used natural method in Moldova is withdrawal or *coitus interruptus* (used synonymously in this thesis). Periodic abstinence is another form of natural contraception, comprising a plethora of fertility awareness methods such as the Rhythm method and Billings method. Lactational Ammenorheic Method (LAM) is also widely practised to control fertility in the immediate postpartum period.

The use of natural contraception in historical populations is well-established (Santow 1993, 1995; Van Bavel 2004, Fisher 2000, Pitkänen 2003 Hionidou 1998). Santow (1993, 1995) highlights the role of natural methods in the European fertility transition during the early 20th century, and fertility control even in pre-transitional Europe. Evidence for natural method use comes from various historical sources; including beliefs that semen poisons a mother's milk, Catholic penitential as well as Lutherian and Calvanistic criticisms of withdrawal use. Legal proceedings also referred to withdrawal as evidence for both defence in a paternity case and, in contrast, as grounds for divorce. Withdrawal use persisted beyond the completion of the fertility transition, with population sub-groups continuing to practice the method after the widespread acceptance of modern contraceptives in the general population - for example, Italian immigrants in Australia (Santow 1993).

Van Bavel (2004) examines motivations for natural method use to space births in nineteenth century Belgium. To reduce short term costs and facilitate employment contributions from older children to the household budget, women attempted to increase the interval between births relying almost exclusively on withdrawal. Indeed, during that period, high income households made rapid transitions to successive births than their low income counterparts. Additionally, where women could combine work with child care, inter-birth intervals tended to be shorter.

Fisher (2000) uses oral histories to investigate the decision making process behind natural contraceptive use in early 20th century Britain. Fisher finds there was little discussion between partners regarding contraception and use was initiated by the male partner. Contraception was practised as a normative sexual behaviour and a "non-decision" (Fisher 2000, p. 308). Fisher and Szreter (2003) further examine these oral history data and conclude that working class women distrusted modern methods doubting their efficacy and found associated side effects to be unacceptable. In contrast, withdrawal was perceived to be 'natural' and 'hygienic.' Withdrawal users attributed accidental pregnancy to user failure which was deemed acceptable. Modern method failure was attributed to shortcomings of the method (perceived method failure) which, on the other hand, was unacceptable. Interestingly, these attitudes are similar to those identified in a modern context by Breslin (1997).

Pitkänen (2003) examines the use of natural methods in the context of the 20th Century Finnish fertility decline. Pitkänen finds that older women did not report using contraception. Fertility control attitudes were seen in later generations, and increasing natural contraceptive use was associated with the dramatic falls in Finnish fertility during 1900-1920. The type of contraceptives adopted differed by social groups. The residents of industrial areas and those belonging to poor socioeconomic groups relied on withdrawal (combined with illegal abortion when required). These women also reported abandoning modern methods in favour of natural methods.

Hionidou (1998) examines the changes in fertility behaviour in Mykonos during the early 20th century. Hionidou finds that birth spacing using natural methods was important in the early stage of the Mykonotani fertility transition. Average birth intervals did not vary considerably but post -1914 marriage cohorts had lengthy final birth intervals suggesting increasing use of modern methods and stopping behaviour. Further qualitative evidence showed that most methods used in this population were natural (although there was some condom use reported), used in conjunction with breastfeeding to lengthen the interval between births (Hionidou 1998). Male

peer networks were an important vector for transmitting contraceptive information ("coffee houses").

Following the Cairo 1994 ICPD, natural contraception regained significance in family planning and reproductive health programmes. Gribble (2003) identifies a number of advantages of natural method use. Clinical research has enabled greater understanding of the efficacy of natural methods and strategies to minimise method failure (Arévelo *et al.* 2000, Arévelo *et al.* 2002). Methods such as the Standard Days also have the advantage of encouraging male involvement in family planning (Arévelo *et al.* 2000, Arévelo *et al.* 2002). Further, natural methods also provide a sustained means of fertility control even in the event of disrupted family planning funding or shortage of contraceptive supplies (Gribble 2003).

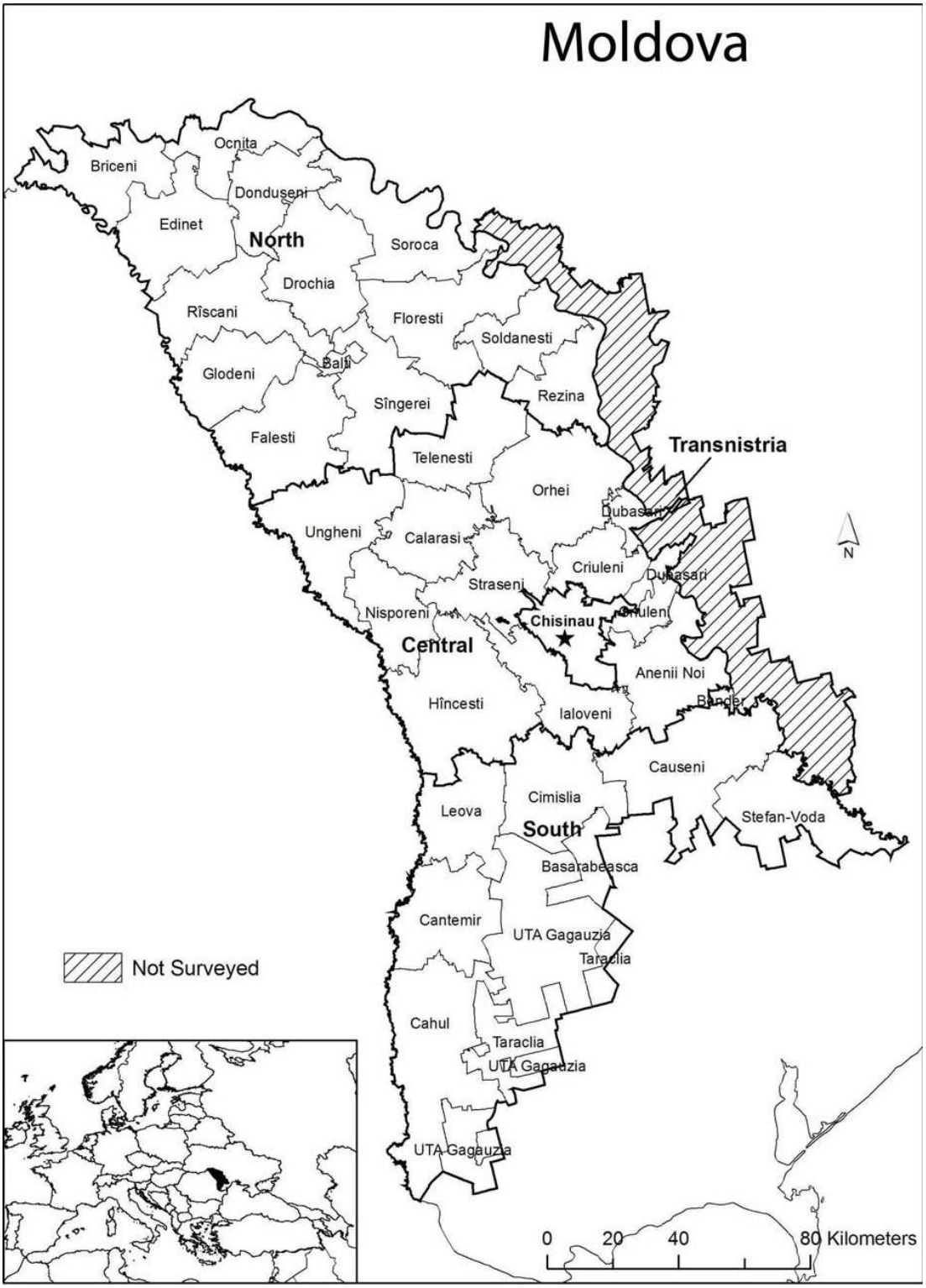
Natural methods are also free from medical side-effects (Breslin 1997). Modern method users reporting side effect symptoms (even if not formally diagnosed, indicating the impact of the fear of side effects) tend to abandon or switch their method. These negative experiences can dissuade women from using methods again, and bad experiences among peers can influence women to refuse modern methods even if they have not experienced side-effects themselves. Kohler *et al.* (2001) and Potter (1999) report similar findings.

1.5 The Moldovan demographic and socioeconomic context

Moldova emerged as an independent republic following the collapse of the former Soviet Union in 1991. The republic lies between the Dniester and Prut rivers, and is landlocked by Romania and Ukraine. Since independence, Moldova has experienced economic turmoil exacerbated by ethnic tensions- which resulted in full-scale civil war between separatist Transnistria (shaded region in Figure 1.1) and the Moldovan government in 1992. Transnistria has since acted as a defacto independent region following a peace settlement ending the war in 1992. Gaguaz (*UTA Gagauzia* in Figure 1.1) has acted as a semi-autonomous region in an effort to assuage ethnic tensions ('National Scientific and Applied Center for Preventive Medicine (NCPM and

ORC Macro 2006). The population at the last census was 3.4 million (excluding Transnistria) - a decline of 274,000 since 1989 equivalent to an annual rate of population decline of 0.5%.This decline is largely driven by the out-migration of working age Moldovans (NCPM and ORC Macro 2006)

Figure 1.1: Map of Moldova, showing administrative districts (raions)



Note: Shaded region represents Transnistria, not included in MDHS sampling frame

Source: NCPM and ORC Macro 2006: p. xxvi

Similar to many post-Socialist transitional economies in Central and Eastern Europe (CEE), Moldova suffered worsening of macro and micro economic conditions in the period following the collapse of the USSR. By 2000, the Gross Domestic Product (GDP) had fallen to 34% of its pre-independence level, accompanied by an increase in the proportion of Moldovans in poverty to 70% (NCPM and ORC Macro 2006). The reliance of the Moldovan economy on primary agricultural product export - especially to Commonwealth of Independent States (CIS) countries - meant that the wider economic decline of the post-Socialist bloc lead to sustained deterioration of the export market and vulnerability to external economic shocks. The nadir of Moldovan economic performance (GDP decline of approximately 7% and budget deficit in excess of 10%) occurred following the Russian financial crisis of 1998 (World Bank 2005). By 2000, Moldova was the lowest scoring European country in the UNDP Human development report, and ranked 102 of 174 countries globally (only Tajikistan and Uzbekistan ranked lower in the CIS, World Bank 2005).

Moldovan economic conditions have improved in the period 2000-2005, with a real increase in GDP of 30%- equivalent to 6.9% per annum- and a decline in the proportion of Moldovans living in poverty. However, this growth lags behind the majority of the CIS (World Bank 2005). Moldova still relies on agricultural production for a substantial proportion of its GDP (19.2% including primary production alone, 30% including associated secondary processing, World Bank 2005) and employment (43% of employment is in this sector). Despite the comparative advantage of this sector in the production of cash-crops such as tomatoes and table grapes, market distortions mean that farmers receive prices 15% below international market rates for their crops, while paying above market price for inputs (World Bank 2005). Additionally, a limited domestic market means that Moldova is still reliant on trade with Russia and the CIS for most of its agricultural income. A large proportion of economic growth was supported by remittance - 25% of the working age population is employed overseas and remittances are equivalent to 27% of GDP (World Bank 2005). These remittances prompted economic growth within Moldova largely through increased consumption - nearly 45% of migrants reported domestic consumption as their primary motive to migrate (World Bank 2005). The

sustainability of migration as a source of economic growth has been questioned: there has been little domestic investment to ensure continued economic improvement (only 2% of GDP increase since 2000 has been as a result of government investment, 18% resulting from private investment, World Bank 2005). Additionally, Moldovan migration patterns indicate a 'brain drain', with 37% of migrants in 2005 highly skilled and 45% below the age of 20 (World Bank 2005).

Prior to independence, the Moldovan demographic regime exhibited the same characteristics as other Socialist countries. This was characterised by low fertility, early marriage and rapid progression to first birth, albeit a low proportion of premarital conceptions (Sobotka 2003). Following the collapse of Socialism, and consistent with other post-Socialist countries, fertility fell in reaction to the deteriorating economic environment and rapidly changing social conditions (Sobotka 2003, Witte and Wagner 1995), with the Total Fertility Rate (TFR) reaching a low of 1.3 in 2000 (NCPM and ORC Macro 2006). Other indicators also responded adversely, such as male life expectancy (which stood at only 64.5 in 2004, NCPM and ORC Macro 2006) and the infant mortality rate (13 per 100 live births, NCPM and ORC Macro 2006).

Similar to other post-Socialist regimes, Moldova has low prevalence of modern contraception and a widespread reliance on induced abortion (Sobotka 2003). There was only a slight increase in overall contraceptive use post-independence (NCPM and ORC Macro 2006) which stagnated between 1997 and 2005 (author's calculations from 1997 Moldova Reproductive and Health Survey, MRHS, and 2005 MDHS). The contraceptive method mix in Moldova also demonstrates a persistently high prevalence of natural contraceptive use - natural method use still accounts for in excess of 20% of methods among women in union (author's calculations, MDHS 2005). Among modern method users there is a skew toward IUD use, as commonly seen under Socialist regimes (Popov *et al.* 1993). IUD was used by 41.6% of women in union aged 25-29 during the 1990s and was still used by 27% of this age group in 2005 (NCPM and ORC Macro 2006). Only 3% of women in the age group 25-29 in union used hormonal methods during the 1990s (Sobotka 2003, MRHS 1997) rising

only slightly to 5.3% in 2005 (author's calculations Moldova Demographic and Health Survey, MDHS 2005). Low hormonal contraceptive use results from the persistent bias against these methods under the Socialist government. Popov (1991) and Popov *et al.* (1993) highlight that the official position of the Socialist administration was that hormonal contraception was prohibited and that the long-term use of hormonal contraception was medically dangerous. The mistrust of hormonal contraception persisted among clinicians during the post-independence era and was passed onto users, with a continued reluctance to include hormonal contraception in family planning programmes (NCPM and ORC 2006, Sobotka 2003).

Under the pre-1991 Socialist government, the use of contraception was discouraged while abortion was made widely available for ideological motivations and in an effort to promote female equality (Avdeev *et al.* 1995). Abortion use remains common, with an estimated Total Abortion Rate (TAR) of 1.1 - indicating that on average women can expect to have at least one abortion in their reproductive lifetime (UNData 2009). Although this rate is high, it does represent a fall from the TAR of 1.55 observed immediately post-independence (Sobotka 2003) - possibly due to the introduction of charges for abortion services (about $7-$11 roughly equivalent to 1 months wages in Moldova, NCPM and ORC Macro 2006). Abortion use is especially common among older women who regard termination as a normal part of fertility control, rather than a response to unexpected contraceptive failure (Agadjanian 2002, Westoff 2005). Older women express few negative attitudes to abortion, reflecting the acceptability and frequency of abortion engrained during the Socialist era (Agadjanian 2002, Anderson *et al.* 1994).

1.6 Policy relevance

This thesis will contribute to the FP policies of Moldova in two key respects. Firstly, in contributing to the understanding of the dynamics of natural method use in Moldova, this allows the better orientation of FP policy designed to reduce natural contraceptive use. The reduction of natural method use is a priority for the Moldovan government (NCPM and ORC Macro 2006). However, the resources

available to Moldova to achieve its goals are very limited due to recent economic performance and the FP system is almost entirely reliant on foreign donors (Comendant 2005). Therefore, in identifying the key determinants of natural contraceptive use, this thesis will identify the most effective points of intervention for reducing natural method use in a setting where programme parsimony is vital.

This thesis will also examine the interaction between abortion and natural method use. While many studies have investigated the determinants of natural method use and abortion use separately, there has been little work into the synergistic relationship in the post-Socialist setting beyond describing the relationship (e.g. Agadjanian 2002). Policy designed solely around contraception or abortion alone therefore lacks a full appreciation of the reproductive health environment in Moldova, and may therefore not be fully successful. By providing a full picture of the interrelationship between abortion and natural method use, this thesis allow the correct design of FP programmes pertaining to both abortion and natural method use.

1.7 Structure of the thesis

The remainder of this thesis consists of four interrelated chapters, each designed to be free-standing and contributing individual research and findings, and a concluding chapter. Chapter 2 evaluates the correlates of natural method use with the aim of explaining the persistence of natural method use in Moldova. This chapter addresses the first research question. In particular, the chapter contributes to demographic literature by examining the hypothesis that economic deterioration within Moldova may explain persistently high reliance on natural contraception, due to the prohibitive costs of modern contraceptive methods. Additionally, the chapter hypothesises that uneven access to family planning services may reduce the use of modern contraception due to increased opportunity costs in these areas.

Chapters 3 and 4 expand on the understanding of the correlates of natural method use by examining the potential influence of natural contraception on fertility

patterns in Moldova. These chapters address the second research question. The aim of these chapters is to extend the contraceptive confidence hypothesis from Western European populations to the Moldovan setting, and to expand the theory to the role of induced abortion. Chapter 3 extends this hypothesis to the first birth intervals and the transition to motherhood, which has undergone considerable change since the fall of Socialism in Moldova. In particular, this chapter tests the hypothesis that women with low contraceptive confidence will tend to delay their first birth in an effort to restrict their completed family size, while women with higher contraceptive confidence will tend to have more rapid first births. The paper also examines potential crisis and adjustment explanations for recent delays in first birth following marriage among recent marriage cohorts. Chapter 4 evaluates the effect of contraceptive confidence on inter-birth intervals, extending the traditional hypothesis to incorporate the effect of induced abortion. This chapter hypothesises that induced abortion increases contraceptive confidence, and a high propensity to use induced abortion is therefore associated with shorter inter-birth intervals.

Chapter 5 tests the assumption that natural method use is associated with more frequent contraceptive failure than modern contraceptive use. This addresses the third research question. The aim of the chapter is to reconcile low population fertility with the widespread use of ineffective contraception. The paper also evaluates the determinants of contraceptive abandonment and switching. The conclusion, chapter 6, synthesises the research findings of the 4 research papers. The chapter also evaluates potential limitations of the thesis as a whole and provides overall policy recommendations.

Chapter 2: The correlates of natural method use in Moldova

Abstract

This study investigates the correlates of traditional contraceptive use in Moldova, a poor post-Socialist country in Europe with one of the highest proportions of traditional method users. It is hypothesised that economic and spatial disadvantage increase the reliance on traditional methods whereas exposure to FP/RH programmes increases reliance upon modern methods. The analysis considers a sub-sample of 6039 sexually experienced women from the 2005 Moldovan Demographic and Health Survey. Results from multilevel multinomial models, controlling for relevant characteristics and data structure, show that economic disadvantage increases the probability of traditional method use; but the overall effect is small. FP media exposure has only a marginal effect in increasing modern method use among older women. The policy implications of these findings are that FP efforts directed towards the poorest may have limited impact, but better targeted interventions at older women could reduce the burden of unwanted pregnancies and abortions.

Notes

Findings from this chapter are published in the paper: Lyons-Amos, M.J., Durrant, G., Padmadas, S.S. 2011 *Is traditional contraceptive use associated with Poverty and Isolation?* Journal of Biosocial Science, 43(3) 305-327. A previous version of this paper was presented at the 2009 XXVI IUSSP International Population Conference, Marrakech, and at 2008 British Society for Population Studies Annual Meeting (University of Manchester).

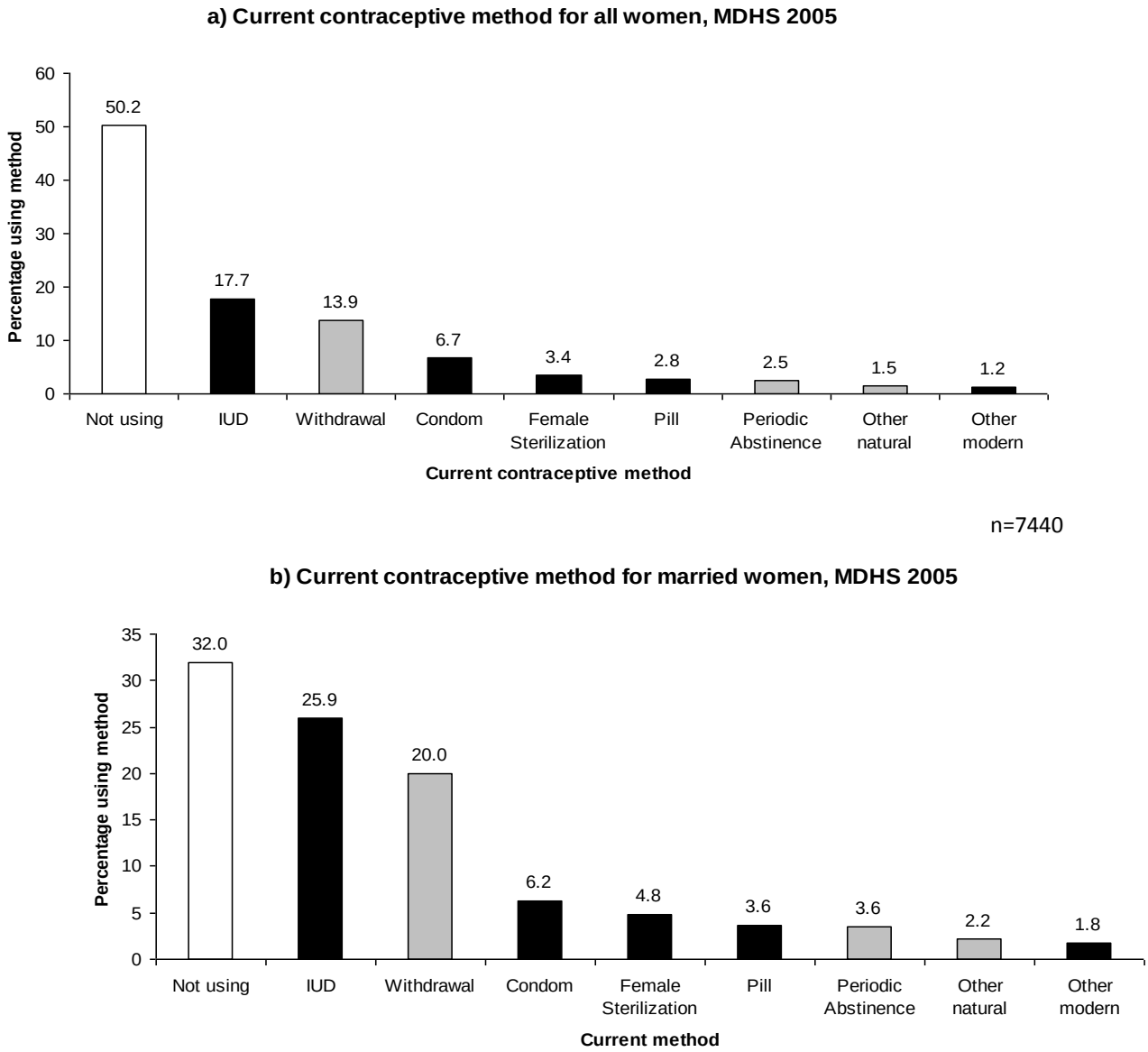
2.1: Aims and introduction

This study investigates the factors associated with natural method use in Moldova. The determinants of natural method use are poorly understood in demographic literature, especially in the Eastern European setting (Rogow and Horowitz, 1995, Santow 1995, 1993). However, natural methods account for roughly 25% of current contraceptive method use by married women in Moldova (National Scientific and Applied Center for Preventive Medicine [NCPM] and ORC Macro 2006). This is associated with a number of adverse health outcomes, including a high reliance on induced abortion - the Gross Abortion Rate is 35 per 1000 (UNData 2009) and nearly half of all sexually experienced women have had at least one pregnancy terminated (author's calculations from Moldova Demographic and Health Survey (MDHS) 2005). Understanding the factors associated with persistent natural method use is therefore vital if Family Planning (FP) policy interventions are to be successful. In particular, the analysis aims to assess whether natural method use is associated with poor financial and geographic access to modern contraception.

A high proportion of Moldovan women currently use a contraceptive method (68% of married women). Controlling for marital status, the proportion of women not currently using a method is 32.0%. 31.9% of all women and 42.3% of currently married women currently use a modern contraceptive, while 17.9% of all and 25.7% of married women currently rely on natural methods (all figures author's calculations from MDHS 2005). However a large proportion of contraceptive use is accounted for by natural methods. The distribution of contraceptives currently used is shown for both all and married women in Figure 2.1.1. The proportion using natural methods is comparable to levels in South-East Europe (Ukraine 29.5%, Romania 32.0%), but considerably higher than observed in other former-Soviet countries (Latvia 8.7%, Hungary 9.0% and Bulgaria 15.7%) and especially Western Europe (Netherlands 2.9% and Germany 4.5%, all values United Nations 2007). A large proportion of Moldovan women (13.9%) use *coitus interruptus* (withdrawal) as their primary means of birth control, and an even higher proportion of married women use *coitus interruptus* (20.0%, author's calculations from MDHS 2005). IUD is the only modern

contraceptive with any significant share of the method mix, currently used by 17.7% of all women and 25.9% of married women (author's calculations from MDHS 2005).

Figure 2.1.1; Current contraceptive method for a) all women and b) currently married women, MDHS 2005



Note:

- Colour of bar denotes contraceptive type:

Modern method ■

Natural method ■

No contraceptive □

- Scale between graphs alters to improve visual clarity
- 'Other modern' consists of vasectomy, injectable, foam and sponge and diaphragm
-'Other natural' consists of Lactational Amenorrheic Method (LAM) and folkloric methods

After adjusting for the sampling design[2], the use of modern methods has fallen by nearly 3% points between the 1997 Moldova Reproductive and Health Survey (MRHS) and 2005 MDHS. In comparison natural method use has fallen by 1.3% points. This implies that natural methods account for a slightly greater share of the method mix in 2005 MDHS than in the 1997 MRHS. This represents an interruption of the steady increase in modern method use that had been seen since 1991 (Westoff 2005). Moreover, the proportion of births classified as unwanted has also increased - which the Moldovan government attributes to persistent use of natural methods. This conclusion is supported by Westoff (2005), who estimates that 43% of unwanted fertility in Moldova is due natural method failure. Further, high levels of natural method use are associated with a sustained high abortion rate (Gross Abortion Rate 35 per 1000, Total Abortion Rate 1.1 - UNData 2009). Westoff (2005) estimates that the induced abortion rate in Moldova could be reduced by 33% if natural method users were to switch to modern methods. Many of these abortions are medically risky, due to high use of invasive dilation and curettage procedures (Comendant 2005). Vacuum aspiration and drug-induced abortions are very rare. The result is that abortion in Moldova is associated with a high rate of maternal death; 30.3% of maternal deaths in 1992- 2002 were attributed to repeated abortion use (Comendant 2005).

This study also evaluates the effect of Family Planning programmes on contraceptive choice. The reduction of natural method use is a priority for the Moldovan government (NCPM and ORC Macro 2006). In an effort to reduce the number of unwanted births, the Moldovan government introduced the 'National Program in Family Planning and Protection for Reproductive Health for the years 1999-2003,' (NPRH) with the explicit aim of reducing unwanted fertility, associated repeat abortions and maternal death. To improve reproductive health, a 'National Program

[2] 1997 MRHS and 2005 MDHS used different target populations. The 2005 MDHS consists of women 15-49 in the Chisinau, North, Center and South regions. 1997 MRHS sampled women 15-45, and included the Transnistria region in addition to Chisinau, North, Center and South. In order to make valid comparisons, figures from the MRHS and MDHS are re-estimated to include only women 15-45 in all regions excluding Transnistria.

for combating HIV/AIDS' (NPAIDS) was implemented with the expressed aim of reducing the prevalence and incidence of HIV infection in Moldova.

Other Eastern European countries have introduced similar FP programmes in an effort to increase contraceptive prevalence and reduce abortion incidence. However, these efforts were hampered by economic instability in Eastern European transitional economies. Evaluating FP programmes in Bulgaria, Carlson and Lamb (2001) found no significant impact on the levels of modern method use controlling for demographic characteristics. Awareness of FP programmes was also poor (under 10% of women were aware of the existence of clinics 5 years after introduction). Carlson and Lamb attribute this disappointing result to "Political corruption and paralysis, economic stagnation, rising inequality and social chaos," (p. 336). Serbanescu *et al.* (1995) found similar results in Romania, where 70% of any contraceptive prevalence increase was accounted for by new natural method users. Among current contraceptive users in Romania, 34.3% reported that they were using a natural method as a result of prohibitive cost of modern methods (Serbanescu *et al.* 1995). Moldova has suffered comparable if not greater economic instability, with 2005 GDP reported to be 40% of its 1991 value (NCPM and ORC Macro 2006). Similar macro-economic conditions may therefore impact on the success of NPRH and NPAIDS. The history of other Eastern European FP campaigns indicates that NPRH and NPAIDS may be severely affected by contextual economic conditions.

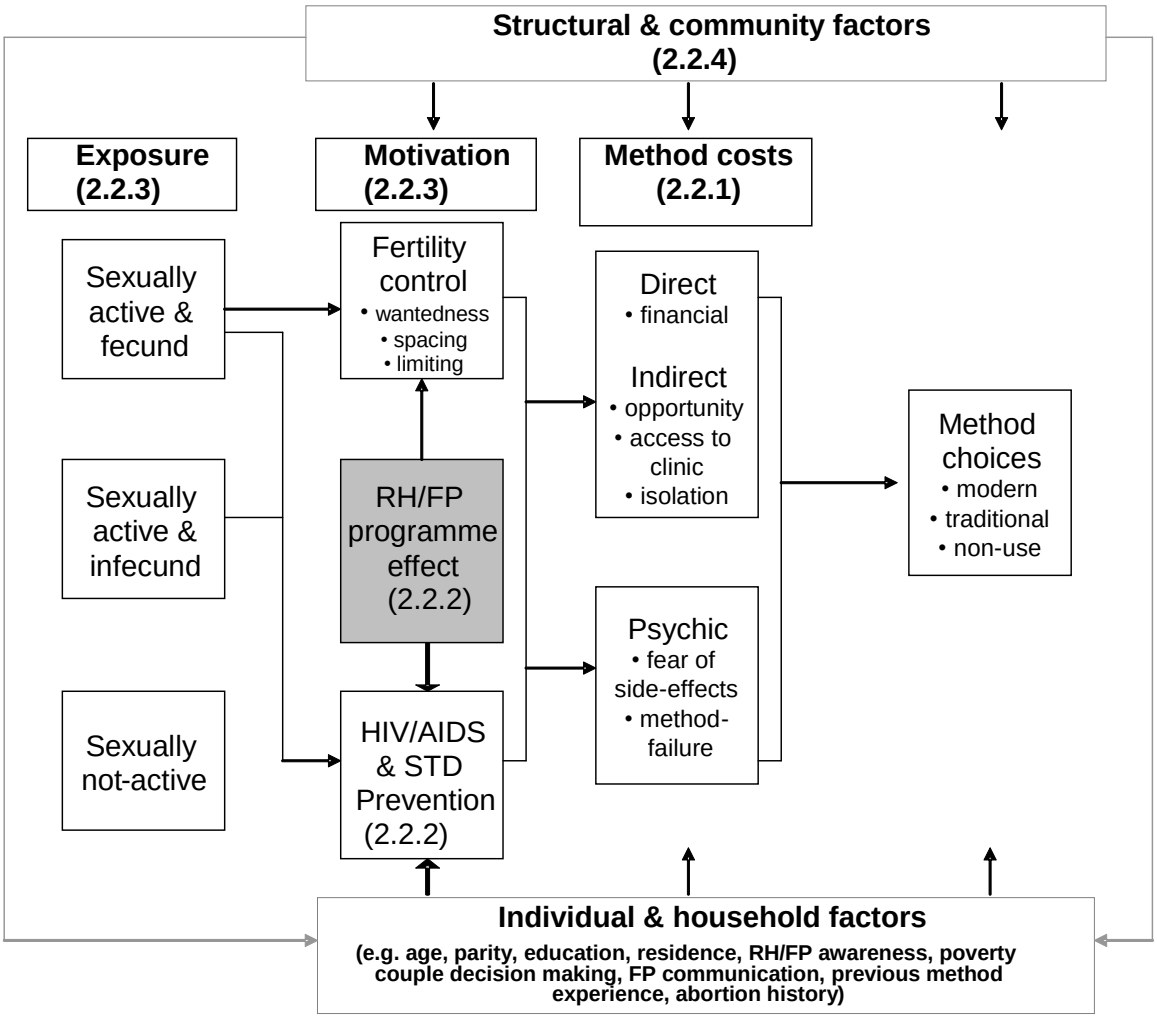
The remainder of this chapter takes the following structure. Section 2 reviews existing literature to generate hypotheses of the influences of both economic disadvantage, spatial isolation and the effect of FP programmes on the use of natural contraceptives. Possible confounding factors are identified. Section 3 defines the analysis sample, and considers the implication of sample selection. The limitations of the data and study are considered. Section 4 identifies and describes variables used in the analysis. Section 5 presents the multilevel multinomial methodology used in the study, as well as the modelling strategy. Section 6 considers the descriptive and regression results. Section 7 synthesises the results of the modelling, and examines the validity of the hypotheses made in the light of this evidence. Finally, future

implications and strategies for FP programmes within Moldova are identified, in an effort to focus and increase the impact of existing policies.

2.2: Conceptual framework and research hypotheses

The conceptual framework used for this analysis is derived from the Easterlin synthesis hypothesis (Easterlin 1975). This framework is presented in Figure 2.2.1. The following section discusses the influences identified by the conceptual framework - the section numbers are included in the Figure for reference.

Figure 2.2.1: Conceptual framework for analysis, derived from Easterlin (1975)



Note: Numbers in brackets denote section number with accompanying discussion

2.2.1: The effect of economic disadvantage

Easterlin (1975) argues that a couple wishing to restrict its fertility may not make use of contraception due to a high associated cost of use. Cost comprises the 'market cost.' This has two components; direct cost - financial expenditure required to purchase the contraceptive - and the indirect/opportunity cost of accessing a source of contraception. 'Psychic cost,' is the additional cost associated with method use in the face of opposition from religion, family members or society.

This study extends the Easterlin hypothesis from a dichotomy of contraceptive use/non-use to three categories of; modern method use, natural method use and non-use. The ranking of total costs of method use are shown in the inequality in Equation 2.1.

$$C_{Modern} > C_{Natural} > C_{None}$$

Equation 2.1

C_{Modern} denotes the cost of modern method use, comprising a combined market and psychic cost.
$C_{Natural}$ denotes the cost of natural method use, comprising only reduced psychic costs.
C_{None} denotes the cost of no method use, in this framework 0.

The greater cost to modern method use results from the absence of any market cost associated with natural method use. Natural method use incurs neither medical costs of uptake nor any supply costs associated with modern method use (Torres and Forest 1983). Further there are no associated opportunity costs of access (Rogow and Horowitz 1995, Gribble 2003) - as natural methods do not require access to FP services. Although periodic abstinence requires some information to be used effectively, this can be obtained through peer networks of users (Kohler *et al.* 2001). While Equation 2.1 reflects overall cost, it is important to recognise that the psychic costs of natural and modern method are not equal. For example, Kulczycki (1995) identifies strong opposition to 'artificial' (modern) contraception in Poland from the Catholic Church and an acceptance of some natural methods (rhythm in particular) -

with the implication that the psychic cost of modern method use is higher than natural method use.

Direct financial costs may discourage some couples from using a modern method, instead they use a natural method to control their fertility. Serbanescu *et al.* (1995) find high monetary cost is cited as the major reason for not using modern contraception by 35.9% of Romanian *coitus interruptus* users and 27.6% of periodic abstinence users. The decline in economic wellbeing in Moldova since independence may also make modern contraception unaffordable (modern methods are not free in Moldova, MacLehose 2002). When modern methods are unaffordable, couples may resort to natural methods to control their fertility. This is tested in the first research hypothesis;

Hypothesis 1: Natural contraceptive users tend to have a poorer economic status than modern method users.

Market costs also include the opportunity cost in reaching a source of contraception. In Romania, Serbanescu *et al.* (1995) find 38.2% of *coitus interruptus* and 39.5% of periodic abstinence users are dissuaded from modern method use due to difficulty in accessing modern methods. It is expected that the sparsity of population in rural or isolated areas, as well as the underdevelopment of the FP network (MacLehose 2002), would increase the time required to travel to a FP clinic, therefore increasing the opportunity cost of use (Paul 1990). As natural methods do not require any clinical support (Gribble 2003) - clinical access is not a necessary precondition for use - there are no opportunity costs. It is expected that natural method use should be higher in rural or more isolated areas since modern methods are less easily accessible;

Hypothesis 2: Natural method use is associated with a lack of clinic access, spatial isolation and rural residence.

2.2.2: The effect of Moldovan FP programmes - NPRH and NPAIDS

NPRH was introduced as part of a package of health reforms in the '1997-2003 Health Sector Strategy' by the Moldovan government designed to address inefficiency, lack of access and under-financing of health care, streamline resources and improve responsiveness to national policy (NCPM and ORC Macro 2006, MacLehose 2002). The particular focus of NPRH is to promote family planning and to counsel the Moldovan population on reproductive health. The 'National Program for Combating HIV/AIDS' (NPAIDS) is designed to reduce the prevalence and incidence of HIV/AIDS. A key aim of both these programmes is to reduce the prevalence on natural contraception, which is associated with continued reliance on induced abortion in Moldova. Real political commitment to these programmes has been made, including the introduction of community level FP facilities (MacLehose 2002), facilities for the treatment of HIV positive patients in the Republican Dermatologic-Veneroligic Dispensary, and the provision of anti-retrovrial treatment (NCPM and ORC Macro 2006). Both NPRH and NPAIDS both heavily utilise media to increase the use of modern contraception, reduce reliance on induced abortion and for AIDS awareness to achieve the "mass character" (NCPM and ORC Macro 2006) it currently lacks.

Hypothesis 3: Greater exposure to FP media is associated with greater modern method use, and lower natural method use.

Despite this impressive political and resource commitment to improving the reproductive health of Moldova, the evidence of performance of FP programmes in post-Socialist Europe is mixed. Carlson and Lamb (2001) examine the impact of a FP programme in Bulgaria, which provided subsidised contraception dispensed by medically trained staff, and contraceptive counselling centres manned by volunteers. However, the introduction of these centres had only a limited impact, with only 10% of subsequent respondents aware of their existence, and fewer than 3% of respondents actually using the centres. Carlson and Lamb attribute the failure of this FP programme to the economic collapse in the post-Socialist region. There was also a

persistent normative reliance on abortion for birth control within the Bulgarian fertility control regime. This conclusion is supported by evidence that modern method use had increased among the minority of Bulgarian women who were unaffected (or benefited) from the collapse of Socialism.

Popov *et al.* (1993) note the negligible uptake of many modern methods in former Soviet states - especially hormonal methods - attributed to the negative attitudes of gynaecologists and FP workers. Popov *et al.* cite '[n]egative public opinion and the generally apprehensive attitude toward oral contraceptives… [are] direct consequences of the position taken by Soviet doctors,' (pp. 232). It is worth noting that medical concern may not be entirely unfounded due to the continued use of high dose pills in Eastern Europe (Kulczycki 1995). Reinforcement and feedback loops (Behrman 2002, Kohler *et al.* 2001, Potter 1999) may exacerbate the effect of clinical negativity within the community, leading to a mistrust of hormonal modern methods by potential users.

Comendant (2005) also identifies poor service quality as a potential problem. In particular, there is no pre-test counselling for HIV or syphilis screening, and pre- and post-procedure counselling for abortion is non-compulsory (and rarely implemented). Comendant also notes that patient confidentiality is often abused and that "the fact that a woman has had an abortion rarely remains unknown to other people in the community where she lives" (pp. 96). In addition there is little privacy afforded patients, with different patients waiting in the same room pre- and post- procedure, and procedures being carried out with doors left open.

While it is anticipated that the FP programmes in Moldova therefore does improve modern method uptake, it should be noted that the quality of the FP programmes may vary. Therefore, where possible this analysis will include proxy measures of quality when assessing the effect of FP programmes.

This study also examines the effect of the NPAIDS anti-AIDS programme introduced in Moldova. NPAIDS aims to increase AIDS awareness to achieve a "mass character"

(NCPM and ORC Macro 2006), increase condom use and reduce sexually risky behaviour. Modern method use, particularly the use of condoms, is likely to increase with greater AIDS awareness. This programme should reduce the use of natural contraceptives and through counselling against their use, as these methods offer limited[3] protection from HIV transmission. Encouraging the use of modern methods should also reduce the probability of no method use, and the study therefore tests the hypothesis;

Hypothesis 4; Awareness of the transmission of HIV/AIDS is associated with a lower use of both natural and non- use, and a corresponding increase in modern method (condom) use.

2.2.3: Confounding factors: demographic effects and the desire and ability to have children

This study controls for a number of key influences on contraceptive use. These confounding influences take the form of demographic characteristics, fertility preferences and exposure to risk of pregnancy. Formal hypotheses are not considered for these influences, but expected associations are identified in this section.

Magadi and Curtis (2003) map the determinants of the use of natural, short term, long term and permanent contraceptives. Magadi and Curtis find significant effects of parity, age, education and religion, although only parity significantly affects natural method choice. Probability of natural method use declines significantly at higher parities, with women having one child (42% points) and two or more children (49% points) less likely to use a natural method than nulliparous women respectively.

[3] De Vincenzi (1994) finds that couples using withdrawal demonstrate statistically significantly slower seroconversion than couples using no contraceptive method, suggesting some protective effect associated with the use of *coitus interruptus.* However, medical consensus is that *coitus interruptus* offers no protection from HIV/AIDS infection (Kowal 2004).

Robinson (1996) uses DHS data from 9 countries to investigate the association between educational level and natural method use. The effect of education is inconsistent; in Bolivia and Peru higher education decreases probability of natural method use, while in Indonesia and Tunisia higher education increases probability of natural method use. The remaining countries show no significant educational effect. Robinson also finds a significant age effect, with older women more likely to make use of natural methods. These findings are verified by Westoff (2000). Westoff also finds significant differences in contraceptive behaviour by ethnicity making use of DHS data from Kazakhstan. Method mix varies between ethnic groups - Russian women are more likely to use a modern method than Kazak (native) women.

Religion is highly significant in contraceptive method choice. Christopher (2006) identifies the influence of religious teaching. The influence of religion varies, with Orthodox Christianity and Protestantism taking no official position on contraception, while Roman Catholicism denies the use of any contraceptive method except periodic abstinence. This is supported by Santow (1993, 1995) and Kulczycki (1995). This study will include potential controls including age, parity, educational level, ethnicity and religion.

The desire for future fertility has also a confounding influence on contraceptive use. Desire for children can influence contraceptive use at population level (Pritchett 1994) and is a highly significant predictor of contraceptive use at individual level (Robinson 1996, Easterlin 1975). Clearly, women who have a desire for children within the near future are unlikely to use a contraceptive method. In contrast, women who are strongly motivated to avoid pregnancy are likely to use a modern (effective) method to avoid contraceptive failure.

Whether a woman is at risk of conception is another confounding factor. A woman who is not sexually active clearly has no demand for contraception (Easterlin 1975, Robinson 1996). Marital status is closely associated with sexual activity - women currently married or in union are assumed to be sexually active. Magadi and Curtis

(2003) find that never-married or formerly married women are significantly less likely to use a contraceptive, while Lindstrom and Munoz-Franco (2005) find currently married women are significantly more likely to be contraceptive users than never married women.

Fecundity is the second determinant of risk of conception. Clearly women who are infecund are unable to conceive, and therefore unlikely to use a contraceptive to prevent pregnancy. These women may still make use of barrier contraceptives to prevent AIDS infection. Temporary postpartum amenorrhea can also influence contraceptive choice. Salway and Nurani (1998) investigate the association between postpartum amenorrhea and contraceptive uptake using data from Matlab Bangladesh. The study finds that use of Lactational Amenorrheic Method (LAM) dominates contraceptive method mix in the postpartum period. The majority of respondents perceived modern method use in the postpartum period as unnecessary or dangerous. In addition, respondents were reluctant to use hormonal contraception which could induce early return of menstruation.

2.2.4: Contraceptive network effects

Kohler *et al.* (2001) and Montgomery and Casterline (1996) examine the effect of social networks on contraceptive choice. Peer groups can influence contraceptive choice through the processes of social learning and social influence.

Social learning influences contraceptive use by providing information about contraceptive methods. Modern method use in Moldova could be discouraged due to rumours of side effects from official sources (e.g. Soviet doctors distrust of hormonal contraceptives, Popov *et al.* 1993), and from other women's reported side effects (Breslin 1997). In this situation a woman may choose a natural contraceptive, in an effort to avoid health complications associated with modern methods. Conversely, social learning could also discourage natural method use through perceptions of method inefficacy (e.g. periodic abstinence nicknamed 'Vatican roulette' in Poland, Kulczycki 1995). Peer networks also provide role model users

(Kohler *et al.* 2001). Social learning has strongest influence within sparse networks (where women have little contact with each other), as this facilitates the most rapid diffusion of contraceptive information (Kohler *et al.* 2001).

Social influence can either promote or constrain use of a given method within a peer group. Influence functions where individuals within a social network adopt normative behaviours to avoid interpersonal conflict (Montgomery and Casterline 1996). A network where a diverse range of contraceptives is used can increase method choice, as a "risk-averse person may be expected to opt for a… [method] that their peers have used successfully," (Potter 1999, pp. 713). Social networks can also encourage method uptake once a critical proportion of women within a peer group choose to use a particular method (Kohler *et al.* 2001). These effects are strongest when the network is dense (women regularly interact with each other), and weakest when the network is sparse.

In many surveys it is difficult to obtain accurate estimates of the peer networks to which a woman belongs. This is typically overcome by assuming that women are members of networks defined at the local geographic area, such as Primary Sampling Unit (PSU). This approach is followed by Lindstrom and Munoz-Franco (2005).

2.3 Analysis sample

The analysis sample consists of sexually experienced women - that is, women reporting that they have ever had sex. The original 2005 MDHS consists of 7440 women. Women who had never been sexually active at the time of the survey were excluded from the study population (n=1401) since they have had no opportunity to use contraception. The final analysis sample therefore consists of 6039 women.

To examine the effect of exclusion of this subgroup on whether the analysis sample is representative, a binary logistic regression was conducted to determine the characteristics associated with exclusion. The response variable *y* for woman *i* is an indicator of inclusion in the analysis and defined as;

$$y_i = \begin{cases} 0 = Included \\ 1 = Excluded \end{cases}$$

The model estimates the probability of being excluded from the analysis sample for respondent *i*, which is defined as $\pi_i = \Pr(y_i = 1)$. A logistic regression is used to model the effect of respondent characteristics on inclusion in the analysis sample. The model is written in the form of Equation 2.2.

$$\ln\left(\frac{\pi_i}{1-\pi_i}\right) = \boldsymbol{\beta}^T \mathbf{x}_i$$

Equation 2.2

In Equation 2.2 $\mathbf{x_i}$ is a vector of explanatory variables, and $\boldsymbol{\beta}^{\mathbf{T}}$ a transposed vector of coefficients.

Forward stepwise model selection was used to determine the socio-demographic predictors of membership of the analysis sample. Significance was based on the Likelihood Ratio test. Significance was set at the 5% level. The model was estimated in R 2.9.0 and the estimated model is presented in Table 2.3.1. There is a high probability of being excluded from the analysis sample given a young age (women not old enough to have experienced sexual debut), secondary or lower education, and a desire either to delay fertility, or indecisive about future fertility (both associated with young age). The model indicates an under-representation of Protestants and Catholics in the analysis sample, and the North and Center regions are underrepresented while the South is overrepresented.

Table 2.3.1: Binary logistic regression of demographic influences of exclusion from the study population, MDHS 2005.

Variable	$\hat{\beta}$	SE($\hat{\beta}$)			Estimated odds ratio ($e^{\hat{\beta}}$)
Intercept	-6.440	0.341			
Age of respondent (ref=35 or more)					
25-34	0.718	0.323	*		2.05
15-24	3.830	0.296	*	*	46.06
Region (ref=Chisinau)					
North	0.135	0.126			1.14
Center	0.168	0.129			1.18
South	-0.056	0.136			0.95
Education (ref=Secondary or lower)					
Higher	-0.930	0.111	*	*	0.39
Religion (ref=Orthodox)					
Catholic	2.077	0.985	*		7.98
Protestant	1.145	0.234	*	*	3.14
Jewish	-0.885	0.769			0.41
None/Other	0.336	0.345			1.40
Desire for future fertility (ref=Wants no more)					
Wants, within 2 years	0.185	0.382			1.20
Wants, more than 2 years	1.851	0.253	*	*	6.37
Wants, unsure of timing	3.995	0.247	*	*	54.33
Undecided	3.174	0.285	*	*	23.90
Can have no more	1.697	0.399	*	*	5.46

Notes;
** denotes $p<0.01$
* denotes $p<0.05$

n= 7740

2.4: Variable operationalisation.

Response and explanatory variables are considered below, and the concepts identified in Section 2.2 are operationalised. The derivation procedure for key variables to measure market cost, and FP exposure is described in detail. Control variables are also outlined.

2.4.1: Response variable

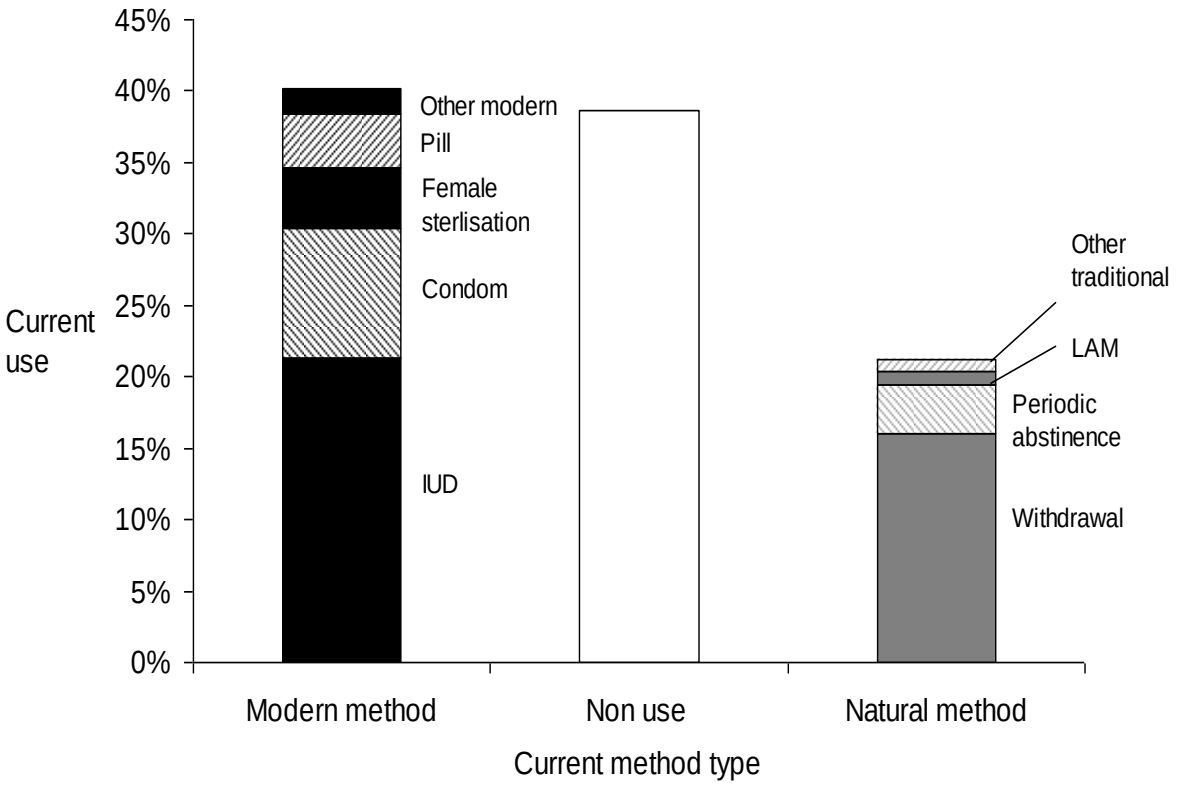
The response variable for this analysis is the type of contraceptive use on the date of the MDHS survey (NCPM and ORC Macro 2006). The current use is collapsed into three categories; Modern method, Natural method and Non-use. The methods included in each of these categories are broadly similar to those in the categories of contraceptive type defined in DHS, but this study defines the deliberate use of breastfeeding to prevent pregnancy (Lactational Ammenoreic Method, LAM) as a natural rather than modern contraceptive.

The distribution of respondents in these categories is displayed in Table 2.4.1, and the method mix by category in Figure 2.4.1. Within the analysis sample, modern method use is the largest single category. This contrasts to the overall sample, where non-use is the largest group. This is a result of the exclusion of women yet to have sex, who are universally non-users of contraception.

Table 2.4.1: Distribution of respondents by response category (current method type)

Current method	**Frequency of respondents**	**Proportion of total respondents (%)**
Modern method	2431	40.2
Natural method	1275	21.2
Non-use	2333	38.6
TOTAL	**6039**	**100.0**

Figure 2.4.1: Method mix in the analysis sample by contraceptive method (nested within contraceptive type)



n=6039

2.4.2: Measurement of market cost barriers

As noted in the conceptual framework (Figure 2.2.1), the market cost of contraceptive use comprises two elements; the direct costs of use and an (indirect) opportunity cost of use. The direct cost of use is measured through the use of an asset wealth index. MDHS collected no information on household income or expenditure, and so this analysis uses an index of asset wealth to measure household economic status. Four variables measuring ease of access to contraception are used to measure indirect cost.

Direct market cost

The index of asset wealth used in this study adapts the technique proposed by Filmer and Pritchett (2001). Filmer and Pritchett argue that a simple combination of the ownership of assets introduces the problem of deciding the appropriate weighting for each variable within the index, the magnitude of which cannot be estimated. Although this problem is overcome by including the ownership of asset variables as individual predictor variables (the coefficient provides the appropriate weight), this does not overcome the potential indirect effects of assets e.g. electricity supply is not a good measure for the effect of wealth on schooling outcomes, since there is an indirect effect on ability to complete homework (Filmer and Pritchett 2001). Filmer and Pritchett construct an index of wealth using the score generated from the first component of a Principal Component Analysis (PCA) of variables measuring the ownership of assets, housing/roof material and toilet facilities. This score is then used to allocate respondents to quintile of wealth. Filmer and Pritchett demonstrate that this index is internally consistent, and functions well in analysis as a proxy for expenditure data.

This study makes used of an adapted index of wealth, which uses only asset variables, excluding variables on house/roof material and toilet facilities. These variables vary little between respondents in Moldova - unsurprisingly given the recent socialist government control of housing construction and allocation. This situation mirrored the housing allocation in other countries in the Soviet bloc (Witte and Wagner 1995). The invariance between respondents means that these variables are poorly correlated with the asset ownership variables, reducing the explanatory power of the index if included. The index used for this study therefore makes use of a PCA of seven[4] asset ownership variables, scoring factors for which are presented in

[4] Asset variables used for the PCA are; 'Respondent has electricity,' 'Respondent has radio,' 'Respondent has Television,' 'Respondent has refrigerator,' 'Respondent has bicycle,' 'Respondent has motorcycle/scooter,' and 'Respondent has car.' Unlike the Filmer and Pritchett (2001) asset index,

Appendix A. It is worth noting that the index used by this study accounts for a greater proportion of variance (31.8%) with its first component than the first component of the index used by Filmer and Pritchett (25.6%). The original asset ownership variables are used to check the index for internal validity. The two variables with the highest correlations in the correlation matrix - 'has television' and 'has refrigerator' - and the two variables with lowest correlations - 'has bicycle' and 'has motorcycle/scooter' - are used to perform a one way analysis of variance (ANOVA). For each of these variables, the mean asset score differs significantly between categories (p<0.01), with the mean score in household with assets is higher than for households without assets. The scores generated by the index are therefore internally consistent.

The assumption behind using this index is that the ownership of assets is an indicator of 'economic' status. Key to the assumption is that households of higher economic status have a greater ability to purchase certain goods, and hence can more easily accommodate the direct cost of contraception than household from lower economic status households. The index satisfies this role if two conditions are met. Firstly, that the ownership of assets reflects the long-run smoothed economic status (Filmer and Pritchett 2001, Montgomery *et al.* 2000). The advantage of this is that long-run economic status smooths over potential income and expenditure shocks. Since the long run economic status is more important than temporary income in decisions such as contraceptive use, this is a superior indicator of the contraceptive decision making process. The second condition is that given a higher economic status a woman will be better able to accommodate the higher financial costs of modern methods than lower status women. This is equivalent to a woman with higher economic status experiencing a less severe budget constraint on her contraceptive decision, and hence exhibiting less sensitivity to contraceptive method cost (Easterlin 1975). Clearly, this may not fully account for the decision with respect to cost, for example if the woman has higher priority expenditures. Additionally, cost of

'Respondent has sewing machine' was not used for the asset score, as data for this variable were not collected in MDHS.

contraceptive method will only have an interpretable effect in the presence of controls for motivation to avoid pregnancy- for example, where women wish to become pregnant, the cost of contraception is irrelevant.

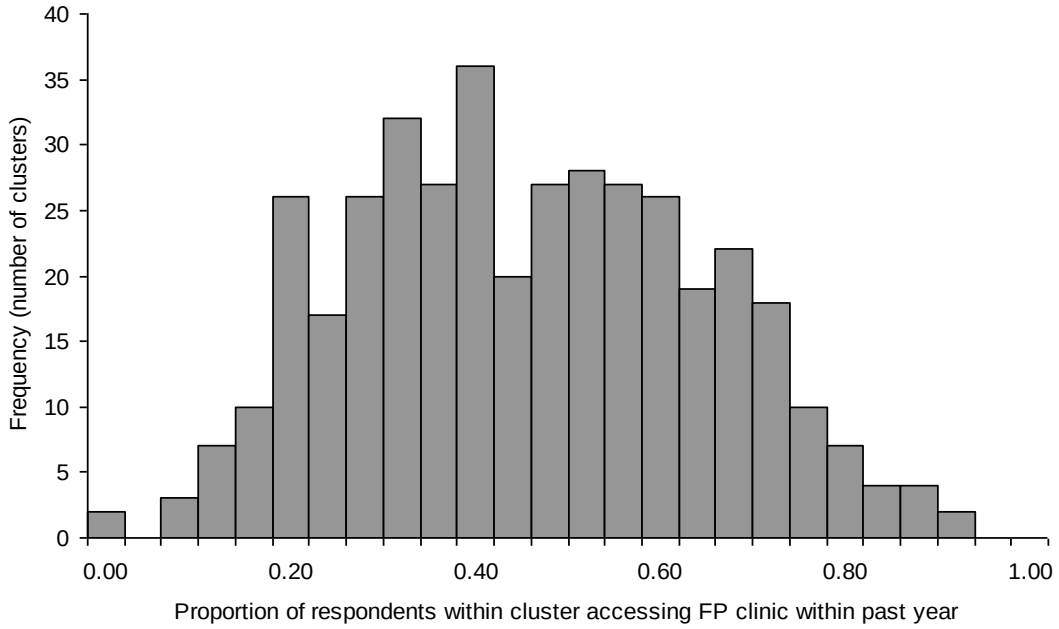
Indirect market cost

Four variables of ease of access to FP clinics are used to proxy the opportunity cost of clinic access - two measure of use of a FP clinic at individual and PSU level, and two indirect measures of isolation.

Individual access to a FP clinic has three levels contrasting women who had not visited a clinic; women who had visited a clinic but not received FP counselling and women who had both visited a FP clinic and received FP counselling. These levels are used to incorporate FP service quality within the access variable. Contraceptive acceptance and continuation are both associated with the quality of service received from FP providers (Jain 1989, Bruce 1990, Pariani *et al.* 1991, Steele *et al.* 1999, Comendant 2005) and the problems of programme implementation in the context of poor service quality were highlighted in section 2.2.2. Given the low levels of counselling within the Moldovan reproductive health setting, and a provider- rather than client - focussed delivery system (Comendant 2005), service quality is a major potential barrier.

The PSU level variable measures the proportion of women within the PSU who had visited a clinic within the past year (whether they had received counselling or not) within each cluster. This is used as a proxy for accessibility of FP facilities within the clinic, due the lack of information on the site of FP clinics at community level. The distribution of this variable is presented in Figure 2.4.1. This figure shows that the proportion of women within a PSU visiting a clinic is roughly symmetrically distributed around the mean proportion (0.44). There are only 2 PSUs where no women have accessed a clinic within the past year.

Figure 2.4.2: distribution of Proportion of Respondents within PSU visiting FP clinic within past year, MDHS 2005



Notes:

Mean proportion: 0.44

Range of proportions: 0.00- 0.92

Total of 400 PSUs.

Rural/urban residence is used in this incidence to model scarcity of population and services, and a correspondingly higher opportunity cost of accessing FP clinics, which can discourage method use. In Moldova, FP networks are underdeveloped in a rural context (MacLehose 2002) and accessing FP is therefore more difficult.

Region of residence is also used as an indirect measure of accessibility. In examining the effect of region of residence, Chisinau is the central and least remote region, whereas all other regions demonstrate some degree of greater spatial dispersion of population. This is correlated with accessibility to clinics, since FP infrastructure in regions outside the capital is poorly developed (MacLehose 2002). This is reflected in the crosstabulation of rural/urban residence and region (see Table 2.4.1). Chisinau is

overwhelmingly (though not universally) urban with all other regions demonstrating a higher rural population.

Table 2.4.2: Crosstabulation of rural/urban residence and region of residence, MDHS 2005

Region of residence	Proportion of respondents living in urban area	Frequency of respondents
North	52.0	1691
Center	32.8	1411
South	43.4	1167
Chisinau	95.6	1770
TOTAL	**58.7**	**6039**

2.4.3: Measurement of FP impact; variables measuring the effect of NPRH and NPAIDS

The effect of FP media is examined using an index of exposure to FP media, previous method discontinued and use of induced abortion. Media is a key source to promoting modern contraceptive use, and the impact of the media campaigns is vital to the success of NPRH. Three variables are used to measure media exposure, which report whether or not a respondent had heard FP mentioned in the radio, television and newspaper. These variables are combined into an index of FP media exposure using PCA (scoring factors presented in Appendix B). An internal consistency check, the mean PCA score for women who had heard of FP is higher than the mean for women who had not, confirmed the internal validity of the index. Respondents are allocated to low, medium or high exposure to FP media based on their PCA scores, each group consisting of approximately one third of the respondents.

The efficacy of NPRH is also assessed through an evaluation of discontinuation behaviour. The effect of a contraceptive switch is examined through the effect of the last method discontinued on current method use. The key association to evaluate the impact of NPRH is the extent to which natural discontinuations are followed by current modern method use, indicating switching from natural to modern method

use - a key goal of NPRH (NCPM and ORC Macro 2006). Additionally, previous authors have found a repeated use of natural methods, even after contraceptive failure. Kost (1993) finds evidence repeated natural method uses as a result of fatalistic acceptance of failure in Peru. Goldburg and Toros (1994) note that method failure is often insufficient motivation for natural method users to switch to a more effective contraceptive.

In many post-Socialist countries, natural methods are used in conjunction with induced abortion to control fertility (Popov *et al.* 1993, Westoff 2005), women compensating for high failure rates through the use of repeated abortion (NCPM and ORC Macro 2006). For this reason, the count of past induced abortions is used to examine the association between abortion use and current natural method use. Given the close association between natural methods and abortion use, it would be expected that natural method use should be concentrated among high abortion women. Alternatively, if post-abortion counselling is effective in encouraging modern method uptake (Comendant 2005), then women with a greater history of abortion should demonstrate a greater propensity to use modern methods.

The efficacy of NPAIDS is assessed through the effect of AIDS awareness on current contraceptive method. It is expected that generally an awareness of AIDS should be associated with greater modern method use. The limitation of this variable is that it is able only to assess the effect of knowledge on contraceptive choice, and cannot capture other important effects of AIDS awareness, e.g. a reduction in number of partners.

2.4.4: Confounding factors.

This analysis controls for three major confounding factors. These influences are respondent demographic characteristics, the desire for further children and the ability for a woman to conceive ('supply of children,' Easterlin 1975).

Demographic characteristics

Age is an important determinant of contraceptive use (Robinson 1996, Magadi and Curtis 2003, Westoff 2000, 2005). Age is the current age of the respondent as provided in the MDHS dataset. In order to overcome non-linear age effects, the variable of age is divided in three categories, 15-24, 25-34 and 35-49. This coding is consistent with Magadi and Curtis (2003). Parity specific effects are reported by Magadi and Curtis (2003) and Westoff (2000), and the number of children a woman has is also included as a control variable.

The effect of having had a recent birth is included to reflect the effect of breastfeeding status in the postpartum period on contraceptive choice (Salway and Nurani, 1998). This explanatory variable is operationalised as a dichotomous contrast of whether the respondent reports a birth within the past year. The proportion of the study population reporting a birth within the past year is relatively small (5.8%, n=352), but large enough to consider in statistical modelling.

Robinson (1996) finds that level of education can influence the choice of natural contraception. Highest competed educational level and literacy were considered as measures of education. However, it was found that illiteracy was negligible in the analysis sample (0.48%, n=29). Therefore, the measure of education in this analysis is restricted to highest educational level achieved.

Magadi and Curtis (2003) find religion to be a significant determinant of natural method use, whereas Westoff (2000) finds ethnicity significant. Since these variables are closely related, it was decided that only one of these variables would be chosen for modelling to avoid multicollinearity. Religion suffered from data sparsity due to small cell counts in a number of categories (over 95% of respondents report Orthodox affiliation) and this study therefore utilises ethnicity as an explanatory variable.

Desire for more children

The desire for future fertility is captured by the variable measuring the preferred timing of next birth. This variable captures whether a woman is actively trying to become pregnant, wishes to delay her next birth or wants no more children. The variable also includes a self-reported infecund status.

Ability to conceive

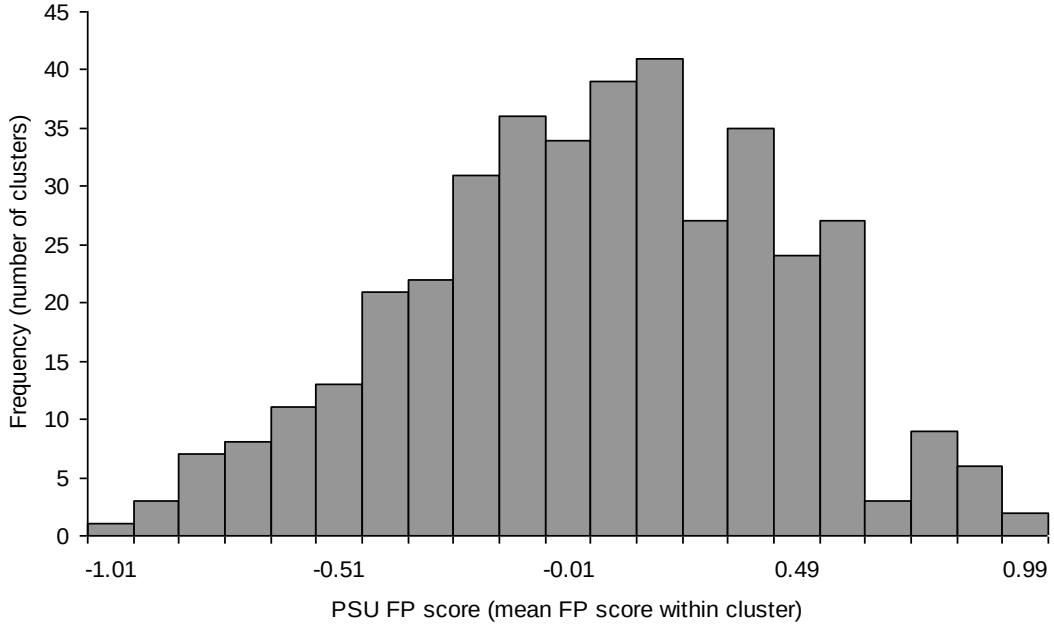
Three variables are used to capture the exposure of women to opportunity to conceive. Fecundity measures the ability of a woman to conceive, while marital status and sexual activity examine exposure to coitus. Marital status has three categories, consisting of women currently married and in a current sexual union, and women never married or formerly married (assumed to be outside a sexual union). Sexual activity records whether a woman was sexually active within the 4 weeks prior to the survey.

Contraceptive network effects

This study makes use of the sampling design and defines networks as operating at the level of Primary Sampling Units (PSU). This provides a better understanding of the role of networks in contraceptive decision making, and is consistent with Carlson and Lamb (2001), Magadi and Curtis (2003) and Lindstrom and Munoz-Franco (2005). Lindstrom and Munoz-Franco (2005) use DHS data to perform a logistic regression to predict contraceptive use. The random effect of the multilevel model is used as a proxy for the effect of the contraceptive network- although this cannot be interpreted directly since there are some confounding factors (such as interviewer effects). Therefore, this analysis extends the measurement of contraceptive network effects to include the FP score for each cluster. FP score for the cluster is defined as the mean of the FP media exposure score for all women within each PSU. This effectively measures the average exposure in the network to FP media, which it is assumed will influence the level of information within the network (social learning)

and also the attitude of women within the network (social influence). The distribution of mean FP score for each cluster is shown in Figure 2.4.2. It is noted that the distribution is slightly negatively skewed, and also there are only a small number of clusters with very high mean FP exposure scores (0.69 or above).

Figure 2.4.2: Distribution of PSU FP exposure score, MDHS 2005



Notes:

Mean FP score: 0.01

Range of FP score: -1.01 – 0.95

Total of 400 PSUs

2.4.5 Data limitations

The Moldova DHS is a high quality and reliable data source, in contrast to the often unreliable data available from the Soviet period of Moldovan history (Sobotka 2003, Livi-Bacci 1993). It is noted however, that the data used in this analysis are limited.

DHS data tends to underestimate the prevalence of natural method use, as only one method can be classified as the current contraceptive (Rogow and Horowitz, 1995). Where two or more methods are used, interviewers are instructed to record the 'most effective' method. The most effective method is recorded even if use is irregular, or related the use of another contraceptive. Rogow and Horowitz (1995) provide the example of a woman who practised periodic abstinence but used a condom during her fertile period would be recorded as a condom user, although for the majority of the month she employs a fertility awareness method. Although this is not technically 'abstinence' (the woman is not actual abstaining from coitus during her fertile period), fertility awareness required in determining the timing of use of the modern method. The result of this is the systematic under-recording of natural methods when used in conjunction with modern methods as a result of survey procedure. There may therefore be additional effects of the under-reporting of natural method use, and the over-reporting of modern method use due to social desirability bias.

The persistent underreporting of natural methods has two major implications. Firstly, any predicted prevalence or probability of natural method use is likely to be an underestimate. This is particularly problematic when estimating the effect of covariates on natural method use, especially when compared to a baseline method of 'modern' method use (which will be overestimated). This will lead to an attenuation of the effect of any β coefficient which predicts increased natural method use and inflation of any β coefficient which predicts a decrease in natural method use. For example, the effect of rural residence will be overestimated (natural method use is higher in rural areas) and the effect of FP media exposure will tend to be overstated (since higher exposure is expected to reduce natural method use). Predicted probability of natural method use should therefore be interpreted as minima.

There are also implications for the effect of contraceptive discontinuation, as the estimation of contraceptive discontinuation is reliant on the type of contraception previously used. Since natural method use is underestimated, estimates of switching

from natural to modern method use will also be underestimated (some switches will be attributed to modern continuation). In contrast modern to natural method switching will be overestimated (some natural continuation will be recorded as a switch). While the very limited modern to natural method switching means that the effect on this study is minimal, the degree of natural to modern switching is used to test research hypotheses 2 and 3 and is a far greater problem.

Another major limitation of this study is the cross-sectional nature of MDHS data. This limits the extent to which causal inference can be drawn from the results of the study, as the direction of causation is ambiguous for some variables used in this study. For example, it is possible that women already using a modern contraceptive are exposed to contraceptive messages at source (for example, when collecting supplies of condoms).

The lack of information at community level is a limitation. Under ideal circumstances, the presence of an FP clinic within a community would be incorporated to measure of access to FP. However, this information is not recorded by MDHS. As a result, the measurement of access within the cluster is estimated from actual use of FP clinics within the PSU. Additionally, information of contraceptive networks would have been included as a derived fixed effect, separate from community level effects. PSU communities are used as proxies for networks, under the assumption that the geographical proximity of women within the cluster will have the strongest influence on their method choice. This parallels Lindstrom and Munoz-Franco (2005).

The final limitation is the lack of detailed information on religion. Religion is closely associated with contraceptive choice (Christopher 2006, Santow 1993; 1995, Kulczycki, 1995). However, there is only information on religious affiliation available, rather than any measure of religiosity. Religiosity is important as women who are more religious may follow religious contraceptive teaching more closely than women with only a tenuous religious association. Further, Orthodox Christianity dominates the religious affiliations available (94% of the analysis sample report Orthodox

affiliation), meaning that there is little scope to examine the effect of religion on contraceptive choice.

2.5: Methodology

2.5.1 Regression model

The model used is a multilevel multinomial random intercept model. The current contraceptive type is denoted by the random variable y_{ij}, with *i* representing an individual woman and *j* Primary Sampling Unit (PSU). y_{ij} can take the following values;

$$y_{ij} = \begin{cases} 0 \;\; Modern \\ 1 \;\; Natural \\ 2 \; Non-use \end{cases}$$

The probability of current contraceptive type is denoted $\pi_{ij}^{s} = \Pr(y_{ij} = s)$ with *s*= 0, 1, 2. As the largest category of the response variable, modern method use is taken as the baseline category. The multinomial model estimates the odds of natural or no method compared to this baseline, where the categories of response are unordered. This model can be written in the form of Equation 2.3;

$$\ln\left(\frac{\pi_{ij}^{(s)}}{\pi_{ij}^{(0)}}\right) = \boldsymbol{\beta}^{(s)T}\mathbf{x_{ij}} + v_j^{(s)}, \qquad s\text{= 1,2}$$

Equation 2.3

$\boldsymbol{\beta}^{(s)T}$ is a transposed vector of beta coefficients specific to response *s*, $\mathbf{x_{ij}}$ a vector of explanatory variables and $v_j^{(s)}$ is the random effect resulting from clustering specific to response *s*. The model estimates two logit equations, estimating the logged odds of current natural method use (*s*= 1) compared to current modern method use (*s*= 0) given $\mathbf{x_{ij}}$, and the logged odds of no use (*s*= 2) compared to modern method use.

Unobserved PSU effects for method *s* are estimated by the residual $v_j^{(s)}$. This multilevel random effect is incorporated to account for clustering within the data and improve standard error estimation. These effects are also used to examine the effect of contraceptive networks (see Section 2.2.4). $\mathbf{v_j}$ is assumed to follow a multivariate normal distribution such that $\mathbf{v_j} = \left(v_j^{(1)}, v_j^{(2)}\right) \sim N(0, \Omega)$, where Ω takes the form of Equation 2.4.

$$\Omega = \begin{bmatrix} \sigma^{2(1)} & \\ \sigma^{(12)} & \sigma^{2(2)} \end{bmatrix}$$

Equation 2.4

$\sigma^{2(1)}$ and $\sigma^{2(2)}$ denote PSU level variance for *s*= 1,2 , and $\sigma^{(12)}$ the covariance between PSU level effects on natural method use and non-use. Note that the model described by Equations 2.3 and 2.4 is a random intercept model; in the more general random slopes model, the coefficient $\boldsymbol{\beta}^{(s)T}$ is also a function of $\mathbf{v_j}$

2.5.2 Modelling strategy

The modelling strategy begins with an investigation of the random structure of the data. Models are estimated in MLwiN 2.02 (Rasbash *et al.* 2005). Random intercepts for natural and non-use are specified and tested for significance at a 5% level. Individual fixed effects are then added to the model, and tested for significance using Joint Wald tests. The effects of asset wealth, access variables and those variables related to the effect of family planning programmes are added to the model. Control variables are then added, in the order of exposure to risk of pregnancy variables, desire for future fertility and then demographic characteristics. On the addition of a significant term, all terms already in the model are checked for significance, and removed from the model if no longer significant. This is a forward stepwise model building procedure. This initial model is estimated using 2nd Order Penalised Quasi-Likelihood (PQL) Restricted Iterative Generalised Least Squares (RIGLS) estimation algorithm. Once selected, the main fixed effects model is estimated using Markov-

Chain Monte Carlo (MCMC) estimation using 80,000 samples with a burn in of 5000 samples. Starting values for the MCMC chains are taken from the 2nd Order PQL (RIGLS) model initially estimated. MCMC estimation is used since the RIGLS algorithm can return downward biased estimated variances, particularly for discrete response models (Browne 2009, Breslow and Clayton 1993*).* After estimating the MCMC model, the significance of variables in the model is verified using the credible interval of the estimated parameters (the credible interval should not include zero).

Following the selection and estimation of the main fixed effects model, two way interactions between significant main effects are added. Interactions between age with asset wealth and age with FP exposure are tested for significance. This is to capture variation in the effect of these variables by age (Westoff 2005). Interactions between region with asset wealth and region with FP exposure are also tested for significance to attempt to capture geographic variation in programme efficacy (MacLehose 2002). On the selection of the interaction effects model, the model is again estimated using MCMC, with 80000 samples and a 5000 sample burn-in. Starting values are from 2nd Order PQL estimation. The significance of the interaction effects estimated is again verified using credible intervals.

When the individual level fixed effects are selected, the model is extended to test for area level random effects. Random slopes for the variables of asset wealth and FP media exposure, last contraceptive method discontinued and AIDS awareness are tested for significance, to allow for potentially differing effects between PSU (these are not described in Equations 2.3 and 2.4). Contextual area level variables of the proportion of women in the PSU who had visited a FP clinic within the past year (as a measure of access) and the PSU mean FP media exposure score (as a measure of contraceptive network effect) are also tested for significance.

Both the main and interaction effects models are presented in Section 2.6. To facilitate straightforward interpretation, predicted probabilities for important explanatory variables are estimated from MLwiN (Rasbash *et al.* 2005). Predicted probabilities are useful for multinomial models since odds ratios have an ambiguous

interpretation (Retherford and Choe 1993). In all cases, the predicted probabilities are median predicted probabilities, where the random effect is set to zero. This indicates that the predicted probability refers to the probability of method use in the median PSU.

2.6: Results and interpretation

This section identifies key findings from the analysis. Descriptive results give an overall impression of the key relationships in the analysis sample. Regression modelling results are presented with interpretation of both random and fixed effects, with a particular focus on the research hypotheses.

2.6.1 Descriptive results

The distribution of key explanatory variables is presented in Table 2.6.1.

Table 2.6.1: Distribution of current method by potential independent variables

Variable Name	Modern method (%)	Natural Method (%)	No method (%)	Frequency
Total	**40.3**	**21.1**	**38.6**	**6039**
Asset wealth category**				
Poor	34.9	22.1	42.9	2511
Medium	42.4	20.2	37.4	2108
Rich	46.5	20.6	32.9	1420
Access to services				
Region**				
North	39.0	24.0	37.1	1691
Center	36.9	24.0	39.1	1411
South	39.1	22.2	38.7	1167
Chisinau	44.9	15.4	39.7	1770
Place of residence**				
Urban	42.7	17.6	39.7	3542
Rural	36.8	26.0	37.2	2497
Clinic counselled respondent about FP**				
Been to clinic, told	41.4	22.7	35.9	897
Been to clinic, not told	40.5	20.6	38.8	2531
Has not been to clinic	39.6	21.0	39.4	2611
Family planning programme				
Exposure to family planning media**				
Low	34.9	22.1	42.9	2511
Medium	42.9	19.4	37.8	1483
High	44.9	21.1	34.0	2045
Respondent knows ways to avoid AIDS**				
No	38.0	20.6	41.4	961
Yes	42.8	20.4	36.8	2200
Has not heard of AIDS	26.4	21.6[a]	52.0	125
Unsure	39.6	21.9	38.5	2753
Last method discontinued**				
Modern	42.1	16.8	41.1	1359
Natural	43.7	26.3	30.1	1214
No recorded discontinuation	38.3	21.0	40.7	3466

Cont.

Variable Name	Modern method (%)	Natural Method (%)	No method (%)	Frequency
Use of induced abortion**				
0	36.3	20.5	43.1	3249
1	46.5	22.3	31.1	1143
2 or more	43.6	21.4	35.0	1647
Demographic variables				
Age category**				
15-24	36.0	20.6	43.4	1209
25-34	47.4	20.7	31.9	1835
35-49	37.6	21.6	40.8	2995
Number of living children**				
Nulliparous	27.2	12.6	60.2	1111
1	41.4	19.3	39.3	1718
2	46.7	23.3	30.0	2253
3+	38.1	29.2	32.7	957
Has had birth within past year?**				
No	41.0	19.9	39.1	5687
Yes	28.4	40.9	30.7	352
Highest educational level**				
Secondary or lower	38.7	21.7	39.6	4603
Higher	45.3	19.3	35.4	1436
Literacy				
Illiterate/Partially literate	31.0[a]	17.2[a]	51.7[a]	29
Literate	40.3	21.1	38.6	6010
Religion*				
Orthodox (Christian)	40.4	21.4	38.3	5703
Roman Catholic (Christian)	18.2[a]	36.4[a]	45.5[a]	11
Protestant (Christian)	33.1	18.3	48.5	169
Jewish	52.9[a]	17.6[a]	29.4[a]	34
None specified	42.6	13.1[a]	44.3	122
Ethnicity				
Moldovan	39.8	21.4	38.8	4445
Romanian	46.9	15.2[a]	37.9	145
Ukrainian	42.0	19.9	38.1	507
Russian	42.4	18.1	39.4	469
Gagauzan	39.9	21.7	38.3	253
Bulgarian	37.4	30.9	31.7	139
Other	35.8	19.8[a]	44.4	81
Exposure to coitus				
Current marital status**				
Never married	32.7	13.7	53.6	483
Currently married	43.5	24.2	32.3	4892
Formerly married	21.7	3.6[a]	74.7	664

Cont.

Variable Name	Modern method (%)	Natural Method (%)	No method (%)	Frequency
Recent sexual activity**				
Active in last 4 weeks	46.6	25.6	27.8	4314
Not active/ Cannot remember	24.3	9.9	65.8	1725
Fecundity**				
Fecund	48.9	25.1	26.0	4673
Amenorrheic, pregnant	14.9	19.1	66.0	388
Infecund, menopausal	9.0	2.7[a]	88.3	978
Desire for future fertility**				
Wants within 2 years	29.6	14.3	56.1	665
Wants after 2 years	46.3	21.5	32.1	859
Wants, unsure of timing	35.1	17.9	47.0	513
Undecided	41.1	19.3	39.6	202
Wants no more	39.9	26.0	34.0	3250
Can have no more	50.0	3.3[a]	46.7	550
Total	**40.3**	**21.1**	**38.6**	**6039**

Notes:

Chi-square test of association;
** denotes p<0.01
* denotes p<0.05
[a] denotes a small cell count (n<30)
Note that percentages may not sum to 100.0% due to rounding.

The association between asset wealth and contraceptive type from Table 2.6.1 is examined first. Women in the lowest wealth category demonstrate the lowest use of modern methods, while there is a corresponding decrease in non-use with increasing wealth. Contrary to the expectations of Research Hypothesis 1, although natural method use is lower in the medium and rich wealth categories relative to the poorest group, this decline is not monotonic, and natural method use in the richest category is 0.4% points higher than natural method use in the medium category.

Examining the effect of visiting a FP clinic, women who reported visiting a clinic demonstrate a higher use of modern methods than women who did not. Women who have received counselling at an FP clinic demonstrate modern method use only 0.9% points higher than women who have visited a clinic but received no counselling. Furthermore, women who have received FP counselling at a clinic exhibit the highest reliance on natural methods, with natural method use 1.7%

points and 2.1% points higher than among women who had not visited a clinic and those who had not received FP counselling respectively.

Rural residents demonstrate a 5.9% point lower reliance on modern contraceptive methods than their urban counterparts, and a 2.5% point lower level of contraceptive non-use than urban residents. There is a corresponding 8.4% point higher reliance on natural methods in rural areas.

Chisinau region demonstrates the highest reliance on modern contraception, 5.9 % points, 8% points and 5.8% points higher than the North, Center and South regions respectively. Chisinau also demonstrates an extremely low reliance on natural methods (5.7 % points below average), while the North, Center and South demonstrate a slightly higher than average reliance on natural method use of 2.9 % points, 2.9% points and 1.1% points respectively.

The four variables used to assess the effect of FP programmes are FP media exposure, previous method discontinued, abortion history, and AIDS awareness. Exposure to FP media is associated with an increasing proportion of respondents using a modern contraceptive method, and a decreasing proportion of respondents using no method. The proportion of respondents using a natural method decreases with higher exposure, but this decrease is not monotonic. Examining the frequencies of reported discontinuation, 1359 (22.5%) respondents report discontinuing a modern method and exhibit a current use of modern method 1.8% points above average, and a below average use of natural or no method. 1214 women (20.1%) report discontinuing a natural method and demonstrate an above average current use of natural methods (5.2% points) and a below average use of modern methods and non-use.

Women who have used abortion (past abortions ‘1’ or ‘2 or more’) are more likely to use a modern or natural method than average, while the proportion of non-users among women who have never used abortion is 4.5% points above average. There seems to be little effect of progression from 1 to 2 or more abortions on modern or

natural method use (although non-use does increase by 3.9% points). It is striking that, of women who report having abortions in the sample, 59% have had 2 or more - highlighting the importance of abortion in the Moldovan fertility control regime (Sobotka 2003).

Only 36.4% of women in the analysis sample reported that they knew how to prevent HIV/AIDS. These women demonstrated a use of modern method 2.5% points above average. A substantial minority did not know how to avoid infection (15.9%) while a small proportion had not heard of AIDS (2.1%). Respondents who had not heard of AIDS demonstrate and above average use of natural (0.8% points above average) or no contraceptive (13.4% points above average respectively).

2.6.2: Results from regression modelling

Random effects

During the model building procedure a null model containing only an intercept was first specified. The random intercept for natural and non-use were significant at the 5% level and there was also a significant negative covariance. The negative covariance indicates that, given no fixed effects, areas with a high (low) proportion of women using natural method have a low (high) proportion using no method.

The estimated variance-covariance matrices are presented in Tables 2.6.2 and 2.6.3 for the main effects and interaction effects models respectively, after the addition of the fixed effects terms. The variance for natural method use is robust to the addition of fixed effects, and remains reasonably large. This indicates systematic unexplained variation in the probability of natural method use between PSUs. This is consistent across the main and interaction models. The random intercepts for non-use in both main and interaction models are small and the lower limits of the credible intervals are close to zero. The covariances for both models are non-significant, since in both cases the credible intervals overlap zero.

Table 2.6.2: Estimated between PSU variance-covariance matrix for main effects model (no fixed effect interactions)

Parameter		95 % credible interval for parameter	
Natural method, $v_j^{(1)}$	0.084	0.030 -	0.161
Non-use, $v_j^{(2)}$	0.017	0.004 -	0.066
Covariance, $\mathrm{cov}(v_j^1, v_j^2)$	-0.017	-0.048 -	0.039

Model estimated using 80000 MCMC samples with 5000 burn-in. Starting values for MCMC from 2nd order PQL (RIGLS).

Table 2.6.3: Estimated between PSU variance-covariance matrix for interaction effects model

Parameter		95 % credible interval for parameter	
Natural method, $v_j^{(1)}$	0.099	0.036 -	0.191
Non-use, $v_j^{(2)}$	0.027	0.004 -	0.094
Covariance, $\mathrm{cov}(v_j^1, v_j^2)$	-0.002	-0.047 -	0.063

Note: Model estimated using 80000 MCMC samples with 5000 burn-in. Starting values for MCMC from 2nd order PQL (RIGLS).

Random slopes for asset wealth and family planning programme variables are not significant. This indicates that the effect of wealth and family planning programme is homogenous between PSUs.

The mean FP media exposure score is not significant at the 5% level. Clearly some PSU influence in the form of social networking may exist within the unexplained variance presented in Tables 2.6.2 and 2.6.3. However, these effects are confounded by other PSU level influences (such as interviewer effects), and the magnitude of any social influence cannot be quantified.

Fixed effects

The estimated coefficients for the main effects model are presented in Table 2.6.4.

Table 2.6.4: Estimated coefficients with standard errors of the main effect multilevel model for natural method and non-use

	Natural method				Non-use			
	$\hat{\beta}(1)$	SE $[\hat{\beta}(1)]$			$\hat{\beta}(2)$	SE $[\hat{\beta}(2)]$		
Intercept	-0.450	0.151			-2.035	0.164		
Demographic								
Age Category (ref= 35+)								
25-34	-0.498	0.097	*	*	-0.501	0.107	*	*
15-24	-0.445	0.145	*	*	-0.386	0.145	*	*
Parity (Number of living children, ref.=2)								
Nulliparous	0.516	0.181	*	*	2.042	0.167	*	*
1	0.004	0.103			0.525	0.106	*	*
3 or more	0.051	0.097			-0.238	0.113	*	
Has had birth in last year (ref.=No)								
Yes	1.227	0.152	*	*	-0.079	0.173		
Highest level of education (ref.= Secondary or below)								
Higher	-0.040	0.091			-0.375	0.092	*	*
Ethnicity (ref.= 'Moldovan')								
Romanian	-0.303	0.252			0.030	0.243		
Ukrainian	-0.084	0.130			-0.282	0.134	*	
Russian	-0.007	0.140			-0.321	0.140	*	
Gagauzan	0.010	0.201			0.201	0.200		
Bulgarian	0.538	0.220	*		0.013	0.250		
Other	0.124	0.310			0.362	0.307		
Access to services								
Region of residence (ref.=Chisinau)								
North	0.403	0.111	*	*	0.100	0.105		
Center	0.329	0.122	*	*	0.269	0.115	*	
South	0.173	0.133			0.210	0.125		
Type of residence (ref.=Urban)								
Rural	0.366	0.090	*	*	0.103	0.090		
Exposure to risk of pregnancy								
Fecundity (ref.= fecund)								
Amenorrheic, pregnant	0.372	0.169	*		3.005	0.158	*	*
Infecund, menopausal	0.442	0.167	*	*	4.704	0.139	*	*
Marital Status (ref.=currently married)								
Never Married	-0.521	0.195	*	*	0.437	0.162	*	*
Formerly married	-0.904	0.216	*	*	1.942	0.127	*	*
Has been active within last 4 weeks (ref.=Yes)								
No/Unsure	-0.232	0.098	*		1.550	0.087	*	*

	Natural method				Non-use			
	$\hat{\beta}(1)$	SE $[\hat{\beta}(1)]$			$\hat{\beta}(2)$	SE $[\hat{\beta}(2)]$		
Asset wealth (ref.=Poor)								
Medium	-0.114	0.082			0.018	0.083		
Rich	-0.276	0.091	*	*	-0.166	0.097		
Desire for future fertility (ref.=Wants no more)								
Wants within 2 years	0.055	0.143			1.027	0.135	*	*
Wants, 2+ years	-0.163	0.127			-0.598	0.134	*	*
Wants, unsure of timing	0.141	0.168			-0.469	0.161	*	*
Undecided	0.028	0.203			-0.266	0.216		
Can have no more	-2.529	0.258	*	*	-1.436	0.152	*	*
Impact of family planning programme								
Exposure to FP through media (ref.= Low)								
Medium	-0.204	0.089	*		-0.282	0.090	*	*
High	-0.206	0.083	*		-0.401	0.087	*	*
Last contraceptive discontinued (ref.= No discontinuation within past 5 years)								
Modern	-0.206	0.092	*		1.033	0.093	*	*
Natural	0.002	0.091			0.606	0.101	*	*
Knows how to avoid AIDS (ref.= Yes)								
No	0.122	0.105			0.386	0.106	*	*
Unsure	0.059	0.079			0.011	0.082		
Has not heard of AIDS	0.082	0.262			0.620	0.267	*	
Use of induced abortion (ref=None.)								
One	-0.103	0.093			-0.508	0.104	*	*
Two or more	-0.099	0.089			-0.276	0.096	*	*

Notes:
Reference category for response variable is modern method use
* denotes significance at 5% level ($p<0.05$)
** denotes significance at 1% level ($p<0.01$)
Coefficients estimated using 80000 MCMC samples with 5000 chain burn-in. Starting values for MCMC from 2nd order PQL (RIGLS).

Significant interactions were detected between age with FP media exposure, region with last method discontinued, and age with last method discontinued. The estimated coefficients from the interaction model are presented in Table 2.6.5.

Table 2.6.5: Estimated coefficients with standard errors of the interaction multilevel model for natural method and non-use

		Natural method				Non-use			
		$\hat{\beta}(1)$	SE $[\hat{\beta}(1)]$			$\hat{\beta}(2)$	SE $[\hat{\beta}(2)]$		
	Intercept	-0.480	0.173			-2.148	0.188		
	Demographic								
†	Age Category (ref= 35+)								
	25-34	-0.739	0.159	*	*	-0.203	0.174		
	15-24	-0.426	0.200	*		0.400	0.199	*	
	Parity (Number of living children, ref.=2)								
	Nulliparous	0.542	0.184	*	*	1.995	0.169	*	*
	1	0.008	0.104			0.543	0.107	*	*
	3 or more	0.046	0.098			-0.197	0.114		
	Has had birth in last year (ref.=No)								
	Yes	1.248	0.153	*	*	-0.073	0.173		
	Highest level of education (ref.= Secondary or below)								
	Higher	-0.048	0.092			-0.372	0.093	*	*
	Ethnicity (ref.= 'Moldovan')								
	Romanian	-0.278	0.252			0.021	0.244		
	Ukrainian	-0.079	0.131			-0.300	0.135	*	
	Russian	-0.016	0.140			-0.329	0.141	*	
	Gagauzan	0.000	0.202			0.223	0.204		
	Bulgarian	0.561	0.221	*		0.065	0.247		
	Other	0.191	0.309			0.369	0.305		
	Access to services								
†	Region of residence (ref.=Chisinau)								
	North	0.579	0.143	*	*	-0.174	0.138		
	Center	0.359	0.155	*		0.017	0.149		
	South	0.251	0.169			-0.159	0.164		
	Type of residence (ref.=Urban)								
	Rural	0.377	0.091	*	*	0.108	0.091		
	Exposure to risk of pregnancy								
	Fecundity (ref.= fecund)								
	Amenorrheic, pregnant	0.363	0.170	*		3.065	0.159	*	*
	Infecund, menopausal	0.404	0.168	*		4.874	0.147	*	*
	Marital Status (ref.=currently married)								
	Never Married	-0.529	0.194	*	*	0.450	0.162	*	*
	Formerly married	-0.893	0.215	*	*	2.049	0.130	*	*
	Has been active within last 4 weeks (ref.=Yes)								
	No/Unsure	-0.220	0.098	*		1.541	0.087	*	*

Cont.

	Natural method				Non-use			
	$\hat{\beta}(1)$	SE $[\hat{\beta}(1)]$			$\hat{\beta}(2)$	SE $[\hat{\beta}(2)]$		
Asset wealth (ref.=Poor)								
Medium	-0.113	0.082			0.037	0.084		
Rich	-0.268	0.091	*	*	-0.152	0.097		
Desire for future fertility (ref.=Wants no more)								
Wants within 2 years	0.056	0.144			1.026	0.136	*	*
Wants, 2+ years	-0.180	0.127			-0.591	0.135	*	*
Wants, unsure of timing	0.137	0.169			-0.445	0.163	*	*
Undecided	0.031	0.203			-0.227	0.217		
Can have no more	-2.536	0.258	*	*	-1.425	0.153	*	*
Impact of family planning programme								
† Exposure to FP through media (ref.= Low)								
Medium	-0.276	0.132	*		-0.174	0.141		
High	-0.201	0.116			-0.196	0.127		
† Last contraceptive discontinued (ref.= No discontinuation within past 5 years)								
Modern	-0.212	0.198			0.877	0.194	*	*
Natural	0.035	0.220			0.854	0.235	*	*
Knows how to avoid AIDS (ref.= Yes)								
No	0.109	0.105			0.359	0.107	*	*
Unsure	0.057	0.080			0.009	0.082		
Has not heard of AIDS	0.094	0.264			0.682	0.271	*	
Use of induced abortion (ref=None.)								
One	-0.108	0.094			-0.538	0.105	*	*
Two or more	-0.093	0.090			-0.305	0.097	*	*
Age x Exposure to FP media								
25-34 x Medium	0.166	0.201			0.000	0.213		
25-34 x High	0.013	0.184			-0.182	0.202		
15-24 x Medium	0.015	0.225			-0.523	0.218	*	
15-24 x High	-0.126	0.214			-0.774	0.214	*	*
Region x Last contraceptive discontinued								
North x Modern	-0.109	0.233			0.701	0.224	*	*
Center x Modern	-0.101	0.250			0.386	0.238		
South x Modern	-0.047	0.267			1.059	0.244	*	*
North x Natural	-0.653	0.236	*	*	0.418	0.259		
Center x Natural	-0.054	0.243			0.636	0.264	*	
South x Natural	-0.286	0.257			0.342	0.282		
Age x Last contraceptive method discontinued								
25-34 x Modern	0.237	0.207			-0.371	0.209		
25-34 x Natural	0.531	0.209	*		-0.699	0.233	*	*
15-24 x Modern	0.130	0.246			-0.611	0.228	*	*
15-24 x Natural	0.177	0.239			-1.166	0.246	*	*

Notes:

Reference category for response variable is modern method use
* denotes significance at 5% level (p<0.05)
** denotes significance at 1% level (p<0.01)
Coefficients estimated using 80000 MCMC samples with 5000 chain burn-in. Starting values for MCMC from 2nd order PQL (RIGLS).
† denotes interaction effect

Retherford and Choe (1993) note that the use of odds ratios in multinomial models can produce ambiguous interpretation and that predicted probabilities provide a more definitive interpretation. Predicted probabilities also provide a more straightforward interpretation of interaction effects.

Predicted probabilities are presented for the model with main effects in Table 2.6.6. The interaction effect model is described in Table 2.6.7, with separate tables for main effects, age with FP media exposure, region with last method discontinued, and age with last method discontinued. The effect of interactions between categorical variables is captured by the manipulation of each main effect in turn, while holding the other variable at their baseline values. The exception to this is that the variable 'desire for more children' is set to 'Wants within the next 2 years' in order to generate probabilities of non-use of sufficient size to allow meaningful interpretation. Predicted probabilities are in all cases median predicted probabilities.

Table 2.6.6: Predicted probabilities for the main effects model.

	Predicted probability		
	Modern	Natural	Non-use
Demographic			
Age Category (ref= 35+)	0.49	0.33	0.18
25-34	0.61	0.25	0.14
15-24	0.60	0.26	0.15
Parity (Number of living children			
Nulliparous	0.20	0.23	0.57
1	0.44	0.29	0.27
2 (reference)	0.49	0.33	0.18
3 or more	0.50	0.36	0.14
Has had birth in last year (ref.=No)	0.49	0.33	0.18
Yes	0.28	0.63	0.09
Highest level of education (ref.= Secondary or below)	0.49	0.33	0.18
Higher	0.53	0.34	0.13
Ethnicity (ref.= 'Moldovan')	0.49	0.33	0.18
Romanian	0.53	0.27	0.20
Ukranian	0.53	0.33	0.15
Russian	0.52	0.35	0.14
Gagauzan	0.47	0.32	0.21
Bulgarian	0.40	0.46	0.15
Other	0.44	0.33	0.23
Region of residence (ref.=Chisinau)	0.49	0.33	0.18
North	0.41	0.42	0.17
Center	0.41	0.39	0.20
South	0.44	0.36	0.20
Type of residence (ref.=Urban)	0.49	0.33	0.18
Rural	0.42	0.41	0.17
Exposure to risk of pregnancy			
Fecundity (ref.= fecund)	0.49	0.33	0.18
Amenorrheic, Pregnant	0.11	0.10	0.79
Infecund, menopausal	0.02	0.02	0.95
Marital Status (ref.=currently married)	0.49	0.33	0.18
Never Married	0.51	0.20	0.29
Formerly married	0.26	0.07	0.67
Has been active within last 4 weeks (ref.=Yes)	0.49	0.33	0.18
No/Unsure	0.31	0.16	0.53

	Modern	Natural	Non-use
Asset wealth (ref.=Poor)	0.49	0.33	0.18
Medium	0.51	0.30	0.19
Rich	0.55	0.28	0.17
Desire for future fertility (ref.=Wants no more)	0.57	0.36	0.07
Wants within 2 years	0.49	0.33	0.18
Wants, 2+ years	0.62	0.34	0.04
Wants, unsure of timing	0.55	0.40	0.05
Undecided	0.57	0.37	0.06
Can have no more	0.92	0.05	0.03
Impact of family planning programme			
Exposure to FP through media (ref.= Low)	0.49	0.33	0.18
Medium	0.55	0.30	0.15
High	0.56	0.31	0.14
Last contraceptive discontinued (ref.= No discontinuation within past 5 years)	0.49	0.33	0.18
Modern	0.39	0.21	0.40
Natural	0.43	0.29	0.29
Knows how to avoid AIDS (ref.= Yes)	0.49	0.33	0.18
No	0.44	0.33	0.23
Unsure	0.48	0.34	0.18
Has not heard of AIDS	0.41	0.30	0.28
Number of induced abortions (ref=None.)	0.49	0.33	0.18
One	0.55	0.33	0.12
Two or more	0.53	0.32	0.15

Table 2.6.7: Predicted probabilities for interaction models, including a) terms in no interaction, b) age and FP media exposure, c) Age and last method discontinued, d) region and last method discontinued.

a) Terms involved in no interactions

	Predicted probability		
Demographic	Modern	Natural	Non-use
Parity (Number of living children)			
Nulliparous	0.22	0.25	0.53
1	0.45	0.30	0.25
2 (reference)	0.51	0.33	0.16
3 or more	0.51	0.35	0.14
Has had birth in last year (ref.=No)	0.51	0.33	0.16
Yes	0.28	0.64	0.08
Highest level of education (ref.= Secondary or below)	0.51	0.33	0.16
Higher	0.54	0.34	0.12
Ethnicity (ref.= 'Moldovan')	0.51	0.33	0.16
Romanian	0.55	0.27	0.18
Ukranian	0.54	0.33	0.13
Russian	0.53	0.34	0.12
Gagauzan	0.49	0.32	0.20
Bulgarian	0.40	0.46	0.14
Other	0.44	0.35	0.21
Type of residence (ref.=Urban)	0.51	0.33	0.16
Rural	0.43	0.41	0.16
Exposure to risk of pregnancy			
Fecundity (ref.= fecund)	0.51	0.33	0.16
Amenorrheic, pregnant	0.11	0.11	0.78
Infecund, menopausal	0.02	0.02	0.96
Marital Status (ref.=currently married)	0.51	0.33	0.16
Never Married	0.53	0.20	0.27
Formerly married	0.26	0.07	0.67
Has been active within last 4 weeks (ref.=Yes)	0.51	0.33	0.16
No/Unsure	0.33	0.17	0.50
Asset wealth (ref.=Poor)	0.51	0.33	0.16
Medium	0.52	0.30	0.18
Rich	0.56	0.28	0.16
Desire for future fertility (ref.=Wants no more)	0.58	0.36	0.07
Wants within 2 years	0.51	0.33	0.16
Wants, 2+ years	0.63	0.33	0.04
Wants, unsure of timing	0.56	0.40	0.04
Undecided	0.58	0.37	0.05
Can have no more	0.93	0.05	0.03

	Modern	Natural	Non-use
Impact of family planning programme			
Knows how to avoid AIDS (ref.= Yes)	0.51	0.33	0.16
No	0.46	0.33	0.21
Unsure	0.49	0.34	0.16
Has not heard of AIDS	0.42	0.30	0.27
Number of induced abortions (ref=None.)	0.51	0.33	0.16
One	0.56	0.33	0.11
Two or more	0.54	0.32	0.13

b) Age and FP media exposure

Age x FP media exposure	Modern	Natural	Non-use
35-49			
Low	0.51	0.33	0.16
Medium	0.56	0.28	0.15
High	0.55	0.30	0.15
25-34			
Low	0.63	0.20	0.17
Medium	0.67	0.19	0.15
High	0.69	0.18	0.13
15-24			
Low	0.52	0.22	0.25
Medium	0.64	0.21	0.15
High	0.67	0.21	0.12

c) Age and Last method discontinued

Age x Last method discontinued	Modern	Natural	Non-use
35-49			
None	0.51	0.33	0.16
Modern	0.43	0.23	0.34
Natural	0.41	0.28	0.31
25-34			
None	0.63	0.20	0.17
Modern	0.57	0.18	0.25
Natural	0.54	0.30	0.17
15-24			
None	0.52	0.22	0.25
Modern	0.49	0.19	0.31
Natural	0.53	0.28	0.19

d) Region and Last method discontinued

Region x Last Method discontinued	Modern	Natural	Non-use
None			
Chisinau	0.51	0.33	0.16
North	0.41	0.48	0.11
Center	0.44	0.41	0.15
South	0.47	0.40	0.13
Modern			
Chisinau	0.43	0.23	0.34
North	0.32	0.27	0.42
Center	0.35	0.24	0.41
South	0.28	0.18	0.54
Natural			
Chisinau	0.41	0.28	0.31
North	0.38	0.24	0.37
Center	0.30	0.27	0.43
South	0.39	0.25	0.36

The first research hypothesis was that natural method use would be concentrated among women of lower economic status. The results of modelling support the research hypothesis. Women who are asset poor have the highest probability of natural method use in both the main and interaction effect models. In contrast, women who are asset rich have the lowest probability of natural method use. Increases in asset wealth are associated with a declining probability of natural method use, although the change in probability is small at only 5% points in both models.

Probability of modern method use is the lowest among poor women and increases monotonically with higher categories of asset wealth. The increase in predicted probability is 6% points and 5% points from asset poor to asset rich in the main and interaction effect models respectively. Non-use shows no monotonic trend, but the probability of non-use for asset rich women is lower than that of either asset poor or medium wealth women in both models. These results support the hypothesis that the financial cost of contraceptive use influences method choice but the magnitude of the effect is small.

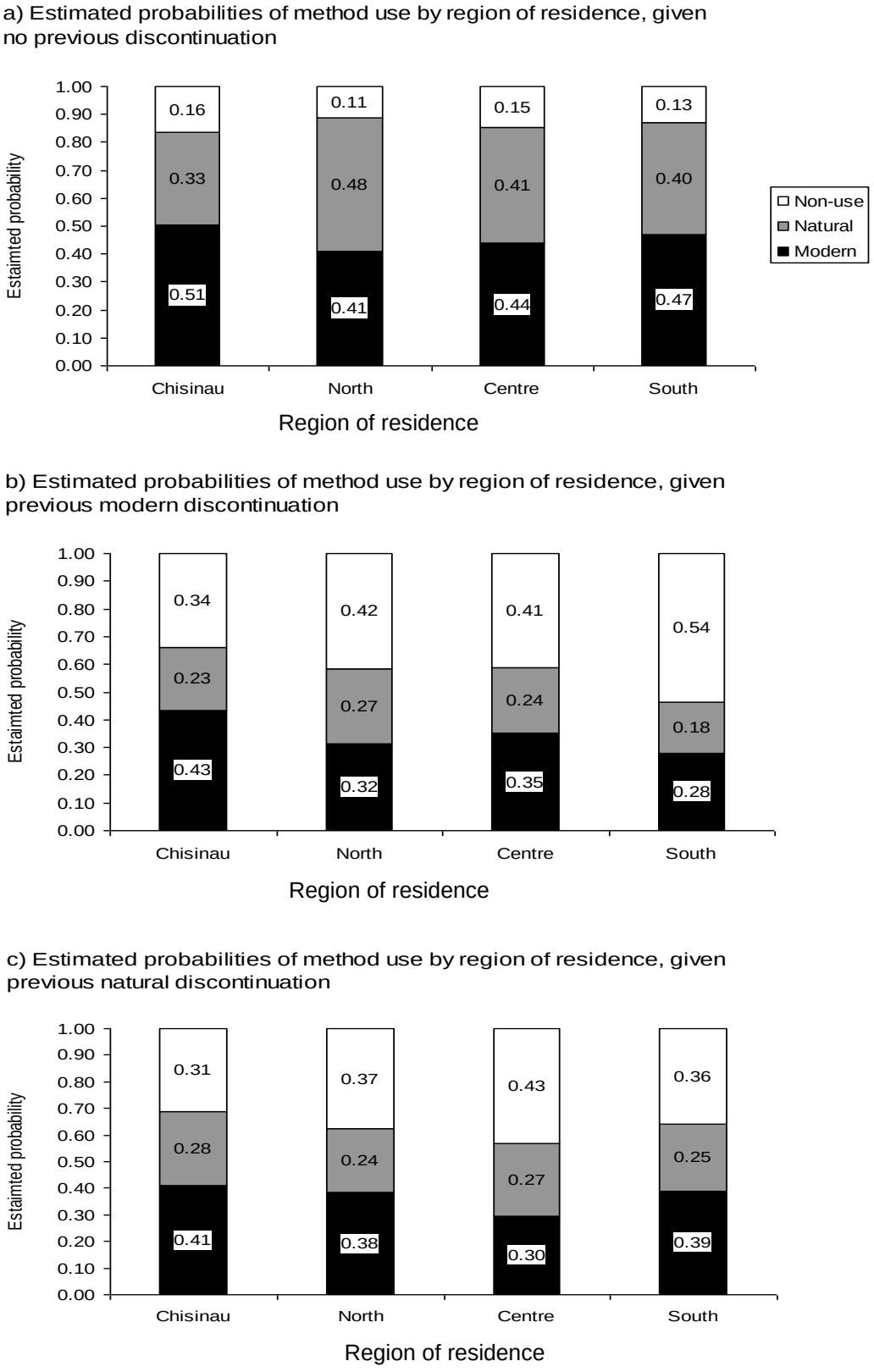
The second research hypothesis was that lack of access to FP services would be associated with greater use of natural methods. Four variables were used to test this hypothesis. The individual level variable directly measuring access to an FP clinic was not significant in the modelling procedure. Further, the PSU level variable of the proportion accessing an FP clinic was not significant, indicating that no direct effect of accessibility is significant.

Indirect variables measuring access (rural/urban residence and region) were significant in the main and interaction effects models. Women in rural areas demonstrate a substantially higher probability of natural method use (8% points) for both the main and interaction effects models and a correspondingly lower probability of modern method use compared to urban residents (7% points and 8% points). Probability of non-use differs by 1% point for the main effect model and is identical for the interaction effect - indicating no substantial urban/rural differential in contraceptive use.

In the main effects model, region of residence is significant at the 5% level. Chisinau has the lowest probability of natural method use, and the regions North, Center and South having probabilities of natural method use 9% points, 6% points and 3% points higher respectively. Modern method use is correspondingly the highest in Chisinau and lower in all other regions (8% points, 8% points and 5% points lower for North, Center and South respectively). It is also noted that there is little variation in the levels of non-use, with only a 3% point difference between regions with the highest non-use (Center and South) and the region with the lowest non-use (North).

There is a significant interaction between region of residence and last method discontinued. This indicates differences in discontinuation patterns in different geographic regions. In general, the regions North, Center and South have a higher probability of natural method use than Chisinau (see Figure 2.6.1).

Figure 2.6.1: Predicted probabilities of method use by region and given a) no previous contraceptive discontinuation, b) previous modern method discontinuation and c) previous natural method discontinuation, interaction effects model



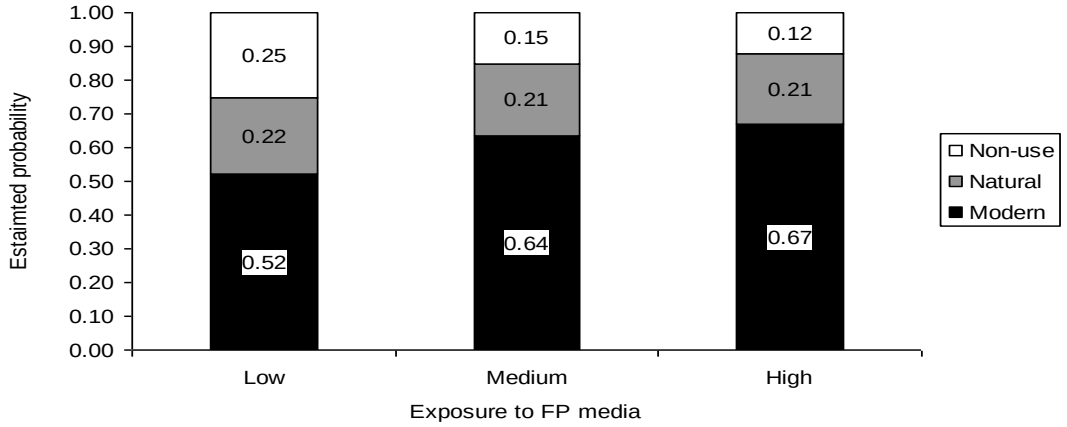
The impact of NPRH is assessed through three variables; FP media exposure, contraceptive discontinuation and abortion history.

The main effects model presented in Table 2.6.4 shows a negative effect of higher FP media exposure on the probability of natural method use, and also on the probability of non-use. The size of the is small effect (based on the predicted probabilities presented in Table 2.6.6), with the probability of natural method use 3% points and 2% points lower in the categories medium and high exposure respectively than in the baseline category. Non-use is 3% points and 4% points lower in the medium and high exposure categories.

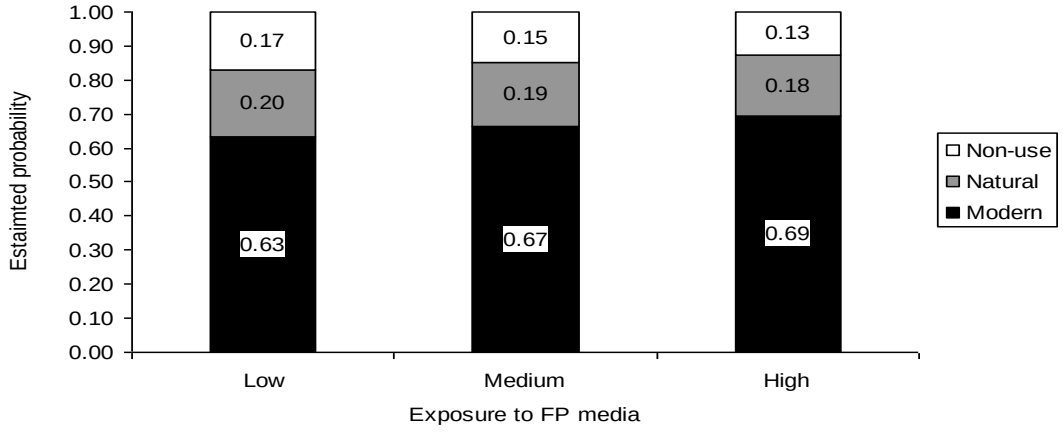
In the interaction model, the effect of FP media is dependent on the age of the respondent (see Figure 2.5.2). There is little impact of FP media on natural method use across age groups, and the major effect is on modern method use. For the 15-24 age group the difference between low to high FP exposure is 15% points. This effect attenuates with increasing age of the respondent. In the 25-34 age group the change in probability of modern method use is 6% points, and 4% points in the 35-49 age group. The contrasting effect is observed for non-use. In the age group 15-24, the difference in predicted probabilities between the low and high FP exposure is 13% points. This falls to 4% points and 1% point for the 25-34 and 35-49 age groups respectively. These results indicate that the FP media messages of NPRH have the greatest effects on younger women and a more limited effect at older ages.

Figure 2.6.2: Predicted probabilities of method use by category of FP media exposure for three age groups a) 15-24, b) 25-34 and c)35-49

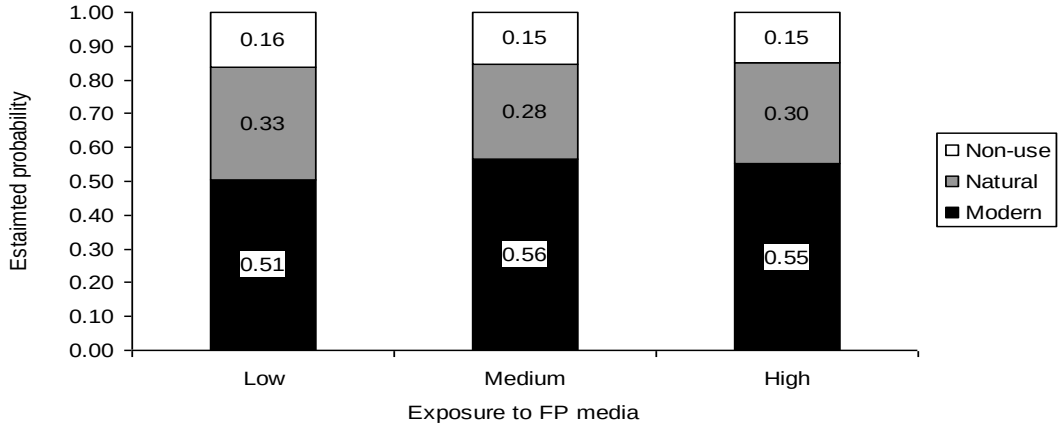
a) Estimated probabilities of method use by category of FP media exposure, given age 15-24



b) Estimated probabilities of method use by category of FP media exposure, given age 25-34



c) Estimated probabilities of method use by category of FP media exposure, given age 35-49



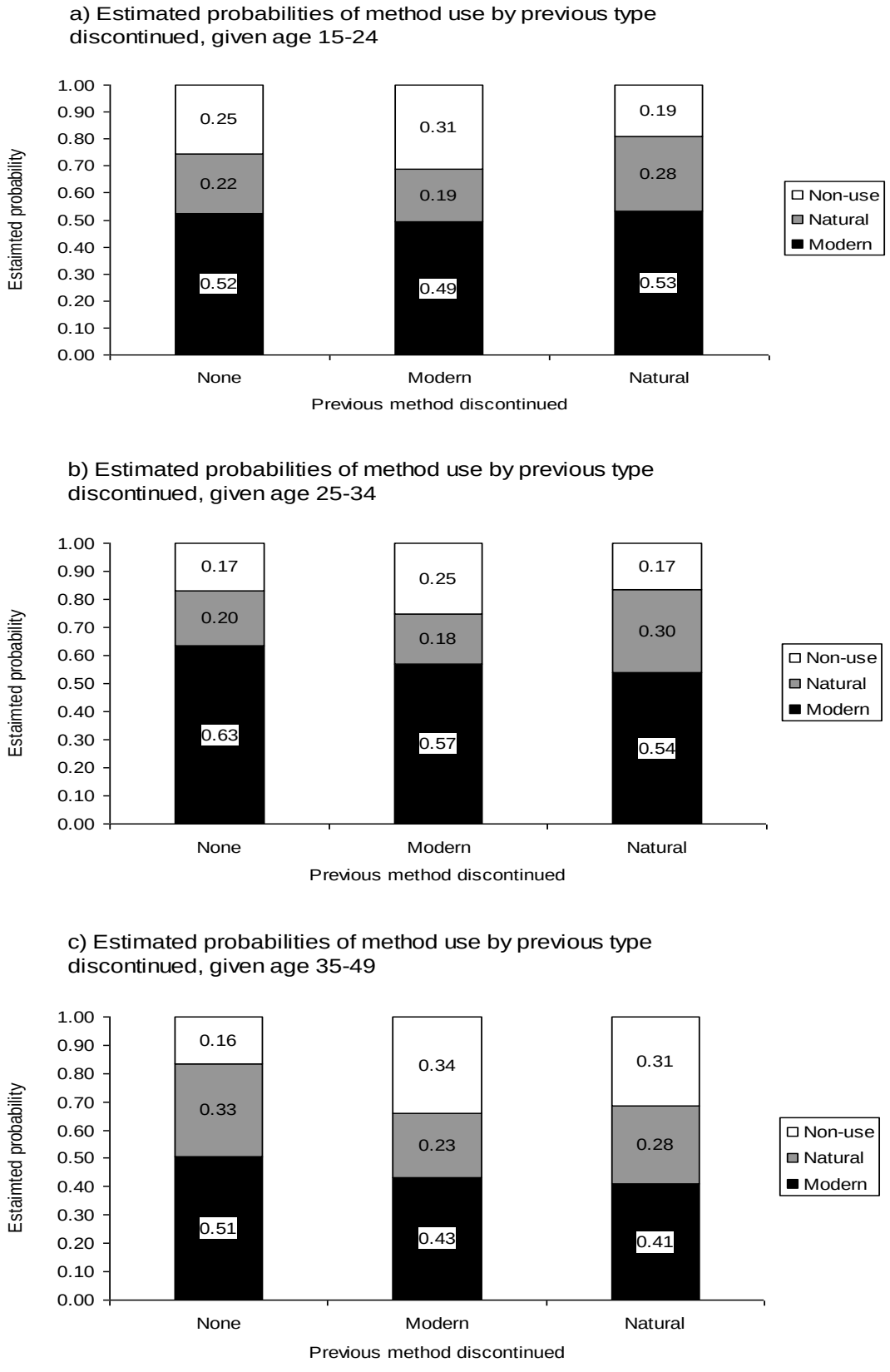
From the main effects model (Table 2.6.4 and Table 2.6.6), the major effect of previous contraceptive discontinuation is increase the probability of non-use of 22% points and 11% points for a previous modern and natural discontinuation respectively. This is indicative that contraceptive discontinuation is largely associated with non-use, rather than switching to another contraceptive method. The probability of current natural method use given a natural discontinuation is 4% points lower than the probability for women who have not discontinued, providing only limited evidence of recurrent natural method use - unlike Kost (1993). The probability of current natural method use given a previous modern discontinuation is 12% points lower than baseline and 7% points lower than women who had discontinued a natural method. This demonstrates that there is little modern to natural switching in Moldova.

As noted in Figure 2.6.1 the effect of previous discontinuation is dependent on the region of residence. Non-use is considerably higher among women who have previously discontinued a contraceptive. This effect is particularly pronounced in Chisinau. For women who have discontinued a modern method (Figure 2.6.1, plot b), the predicted probability of non-use is 8% points, 7% points and 20% points higher in the North, Center and South respectively. For women who discontinued a natural method (Figure 2.6.1, plot c) the differences are 6% points, 12% points and 5% points. This is indicative of far greater contraceptive abandonment in regions outside of the capital. For women who had previously discontinued a natural contraceptive, the probabilities of current modern method use (that is, a switch in contraceptive method) are 3% points, 11% points and 2% points lower in the North, Center and South respectively compared to Chisinau. This indicates lower levels of contraceptive switching from a natural to modern method outside of the capital region.

The effect of the previous method discontinued is also dependent on the current age of the respondent (see Figure 2.6.3). Women in the 35-49 age group have the lowest probability of current modern method use given a previous natural method discontinuation (41%). The probability of modern method use is 13% points and 12% points higher in the 25-34 and 15-24 age groups respectively. This indicates a greater

reluctance among older women to switch from natural to modern methods. In contrast, the probability of current natural method use given a previous modern method discontinuation is the highest in the 35-49 age group. This indicates that switching from modern method use to natural method use is most common at older ages.

Figure 2.6.3: Predicted probabilities of method use by previous method discontinuation for women of age a) 15-24, b)25-34 c) 35-49.



In both the main and interaction effects models, there is little effect of induced abortion use on probability of natural method (Tables 2.6.6 and 2.6.7). Compared to the baseline category (no abortion use), women with one abortion have probability of modern method use 6% points and 5% points higher in the main and interaction effects models respectively. This is matched by a fall in the probability of non-use by 5% points for both the main and interaction effects models. For women with 2 or more abortions, the probability of modern method use is 4% points and 3% points higher compared to baseline for the main and interaction effects model.

The effect of NPAIDS on natural method use is small in both the main effect and interaction models. The probability of natural method use is lowest among women who had not heard of AIDS (30% in the main effects and interaction effects models). Women who 'Knew how to avoid AIDS' have a predicted probability of natural method use 3% points higher than women who had not heard of AIDS for the both main effect and interaction effect models, while women who were unsure how to avoid AIDS have a predicted probability of natural method use 4% points higher than women who had not heard of AIDS (for both main and interaction effects models). This result contradicts the initial expectation that AIDS awareness would be associated with a low probability of natural method use.

AIDS awareness has a more substantial effect on the probability of non-use. Women who had not heard of AIDS have predicted probabilities of non-use 10% points and 11% points higher than women who knew how to avoid AIDS for the main effect and interaction effect models respectively. A similar effect is observed for women who did not know how to prevent AIDS, with predicted probabilities of non-use for the main effects and interaction effects models 5% points higher than baseline. Women who were aware of AIDS but unsure how to prevent infection have predicted probability of non-use equal to that of the baseline category for both models.

Many modern methods offer no protection from HIV/AIDS transmission, since only barrier methods (such as condom) afford any protective effect. To examine the effect of NPAIDS specifically on the use of barrier methods, the interaction model

was refitted to incorporate barrier modern methods[5] as a new category in the response variable. Explanatory variables used are those of the interaction model (Table 2.6.5). An abridged model output is presented in Table 2.6.8, showing the only the variable measuring the effect of AIDS knowledge on contraceptive choice. There is a significant effect of AIDS awareness on the use of barrier methods. Compared to the baseline category ('Yes'), women who did not know how to prevent AIDS were 2.8% points less likely to use a barrier method, while women who had never heard of AIDS had a negligible probability of barrier method use. It is noted however that the highest probability of barrier contraceptive use is below 8% (Knows how to avoid AIDS). This highlights the minor role that barrier contraceptives play in the Moldovan family planning regime and the lack of protection from AIDS currently experienced by Moldovan women.

[5] The distribution of respondents between this new response variable is:
Modern method- non barrier (baseline category): 31.1% (n=1881)
Natural method: 21.1% (n=1275)
Non-use: 38.6% (n=2333)
Modern Method- Condom: 9.1% (n=550)

Table 2.6.8: a) Abridged regression modelling results incorporating condom as a response category, MDHS 2005 b) associated predicted probabilities

a)

Knows how to avoid AIDS	Natural method		Non-use		Barrier	
	Coeff.	(SE)	Coeff.	(SE)	Coeff.	(SE)
Yes (Ref.)	-	-	-	-	-	-
No	0.044	0.117	0.282**	0.127	-0.389**	0.169
Unsure	0.034	0.089	-0.007	0.097	-0.046	0.121
Has not heard of AIDS	-0.023	0.297	0.523	0.322	-1.807	1.051

b)

Knows how to avoid AIDS	Modern (non-barrier)	Natural	Non-use	Barrier
Yes	0.419	0.309	0.194	0.078
No	0.397	0.307	0.245	0.050
Unsure	0.417	0.318	0.192	0.074
Has not heard of AIDS	0.395	0.285	0.308	0.012

Notes;
** p<0.01

Predicted probabilities are generated when all dummy variables are set to their baseline category, except for desire for future fertility which is set to 'Wants within next 2 years'.

N=6039

Demographic confounding factors

Within the main effects model, the effect of age on probability of non-use is statistically significant. Higher age is associated with a higher probability of natural method use. The youngest age group (15-24) and the 25-34 age group have a probability of natural method use of 26% and 25% respectively, while the probability of natural method use is 6% points and 7% points higher among women aged 35 or over. Non-use is also highest in the 35-49 age group, with the probability of non-use 3% points and 4% points lower in the 15-24 and 25-34 age groups respectively. Probability of modern method use is correspondingly lower in the 35-49 age group, with the probability 11% points and 12% points higher among the 15-24 and 25-34 age groups respectively.

In the interaction effects model, there were two significant interactions with age. Older women are less likely to use a modern contraceptive given higher levels of FP media exposure than younger women. A similar effect is observed on the probability of non-use. Age also influences the effect of previous contraceptive discontinuation. At older ages, discontinuation of natural methods followed by current modern method use is more limited than among younger women. Older women are also more likely to abandon modern methods and resume natural method use.

Natural method use is common among higher parity women - women with 3 or more children are 13% points (main effects model) and 10% points (interaction effects model) more likely to use a natural method than those who are nulliparous. Modern method use is also associated with higher parity (women with 3 or more children are more likely to use modern methods than nulliparous women by 30% points for the main effects model and 29% points for the interaction effects model). Nulliparous women have the highest probability of non-use 57% in the main effects and 53% in the interaction effects model.

The effect of having a recent birth on method choice is consistent with the results of Salway and Nurani (1998). Modern method use among recent mothers is 21% points and 23% points lower for the main and interaction effects models respectively than among women who have not experienced a recent birth. There is a reduced probability of non-use in the postpartum period, with women with a recent birth having a probability of non-use 9% points and 8% points lower than women who have not had a recent birth for the main and interaction effects models respectively. The effect on probability of natural method use is substantial, with a recent birth increasing the probability of natural method use by 30% points for the main effects model and 31% points for the interaction model.

The effect of education on natural method use is statistically non-significant (the credible interval overlaps zero). Education has a significant impact on non-use however. Compared to women with ‘secondary or lower’ education, women with

higher education have a probability of non-use 5% points lower in the main and 4% points lower in the interaction effects model. There is a corresponding increase in modern method use - women with higher education having predicted probabilities 4% points and 3% points greater than baseline in the main and interaction effects models.

Ethnicity was found to be statistically significant. However, 'Bulgarian' was the only significant dummy variable in both the main and interaction models for natural method use. Bulgarian women have a 13% point higher probability of natural method use than baseline (Moldovan) for the main and interaction models, and a corresponding 9% points and 11% points lower probability of modern method use for the main and interaction effect model. Additionally, for non-use Ukrainian women have statistically significantly lower probabilities of non-use than Moldovans (3% points for both models).

Fertility preferences.

Fertility preferences have a significant and substantial effect on contraceptive method choice. Women who want another birth within the next 2 years are most likely to use no method (11% points higher than the baseline category for the main effect model, 9% points higher in the interaction effect model). Modern method use is high in the categories 'wants, 2 or more years' and 'wants no more. ' Natural method use is highest in the categories 'wants, unsure of timing' and 'undecided.'

Exposure to risk of conception

There is a clear association between sexual activity and contraceptive use consistent with the expectations of Section 2.2.3. Women who report sexual activity within the past 4 weeks have a predicted probability of natural method use 17% points and 16% points higher than women who report no sexual activity for the main and interaction effects models respectively. A similar effect is observed for modern method use, with the probability of modern method use 18% higher among sexually active women for both the main and interaction effects models. Correspondingly the probability of non-use is lowest among women who report sexual activity within the

past 4 weeks - the probability of non-use 35% points and 34% points higher among women who report no sexual activity for the main and interaction models.

Never married women show lower overall contraceptive use than women currently in union - non-use is 11% points higher for both the main and interaction effects models. This is largely accounted for by a decline in natural method use, which falls by 13% points for both the main and interaction effects models, compared to a 2% point increase in modern method use (for both models). Formerly married women have substantially lower probabilities of natural method use than currently married women by 26% points for both the main and interaction effects models. There is a substantial increase in the probability of non-use among formerly married women. This amounts to 49% points in the main effects model, and 51% points in the interaction effects model.

Women who reported being 'fecund' are most likely to make use of modern contraception in both the main and interaction effect models. The use of either modern or natural methods by infecund women is negligible, and these women have a high probability of non-use (95% and 96% for the main and interaction models respectively). Natural method use is highest among currently fecund women (33% for both the main and interaction effects models). Women who are 'amenorrheic or pregnant' have a considerably lower probability of modern method use than 'fecund' women (38% points and 40% points in the main and interaction models respectively), which is largely accounted for by a substantial increase in the probability of non-use (61% points for the main effects model and 62% points for the interaction effects model).

2.7: Conclusion, evaluation and policy recommendations

Four research hypotheses were tested in this analysis. The first research hypothesis was that natural method use would be greatest among women in the lowest economic groups. The results support the hypothesis, with greater natural method use in the lowest asset wealth groups, and a fall in the probability of natural method

use with increasing wealth. The magnitude of this effect was small however, which indicates that the introduction of subsidies into contraceptive programmes may only have a limited impact in increasing modern method use and reducing natural contraceptive use. This finding is consistent with Lewis (1986), who finds only a small effect of financial incentives on contraceptive use.

The second research hypothesis was that women in more isolated areas would make greater use of natural methods due to the prohibitive opportunity cost of modern method use. Urban/rural residence and region - indirect measures of isolation - were significant. The findings supported the research hypothesis, with natural method use higher in rural areas and regions outside of the capital region, Chisinau. In addition, switching from modern to natural method use is substantially lower outside of Chisinau, indicating a more limited effect of FP programmes outside of the capital region. This provides evidence of an effect of unequal service provision (MacLehose 2002), with women in more isolated areas less able to access modern methods through FP clinics.

The third research hypothesis was that FP media exposure would decrease natural method use. This hypothesis was designed to evaluate the impact of NPRH. Greater FP media exposure was associated with greater modern method use, and a reduction in the use of natural methods. However, the reduction of natural method use associated with greater media exposure attenuated with increasing age. This indicates that NPRH was effective at reaching younger women, although the impact among older women was substantially lower.

The fourth research hypothesis was that greater awareness of HIV/AIDS should be associated with a greater probability of modern method use, and a corresponding decrease in the use of natural and non-use. The results of the analysis supported this research hypothesis. Women with no awareness of AIDS had the highest probability of non-use and there was a greater probability of modern method use among women with greater awareness of HIV/AIDS. However, expanding the analysis to incorporate barrier contraceptives as a distinct category indicated that even given

the highest level of AIDS awareness, use of condoms in Moldova is very low. Clearly, while not all women who are natural method or non-users will take part in risky sexual behaviour, the low prevalence of condom use is worrying when combined with the limited knowledge of HIV/AIDS in Moldova (NCPM and ORC Macro 2006).

Discussion

The results indicate NPRH has had a positive impact, in contrast to some other Eastern European FP programmes (e.g. Carlson and Lamb 2001) and reduced reliance on natural methods. However, the effect of exposure to FP media showed a decline at higher ages. The probabilities of natural method use for all levels of FP media exposure were the highest above age 35, and the difference between low and high exposure was smallest for the 35+ age group. Older women also demonstrated the lowest propensity to switch to a modern method, preferring either resumption of less effective natural methods or contraceptive abandonment. This group of women at the end of their reproductive lives also often make use of induced abortion to stop any further fertility (Westoff 2005, Agadjanian 2002). By redirecting FP media to incorporate messages specifically targeting older women, FP programmes could have a substantial impact in reducing unwanted fertility and demand for induced abortion.

The low level of modern method uptake following abortion is a major policy concern. This analysis found that the number of abortions had a limited impact on natural contraceptive use. This has particular policy significance given the contribution of abortion to maternal death in Moldova (Comendant 2005). Existing post-abortion services and counselling are low quality (Comendant 2005), which can dissuade women from contraceptive use (Jain 1989, Bruce 1990, Steele *et al.* 1999). The use of abortion was particularly prevalent among older women (Westoff 2005, Agadjanian 2002). The improvement of post-abortion counselling could therefore improve maternal health outcomes and increase modern method use.

This study found considerable differences in switching behaviour by region of residence. Modern method use is substantially higher in Chisinau compared to all other regions. Further, women in Chisinau exhibited greater natural to modern contraceptive switching. Outside of Chisinau the tendency to abandon natural methods in favour of modern contraception was more limited. This may be due to a lack of FP services limiting the supply of modern methods and hence increasing reliance on natural methods (MacLehose 2002). By improving access to contraceptive services in rural areas, the uptake of modern methods in isolated areas could be improved.

Finally, condom use in Moldova is dismally low. Predictions from the model incorporating barrier methods indicated that the probability of condom use is less than 8% even among women who have the highest awareness of HIV/AIDS. Clearly, the spread of HIV/AIDS would require more than merely lack of HIV awareness and low condom use, since women are not at risk of contracting HIV in monogamous sexual relationships with an uninfected partner and practising other sex safe behaviours. Although the HIV/AIDS prevalence in Moldova is currently very low (NRCM and ORC Macro 2006) the Moldovan government has expressed concerns over a recent upward inflection in HIV/AIDS prevalence. Given the limited number of women in the DHS who were knew how to prevent HIV/AIDS (36%), the low level of condom use offers the potential for more rapid increases in HIV/AIDS prevalence. Tackling low awareness and condom use is a potential means of removing the conditions in which HIV/AIDS could spread rapidly.

Chapter 3: Contraceptive confidence and the timing of first birth in transitional Moldova

Abstract:

This analysis evaluates the effect of contraceptive confidence on the duration between marriage and first birth. The paper discusses the case of Moldova, a country with a high abortion rate. Differential trends in first birth timing by marriage cohort are also examined. Fertility behaviour in post-Socialist Moldova has undergone significant changes since 1991, with a trend towards later fertility. Data are taken from the 2005 Moldova Demographic and Health Survey, selecting 5377 women nulliparous at marriage. A piecewise constant hazard model is used to examine the effect of covariates on first birth timing. Results show evidence of a contraceptive confidence effect; low-confidence women (natural method users) having a longer interval between marriage and first birth than high confidence women (modern method users). Abortion use increases contraceptive confidence and accelerates first birth. The first birth interval is longer among post-1991 marriage cohorts, reflecting delayed fertility in the post-Socialist era. There is an increasing divergence in fertility behaviour, with delays in first birth greatest among the most highly educated.

Notes:

Findings from this paper are presented in a different form in the paper: Lyons-Amos, M.J., Durrant, G., Padmadas, S.S. 2012 *Contraceptive confidence and timing of first birth in Moldova*, which is under review in *Population Studies.* Results were presented 75th Annual Meeting of the Population Association of America, Dallas TX, and also 2009 British Society for Population Studies Annual Meeting (University of Sussex).

3.1 Introduction and motivation

This paper examines the influences on first birth timing in the Republic of Moldova. Specifically, the paper explores whether the contraceptive confidence hypothesis is applicable to the first birth interval. Keyfitz (1980) suggests that a key mechanism determining birth intervals is the availability and use of modern contraceptive techniques. Effective contraception enables women to compress births, with the assumption that future unwanted births are highly unlikely. In contrast, a woman using less effective contraception is forced to space her births to ensure that she is close to achieving her desired family size. Previous work has established this effect in Western populations (Ní Bhrolchaín 1988, Hionidou 1998). However, no previous analysis has examined the effect of contraceptive confidence on the first birth, due to the complexity of the determinants surrounding entry into motherhood (Ní Bhrolchaín 1988). This analysis extends the contraceptive confidence hypothesis to the first birth interval, hypothesising that lower confidence is associated with a longer interval between marriage and first birth. Moldova offers an excellent setting to evaluate the validity of this extension, due to the widespread persistence of natural method use side-by-side with use of highly effective modern methods within the country.

The widespread use of induced abortion in Moldova is a major constraint in testing the contraceptive confidence hypothesis: 46.2% of Moldovan women reported having had at least one abortion (author's calculations from Moldova Demographic and Health Survey, (MDHS) 2005). Despite recent declines, the use of abortion is still considered too high by the Moldovan government, and hence an important public health priority (NCPM and ORC Macro 2006). The combination of natural method use and induced abortion as a mechanism for fertility control in post-Socialist settings is well documented (Agadjanian 2002, Popov 1991, Popov *et al.* 1993, Sobotka 2003, Westoff 2005). The analysis of contraceptive confidence in this analysis therefore takes account of the important role of induced abortion in Moldova.

The second major contribution of this paper is to evaluate socioeconomic influences on birth timing. Since gaining independence in 1991, Moldova has undergone significant social and economic transitions which have influenced the demographic trends in the country (NCPM and ORC Macro 2006, Sobotka 2003). The timing of the first birth following marriage is sensitive to macro-economic conditions (Ní Bhrolchaín 1988). After independence the Moldovan Total Fertility Rate (TFR) fell to 1.3 children per woman in 2001, before increasing slightly to 1.7 in 2005 (NCPM and ORC Macro, 2006). Although overall parity progression rates have declined, a large part of the fertility decline in Moldova is accounted for by postponement of first births characterised by an increasing age at motherhood (Sobotka, 2003). This represents a shift in childbearing patterns in Moldova, where the traditional norm was that the interval between marriage and first birth was short. By examining the influences on the duration of the first birth interval, this analysis extends the understanding of some of the individual level influences on fertility behaviour in the Moldovan context.

The remainder of this paper is structured as follows. Section 2 identifies the relevant influences on first birth timings, and formulates research hypotheses based on existing literature. Section 3 examines the data available for this analysis, and discusses potential limitations. This section also defines the analysis sample. The potential explanatory variables are considered in section 4 and the methodology and modelling strategy are described in section 5. The results of modelling are presented in section 6. The results are summarised and discussed in section 7.

3.2: Theoretical motivation and research hypotheses

This section explains the contraceptive confidence hypothesis and considers the validity of application to the first birth interval. Two research hypotheses are presented. The effect of crisis and adjustment are also considered as explanations for changes in first birth behaviour in Moldova.

3.2.1: The effect of contraceptive confidence on birth timings

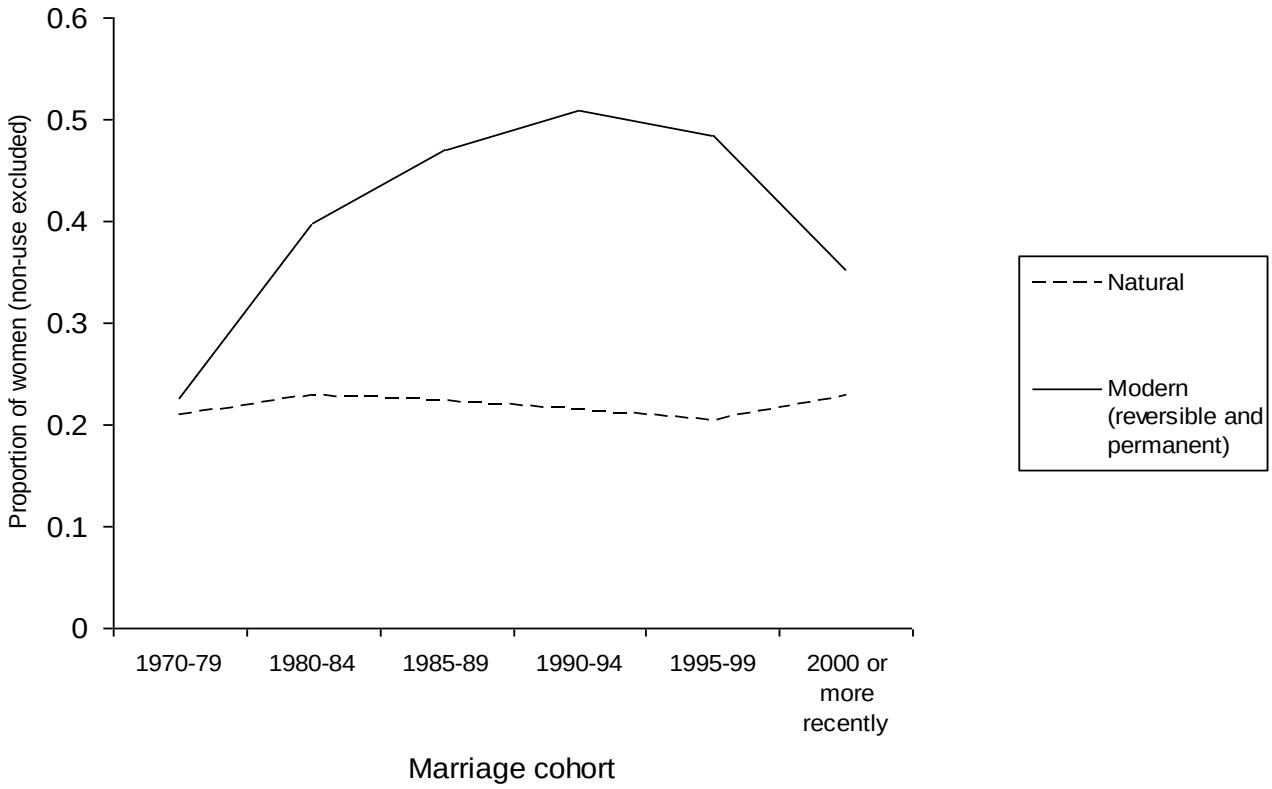
The contraceptive confidence hypothesis was proposed by Keyfitz (1980), and expanded by Ní Bhrolchaín (1988) and Keyfitz and Caswell (2005). Women using less effective contraceptive methods (such as natural methods) have lower levels of contraceptive confidence. High failure rates of natural methods mean that women can achieve their desired family size due to method failure alone (Ní Bhrolchaín, 1988). Low contraceptive confidence is associated with use of contraception throughout the reproductive life span. In contrast women using effective contraceptive methods (for example hormonal or clinically administered methods) have high contraceptive confidence due to the negligible incidence of contraceptive failure. These women can compress their reproduction into a shorter period and subsequently use effective contraception to prevent any further births (stopping behaviour), in order to take advantage of economies of scale in childcare or minimise career disruption (Ní Bhrolchaín 1988, 1986a, 1986b, 1985). The first research hypothesis is derived from this theoretical proposition:

Hypothesis 1: Natural method users will have longer intervals between marriage and first birth than modern method users.

The effect of contraceptive confidence on the first birth interval is more complicated than for the interval between births, due to external economic and social influences (Ní Bhrolchaín 1988, 1986a, 1986b, Witte and Wagner 1995). A number of other trends have led to changes in the pattern of first birth following marriage in Moldova, including the postponement of motherhood and increasing extra-marital fertility (Sobotka 2003). Before proceeding with the analysis, it needs to be established whether there is any potential effect of contraceptive confidence on the first birth interval. Figure 3.2.1 shows the share of current contraceptive method for each marriage cohort in the 2005 MDHS. The proportion of women using a natural method is relatively constant across marriage cohorts - even among recent cohorts, which use natural contraception from the start of their marriage. In contrast, the inverted-U shape for modern method use is indicative of stopping behaviour, since

women in the most recent marriage cohort are not using modern methods at the start of their reproductive lives but initiate contraceptive use later. (For older marriage cohorts, modern method use tends to diminish presumably due to potential infecundability). This pattern of contraceptive use is consistent with the pattern expected under contraceptive confidence hypothesis.

Figure 3.2.1: Proportion of women by contraceptive type (non-users not displayed) by marriage cohort



Source: author's calculations from MDHS 2005

3.2.2: The role of induced abortion in the Moldovan fertility control regime

Induced abortion is widely used as a means of controlling fertility in Moldova. 46.2% of women who have ever had sex report having had at least one abortion and 40.9% of these women having proceeded to two or more subsequent abortions (author's calculations, MDHS 2005). This behaviour is common in many post-Socialist republics (Agadjanian 2002, Popov 1991, Popov *et al.* 1993, Sobotka 2003, Westoff 2005).

Much abortion use results from the failure of natural contraception - Westoff (2005) estimates that 43% of abortions in Moldova result from natural contraceptive failure. Agadjanian (2002) finds that abortion and contraception are perceived as complementary elements of fertility control, rather than discrete alternatives. This view is particularly prevalent among older women, who are also more likely to use natural contraceptives (Agadjanian 2002, Lyons-Amos *et al* 2011).

Induced abortion is a mechanism for natural method users to increase their confidence in their ability to control their fertility. After attaining a desired family size, a woman can use a natural method to limit the possibility of further unwanted pregnancies, although the high failure rate of natural methods means that this is not assured. Any accidental pregnancies resulting from natural method failure are terminated through abortion. Induced abortion in combination with natural method use is equivalent to stopping behaviour (Agadjanian 2002). Abortion therefore increases "contraceptive" confidence of natural method users and should have a similar effect on the first birth interval as effective contraceptive methods. This assertion is tested by the second research hypothesis:

Hypothesis 2: Natural method users who use induced abortion will have a shorter first birth interval than natural method users who are less prepared to abort their unwanted pregnancies.

3.2.3: Temporal effects: crisis and adjustment

Following the collapse of the USSR, there was a universal slump in fertility in the former Soviet bloc. In Moldova TFR declined from 2.8 in 1989 to a record low of 1.3 children per woman in 2001 (NCPM and ORC Macro). Fertility has since recovered slightly, increasing to 1.7 in 2005 (NCPM and ORC Macro 2006). The decline in fertility has been explained in terms of the 'crisis' hypothesis - reflecting insecurity due to the economic collapse (Witte and Wagner 1995, Kohler and Kohler 2002) - or the 'adjustment' hypothesis, which argues that fertility in Moldova is moving to a

Westernised childbearing pattern resulting from the adoption of the Western social and institutional system.

The crisis argument is based on the effect of macro-economic collapse on living standards. In the immediate post-independence period, the Soviet bloc suffered universal decline in the economic environment, demonstrated by declining GDP, rising inflation and worsening labour market conditions further reflected in increased unemployment and job instability (Kohler and Kohler 2002). Economic decline was particularly severe in Moldova, with 2005 GDP estimated at 40% of its 1991 level and real wages at 30% (NCPM and ORC Macro 2006). The collapse of the economy led to a decline in the ability of Eastern European couples to afford children, resulting in a drastic fall in period fertility. Witte and Wagner (1995) find that concerns about both macro-economic conditions and personal economic situation resulted in a substantial reduction in the probability of first birth. Kohler and Kohler (2002) find that women in economically disadvantaged groups react more strongly to macro-economic conditions, with greater depression in first birth rate in lower socio-economic status groups.

Alternatively, the long term changes in the Eastern European fertility have been attributed to the 'adjustment' effect (Conrad *et al.* 1996, Lechner 2001, Witte and Wagner 1995). Adjustment comprises a movement away from the birth pattern observed under state socialism, and the adoption of a Western fertility model (Witte and Wagner 1996, Sobotka 2003). Under Socialism marriage was followed rapidly by first birth, with a peak in fertility around the age of 20 (Sobotka 2003, NCPM and ORC Macro 2006). Motherhood was essential to receiving an apartment and the availability of state run childcare meant that early parenthood did not compromise labour-market or career opportunities. After the fall of Socialism in 1991, many of these incentives to early motherhood were removed in the transition to a more Westernised society. Housing was no longer centrally allocated and the gradual erosion of affordable childcare provision made combining both labour-market activity and motherhood increasingly difficult. Additionally, there was an increasing trend towards a Western lifestyle, with a greater emphasis on women establishing

careers. As a result, first birth behaviour in Moldova has become increasingly heterogeneous since 1991. Sobotka (2003) highlights that traditional marriage and fertility are becoming increasingly disassociated, with increasing extra-marital fertility. That said, the proportion of birth to non-married couples is still low by Western European standards (less than 10%). Where couples marry do so increasingly at later ages in Moldova. Some traditional patterns have persisted, such as the universality of first birth - 'at least one, no more than two' (Sobotka 2003).

The Westernisation of Moldovan fertility should produce fertility behaviour similar to that of Western populations among later marriage cohorts. The incentive to delaying fertility should be strongest among women with the greatest career potential. Therefore, evidence of an adjustment or Westernisation is taken to be delays in fertility among women with high educational attainment, or who are already attached to professional careers.

3.3. Data

3.3.1 Moldovan Demographic and Health Survey

Data for this analysis are drawn from the 2005 Moldovan Demographic and Health Survey (MDHS). The DHS survey collected information on FP, reproductive health, maternal and child health and HIV/AIDS, and included an additional module on abortion -reflecting its importance in the Moldovan fertility control regime. This analysis makes use of the birth history module. This module collected the dates of all births to the nearest month, and additional information on child age, sex, survival status and (where applicable) age at death. Although no marriage history is collected, the date of first marriage is available (accurate to the nearest month), as is the duration of marriage (where relevant).

The data limitations for this analysis are as follows. Firstly, many of the influences identified as important are not collected directly. For example, there is no direct measure of contraceptive confidence available from the dataset, nor any indication

of a woman's career motivation. Much of the current analysis is therefore reliant on the use of proxy variables. This has specific implications for the validity of the measures of contraceptive confidence and abortion propensity. Secondly, much of the information available is collected at the time of survey, whereas the marriage and first birth may have occurred a number of years preceding the interview date. In some circumstances the change in status is likely to be small or relevant only to a limited number of women. For other variables, particularly contraceptive method at survey, there is the potential for considerable discrepancy between survey and first birth interval. Where possible the effect of these changes is reduced by including other variables as controls. Finally there are some influences which this analysis is unable to capture due to non-collection in the MDHS survey – for example temporary spousal separation due to seasonal economic migration. This is common in Moldova, where nearly 25% of the economically active population works overseas (NCPM and ORC Macro 2006). In these circumstances the analysis is forced to assume that there no systematic effect after controlling for other influences.

3.3.2 Analysis sample

The original MDHS sample consists of 7440 women. 1884 women are never married, and are therefore excluded. 74.4% of these women have never had sex - only 1.7% of never married women report at least one birth. This confirms the rarity of extra-marital childbearing in Moldova, consistent with Sobotka (2003). 179 women have a first birth interval of negative duration - that is, their first birth occurred prior to marriage. These women are excluded as the event of interest (birth) for this analysis precedes the start of exposure (marriage). This accounts for only 3.2% of ever-married women. The final analysis sample therefore consists of 5377 women.

The sample of women used in this analysis is determined by the requirements of the hazard model employed. These requirements are a) a defined start point for the period of exposure and b) that the start of exposure precedes the terminal event. This analysis defines the start point as marriage, and the terminal event as first birth. The motivations for choice of marriage rather than sexual debut as a start to

exposure are twofold. Practically, the date of first intercourse displays a high degree of missing information. Secondly, pre-marital childbearing is still rare in Moldova due to persistent social pressure and taboos surrounding pre- and extra-marital fertility (Sobotka 2003, Anderson *et al.* 1994). The majority of pre-marital intercourse would therefore not occur within a setting where a woman was trying to become a mother and is not conceptually relevant.

3.4. Definition of explanatory variables

Explanatory variables considered for the model are outlined below. Current contraceptive method is used as a proxy for contraceptive confidence and abortion ratio is used as a proxy for abortion propensity. The variables used to assess temporal effects, and those relating to the crisis and adjustment theories are described. Finally, control variables, which may confound the effect of the variables used to explore the research hypotheses, are considered.

3.4.1 Contraceptive confidence: Current contraceptive method

This analysis uses current contraceptive method as a measure of contraceptive confidence. This parallels Ní Bhrolchaín (1988), who uses the contraceptive method in the open birth interval at survey as an indicator of contraceptive confidence. This analysis assigns low contraceptive confidence to natural method users, moderate contraceptive confidence to modern reversible method users and high contraceptive confidence to permanent modern method users. Non-users at survey are said to have their contraceptive confidence unobserved. MDHS does collect information about the preferred future method of women, which may serve as a superior proxy to current method since future method is likely to be more closely correlated with contraceptive confidence or overall anticipated contraceptive behaviour. This variable is of little practical use due to the high level of missing information - 83.0% of the analysis sample did not know their preferred future method.

Specifying contraceptive confidence in terms of the current contraceptive method requires strong assumptions. Firstly, it is assumed that the contraceptive method in use at the time of survey is part of the strategy worked out before the reproductive career. At the start of her reproductive career, a woman makes a choice of contraceptive method, in which she has a certain degree of confidence in preventing conception (strongly associated with contraceptive failure rates). It is then assumed that this level of confidence is unchanged across the woman's reproductive life regardless of her experience of contraceptive failure.

Secondly, it is assumed that the measure of contraceptive confidence is an accurate reflection of the entire reproductive lifecourse of the woman. This is a safe assumption where there is little contraceptive switching. However, roughly 60% of women reported some sort of contraceptive discontinuation within the 5 years prior to the MDHS survey. This indicates that there is the potential for misspecification of the level of contraceptive confidence (for example, a change from natural to modern methods would lead to overestimation of the level of contraceptive confidence). This is particularly problematic for permanent method users. Permanent method users are particularly likely to choose their contraceptive method based on contraceptive experience, rather than a strategy adopted *a priori*. Zavier and Padmadas (2000) suggest that the use of sterilisation method is associated with previous contraceptive failure and abortion use. Additionally, events such as foetal loss or child death (Padmadas *et al.* 2004) can affect the use of sterilisation. The problem of contraceptive switching is partially overcome by also including the effect of the previous method discontinued in the model, and specifying an interaction between the current and previous method.

3.4.2 Propensity to use induced abortion

The propensity to us induced abortion is measured as the ratio of abortions to total pregnancies. The ideal measure would be the attitude toward abortion use upon entry into sexual union, but this information was not available from the MDHS

questionnaire. Even if this information were available, the validity could be questioned. For example, Westoff (2005) finds that the odds of approval of abortion are substantially higher among Moldovan women who have past experience of induced abortion. Using the number of past abortions does not necessarily identify a propensity to use induced abortion, since older women have a greater likelihood of reporting abortion due to a greater exposure.

The abortion ratio is formulated assuming that a woman with a higher propensity to use induced abortion will terminate a greater proportion of her pregnancies than a woman with a low propensity to use induced abortion *ceteris paribus*. The proportion of pregnancies aborted is categorised into 'None', 'Low' (0.01-0.39, incorporating 25% of pregnancies aborted), 'Medium' (0.40-0.59, incorporating 50% of pregnancies aborted) and 'High' (0.60-1.00, incorporating 75% of pregnancies aborted).

Abortion is likely to be underreported in many contexts, but this is not considered a serious limitation in the Moldovan context. There is a close association between abortion and fertility control resulting from the wide availability of induced abortion during the Soviet era (Westoff 2005). Abortion is also seen as socially acceptable (Agadjanian 1998, Sobotka 2003). Overall, it is unlikely that there is any systematic underreporting of past abortion use. Anderson *et al.* (1994) examined the consistency of abortion reporting with known past abortion behavior, and found that fewer than 7% of women omitted to report past abortion - although a significantly greater proportion did erroneously report timing. Anderson *et al.* also noted that confusion over the status of vacuum-aspiration as an abortion procedure may have inflated the levels of abortion underreporting.

3.4.3 Temporal effects

To identify the effect of external economic conditions on the fertility behaviour following marriage, the explanatory variable marriage cohort is included in the analysis. The progression from first birth should be rapid in the cohorts 1970-79,

1980-84 and 1985-89, as these cohorts all married under the Socialist system and were therefore exposed to the incentives of early marriage (Witte and Wagner 1995, Sobotka 2003). In the post-independence marriage cohorts (1990-94, 1995-99 and 2000 or more recent), there should be a longer interval between marriage and first birth, reflecting the postponement of first birth in the post-independence era (Sobotka, 2003).

Several variables designed to identify crisis and adjustment effects on birth timing are considered. Economic effects are identified using the index of asset wealth. This index uses the same method as Filmer and Pritchett (2001) but incorporates variables related only to asset ownership. Kohler and Kohler (2002) found that during period of economic stress in the post-Socialist Russia, the economic downturn was associated with a suspension of fertility. This suspension was particularly pronounced among lower socio-economic status women. In Moldova, consistent with the results of Kohler and Kohler (2002), women with the least economic security (lowest category of wealth) should experience the largest postponement of births in more recent cohorts. Women in higher wealth categories should exhibit fertility behaviour more resilient to external economic conditions, and show less postponement post-1991.

Measures of adjustment considered are educational level, type of current employment and seasonality of employment. The transition to a Westernised social system alters the incentives for childbearing in Moldova, with the result that many women in transition economies face increasing pressure to delay their first birth to establish a career. These effects are strongest among women with the best employment prospects, such as those with higher education (Witte and Wagner 1995). Women in careers (professional/clerical) or those with a strong career motivation (all year employment) are also likely to have stronger incentives to alter their childbearing consistent with a Western pattern and postpone their first birth.

3.4.4 Control variables

The model controls for the proximate determinants of fertility as identified by Davis/Blake (1956) and Bongaarts (1978). The influences relevant to the first birth interval are identified as age (at marriage), marital dissolution and use of contraception.

Age is significantly related to length of birth interval. Declining fecundability resulting from increasing age is associated with longer waiting time until first birth. This effect can be drastic, Larsen and Vaupel (1993) finding that fecundability approximately halves from age 20 to age 35. This decline appears to be largely driven by a decline in female ability to conceive, as there is little effect of the age of the male partner on fertility.

Marital status is closely associated with coital activity (Davis and Blake 1956, Bongaarts 1978). While all women in the analysis sample are married at the start of the birth interval, separation from a spouse represents an interruption to regular coital activity. Unfortunately, a complete marriage history is not included in the MDHS. The derived measure attempts to identify whether a woman was separated during the first birth interval. The MDHS records duration of first marriage - although coded in 5 year bands. It is assumed that where a couple separate, the separation occurs at the mid-point of the band. If this separation occurs prior to the date of first birth, then the woman is said to have separated during the first birth interval.

Contraceptive use is key in determining the length of first birth interval. Actual use of contraception during the first birth interval is not collected directly by the MDHS, although the parity at first contraceptive use is available. Women who reported contraceptive use only after parity 1 are assumed not to have used contraception in the first birth interval. Where contraception was used at parity zero, women are said to be contraceptive users in the first birth interval. This variable is included as a measure of contraceptive behaviour, in contrast to the current contraceptive method which is used to indicate contraceptive confidence.

Lyons-Amos *et al* (2011) found a number of key influences on the type of contraceptive method in current use. To ensure that the effect of the proxy variable of current contraceptive method is not confounded by one of these other influences, this study considers urban/rural residence, region of residence, exposure to family planning media, awareness of HIV/AIDS and ethnicity as control variables.

3.5. Methodology

The methodology section describes the regression model employed in this analysis. The modelling strategy used to build the final model is also described.

3.5.1 Piecewise constant hazard model

The model used in this analysis is a piecewise constant hazard model. The response variable is the number of months from marriage until the first birth. Months since marriage are collapsed into pieces of a number of months. The first piece is set at 9 months duration to allow for the identification of pre-marital conceptions in the first birth model. Following this, the pieces are defined as either six-monthly intervals or a multiple of six months (to ensure consistency with existing literature, e.g. Steele *et al.* 1996). The model estimates the hazard of experiencing a birth during one of these pieces. The hazard is assumed constant during each piece. The advantage of this model is that it avoids potential misspecification of the underlying hazard distribution (required for parametric models) and the bias of parameter estimates in Cox models which can result from tied failure times (Yamaguchi 1993). Additionally, the size of the dataset required for the analysis is considerably reduced, as is the computational requirement for model estimation.

The probability of first birth for woman *i* in piece *p* is denoted as $\pi_i(p)$. In this case, $\pi_i(p) = \Pr(y_i(p) = 1 \mid y_i(p-1) = 0)$ where $y_i = 1$ if the woman experiences a first birth and $y_i = 0$ if she does not have a birth or is right-censored in piece *p*. In all

cases $y_i(0) = 0$ i.e. a woman cannot have a premarital birth. The model for the hazard of first birth takes the form of Equation 3.1.

$$\ln\left[\frac{\pi_i(p)}{1-\pi_i(p)}\right] = \alpha(t) + \boldsymbol{\beta}^T \mathbf{x}_i(p)$$

Equation 3.1

In equation 3.1, $\alpha(p)$ is a series of dummy variables for time intervals (describing the underlying hazard profile), $\boldsymbol{\beta}^T$ is a transposed vector of beta coefficients and $x_i(p)$ a vector of explanatory variables for piece *p*. Equation 3.1 presents a proportional hazards model. The assumption of proportionality can be relaxed through the introduction of interactions between $\alpha(p)$ and $\boldsymbol{\beta}$.

The model specified in this analysis has no overall intercept and the dummy variables for time provide an individual intercept for each piece of the piecewise time distribution. The advantage of this specification is that the baseline hazard is for each piece derived as the inverse logit of the estimated $\alpha(p)$ parameter, rather than the sum of the overall intercept and the β parameter. This differs from the model presented in Chapter 4, which has an intercept for conceptual and practical reasons.

This model is used to estimate the monthly hazard of first birth ($h(t)$), where the hazard of birth is defined as $\pi_i(p)$ divided by the average time until event in piece *p.* The hazards estimated from the model are reported directly, and also used to generate cumulative hazards for month 36, defined as $\Lambda(36) = 1 - \prod_{t=0}^{36}[1-h(t)]$. This indicates the proportion of women having had a birth 3 years after marriage and is used to summarise fertility. Additionally, the survival curve is also presented, which describes the proportion of women yet to have next birth by month *t* postpartum. Survival ($S(t)$) is defined as $S(t) = 1 - \Lambda(t)$.

3.5.2 Modelling strategy

The model is built from a null-model incorporating $\alpha(p)$ only. Current contraceptive method and abortion ratio are then added to test research hypotheses 1 and 2. The variables identifying temporal effects (marriage cohort, employment type, education and asset wealth) are then tested for significance at 5% level using a Likelihood Ratio (LR) test and if significant then they are retained in the model. Control variables are then added to the model if significant after a LR test using a forward stepwise model selection procedure.

Once all significant main effects have been determined, the model is extended to incorporate interaction effects. In order to examine the effect of induced abortion in increasing contraceptive confidence among natural method users, a two-way interaction between current contraceptive method and propensity to use induced abortion is added to the model. This allows the investigation of the effect of induced abortion specifically in conjunction with natural method use (Agadjanian 2002, Popov 1991, Popov et al. 1993, Sobotka 2003, Westoff 2005). Secondly, an interaction between current contraceptive method and the previous method discontinued is introduced. This protects against the misclassification of contraceptive confidence due to contraceptive switching. Finally, in order to assess the impact of temporal conditions during the first birth interval, two-way interactions between marriage cohort and asset wealth, type of current employment, seasonality of employment and highest educational level are tested for significance using a LR test at the 5% level. Significant interaction between marriage cohort and index wealth would indicate a crisis effect, while a significant interaction between marriage cohort and current employment, seasonality of employment or highest educational level would suggest an adjustment effect. The final stage of the modelling procedure is a relaxation of the assumption of the proportional effect of explanatory variables across time. Interactions between time and all explanatory variables already in the model are tested for significance at 5% level using the LR test. Significant interactions between time and selected explanatory variables

indicate a time dependent effect. The model is estimated using SPSS 17.0 for Windows.

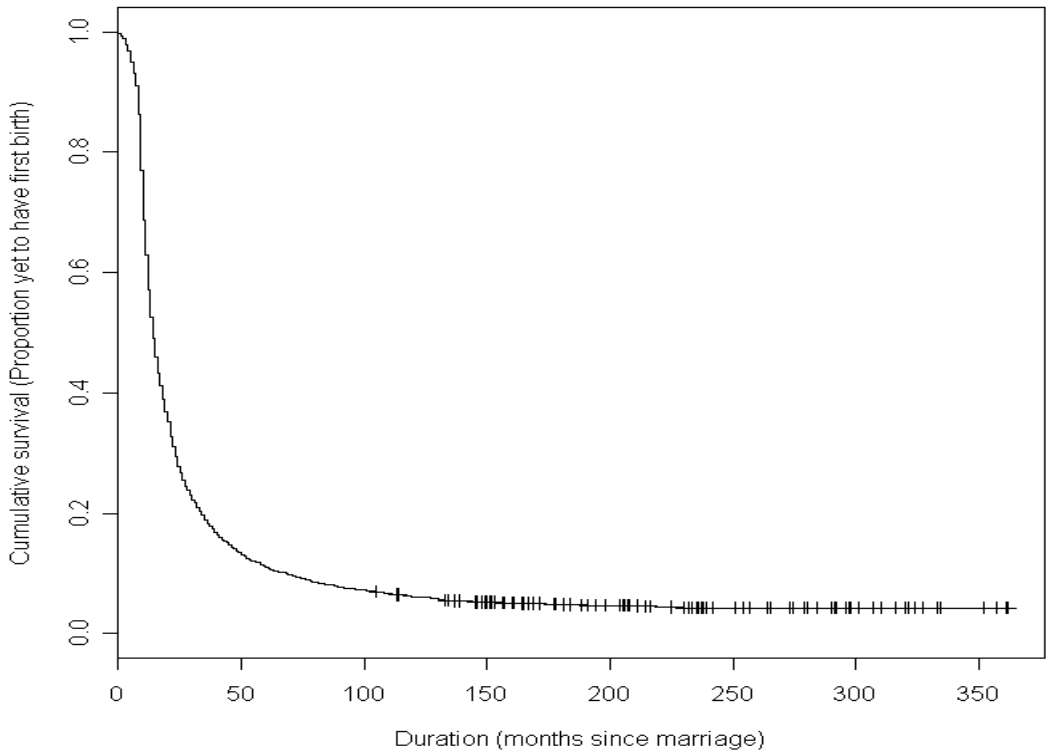
3.6 Results

Results from the analysis are considered below. Descriptive analysis, using Kaplan-Meier plots stratified by key variables, are first considered in Section 3.6.1. Results from the final model with predicted hazards are presented in Section 3.6.2.

3.6.1 Descriptive analysis

The vast majority of women in the sample experience a first birth, with only 12% of intervals right-censored by survey. This is indicative that despite low fertility in Moldova childlessness is rare, and that the childbearing patterns observed in much of former Soviet Europe are also present in Moldova ('at least one, no more than two,' Sobotka 2003). The Kaplan-Meier estimated survival curve of the first birth interval for all women in the sample is presented in Figure 3.6.1. The median survival time is 14 months - indicating that 50% of women who experience first birth do so in just over one year following marriage. Only 167 women have an interval between marriage and first birth greater than 2 years - 3.1% of the analysis sample. The mean survival time (37.8 months) is considerably greater than the median - indicating a small number of extremely long intervals from first birth.

Figure 3.6.1: Kaplan-Meier survival distribution for first birth interval



Note:

Median survival time; 14.0 months, 95% confidence interval for median: (13.6, 14.4)
Mean survival time; 37.8 months, 95% confidence interval for mean (35.5, 40.1)
n=5377
Events=4733 (88.0%)
+ denote censorship occasions

The distribution of potential explanatory variables is presented in Table 3.6.1. Table 3.6.1 presents a number of variables where the median failure time could not be estimated due to a high proportion of women not experiencing first birth. The low proportion of intervals ending in failure makes the estimation of median survival times problematic, since the median case within the stratum does not experience failure. Where this occurs, this is denoted with a superscript 'a.'

Table 3.6.1: Descriptive statistics for potential explanatory variables for first birth interval.

Variable	Number of respondents	Percentage experiencing first birth	Median failure time (Kaplan-Meier Estimate)
All	5377	88.0	14.0
Current contraceptive method (Contraceptive confidence)			
Natural (Low)	1174	98.0	13.0
Reversible (Moderate)	1957	79.0	14.0
Permanent (High)	245	92.8	12.0
Non-use (Unobserved)	2001	93.3	16.0
Propensity to use induced abortion			
Never-used	2727	79.7	17.0
Low	883	99.9	12.0
Medium	1075	99.9	13.0
High	692	88.9	14.0
Last method discontinued			
Modern	1203	87.4	15.0
Natural	1116	94.4	14.0
None recorded	3058	85.9	14.0
Highest education			
Secondary or lower	4176	90.3	13.0
Higher	1201	79.9	18.0
Marriage cohort			
1970-79	756	98.3	12.0
1980-84	979	97.5	13.0
1985-89	898	95.9	13.0
1990-94	941	94.4	13.0
1995-99	800	89.4	18.0
2000 or more recently	1003	56.9	23.0
Seasonality of employment			
All year	2906	88.6	14.0
Seasonal	579	91.9	14.0
Occasional	110	82.7	18.0
Does not work	1782	86.2	15.0
Type of employment			
Not working	1805	85.9	15.0
Professional/technical	1266	87.8	15.0
Clerical/services	696	87.0	15.0
Agricultural	541	94.5	13.0
Household/services	373	89.0	14.0
Manual	696	89.3	14.0
Ever separated			
No	4738	88.0	14.0
Yes	639	87.9	19.0

Variable	Number of respondents	Percentage experiencing first birth	Median failure time (Kaplan-Meier Estimate)
Separation before birth			
No	5188	90.6	14.0
Yes	189	16.9	-[a]
Has used contraception during marriage			
No	3817	94.6	13.0
Yes	1560	71.9	24.0
Age at marriage			
Less than 19	2605	89.0	15.0
20-24	2351	88.6	13.0
25-29	354	81.6	14.0
30-34	49	73.5	21.0
35 or more	18	33.3	-[a]
Knows how to avoid AIDS			
No	850	87.5	14.0
Yes	1961	87.1	15.0
Never heard of AIDS	107	87.9	17.0
Unsure	2459	88.9	14.0
Region of Residence			
North	1541	90.2	14.0
Centre	1270	91.3	13.0
South	1037	90.8	12.0
Chisinau	1529	81.2	18.0
Urbanicity			
Urban	3111	84.9	16.0
Rural	2266	92.4	13.0
Asset wealth index			
Low	2122	86.4	15.0
Medium	1914	88.1	15.0
High	1341	90.5	13.0
FP media exposure			
Low	2216	89.2	14.0
Medium	1385	58.4	15.0
High	1776	88.6	14.0
Ethnicity			
Moldovan	3954	88.4	14.0
Romanian	131	83.2	15.0
Ukrainian	463	87.0	17.0
Russian	402	84.3	18.0
Gagauzan	227	90.3	12.0
Bulgarian	128	93.8	13.0
Other	72	87.5	17.0

Note: -[a] denotes difficultly in estimating median failure time. .

Kaplan-Meier survival plots for current contraceptive method and abortion ratio are presented in Figures 3.6.2 and 3.6.3 respectively, with associated estimated medians and means presented in Tables 3.6.2 and 3.6.4.

Table 3.6.2 and Figure 3.6.2 presents descriptive information for the variable current contraceptive method. It is clear that there is a dichotomous association between time from first birth and contraceptive method. All three categories of contraceptive use show similar median and mean survival times, with median failure times in the region of 12 to 14 months. The one exception is the group of women who were not using a contraceptive method at time of survey, who have a median and mean survival time significantly longer than the other categories.

Table 3.6.2: Kaplan-Meier estimates of median and mean time from marriage until first birth by contraceptive confidence level

Current contraceptive method	**Median survival time (95% confidence interval)**	**Mean survival time (95% confidence interval)**
Modern reversible (Moderate)	14.0 (13.5, 14.6)	23.0 (21.5, 24.4)
Non-use (Unobserved)	16.0 (15.0, 17.0)	62.1 (56.5, 67.6)
Natural (Low)	13.0 (12.3, 13.7)	24.0 (21.9, 26.1)
Permanent (High)	12.0 (11.0, 13.0)	23.9 (17.5, 30.2)

Figure 3.6.2: Kaplan-Meier survival distribution for first birth interval stratified by current contraceptive method (level of contraceptive confidence)

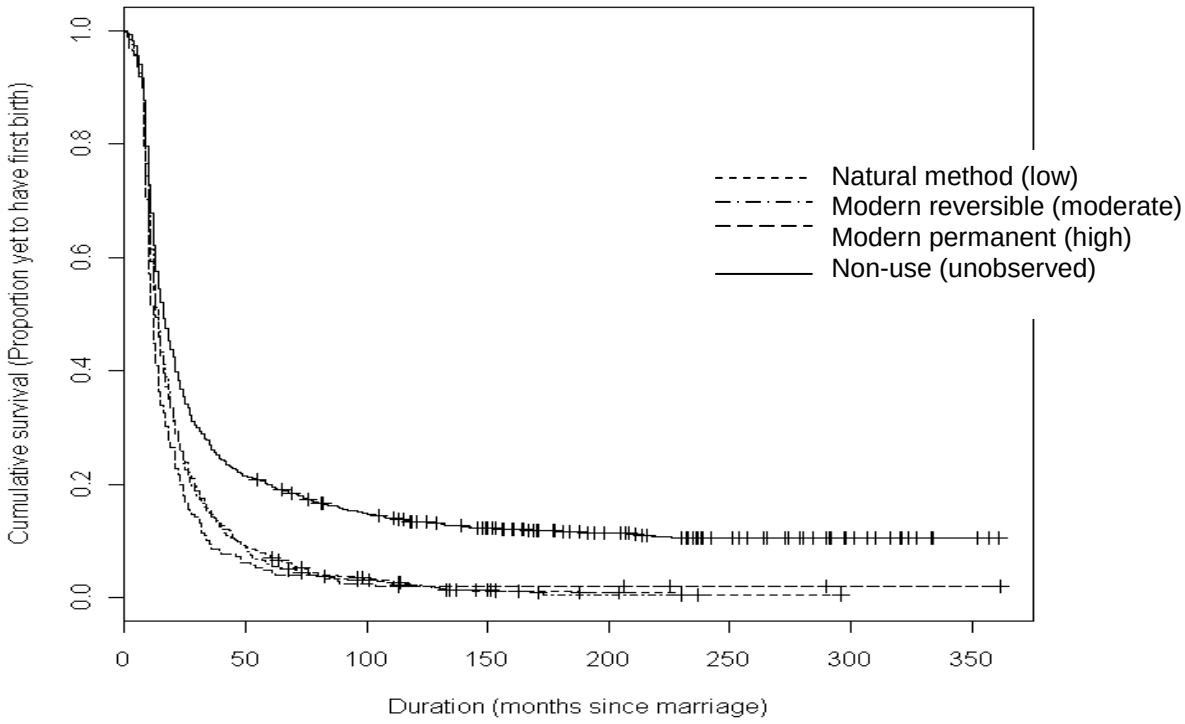
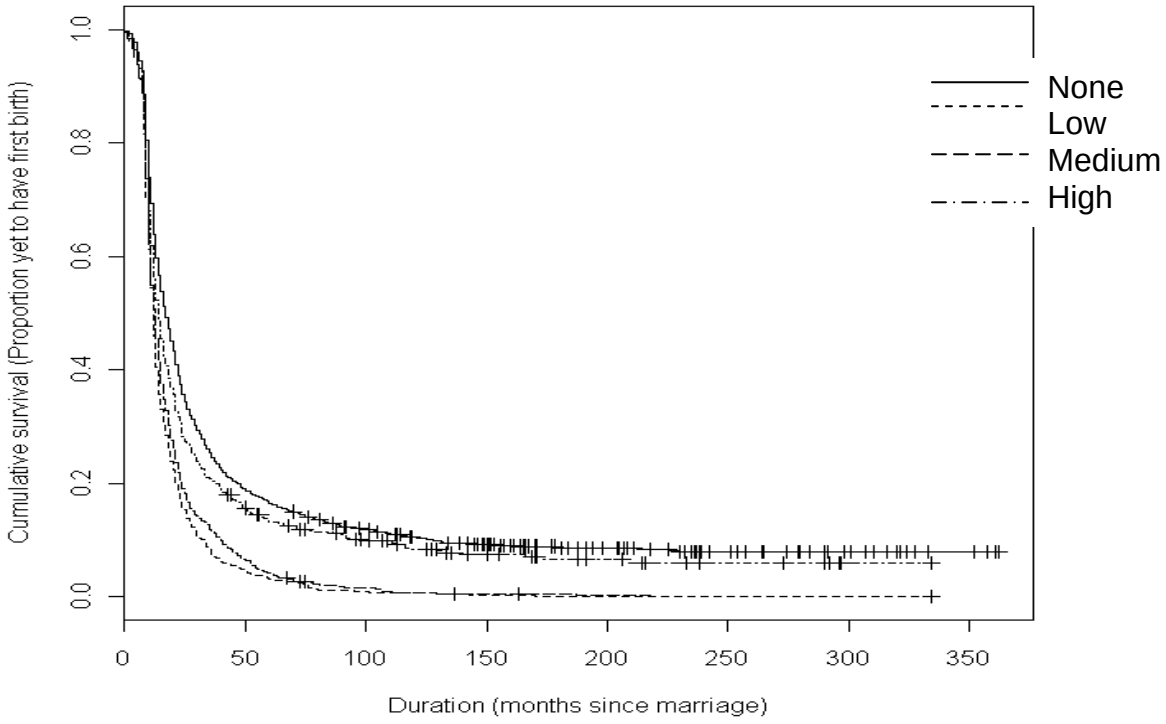


Table 3.6.3 and Figure 3.6.3 present the effect of abortion ratio. Women who have a low or medium propensity to use induced abortion have a much more rapid progression to first birth following marriage than women who do not use abortion. This is indicated by the rapid fall in the Kaplan-Meier curves (Figure 3.6.3), and the significantly lower median and mean times of first birth (Table 3.6.3). In contrast, the Kaplan-Meier curves for women with a high propensity to use induced abortion have a longer time until first birth than women with a low or medium propensity to use induced abortion. Additionally, women with a high abortion ratio have an extremely long mean survival time, indicating a considerable positive skew.

Table 3.6.3: Kaplan-Meier estimates of median and mean time from first birth by abortion ratio.

Abortion ratio	Median survival time (95% confidence interval)	Mean survival time (95% confidence interval)
None	17.0 (16.1, 17.9)	53.3 (48.9, 57.6)
Low	12.0 (11.5, 12.5)	17.6 (12.2, 18.9)
Medium	13.0 (12.9, 15.1)	19.5 (18.2, 20.8)
High	14.0 (13.6, 14.4)	42.8 (36.1, 49.5)

Figure 3.6.3: Kaplan-Meier survival distribution for first birth interval, stratified by abortion ratio



The estimated survival distribution by marriage cohort is presented in Figure 3.6.4. This plot indicates longer intervals between marriage and first birth among more recent marriage cohorts. This is also reflected in the estimates of the median time from marriage to first birth (see Table 3.6.1). In all cohorts married before 1994, the median months until first birth are in the region of 12-13 months following marriage. However, in the 1995-99 cohort this rises to 18 months, and in the post 2000 marriage cohort to 23 months - although this cohort does have a considerable proportion censored (only 56.3% have had a birth).

Figure 3.6.4: Kaplan-Meier survival distribution for first birth interval by marriage cohort

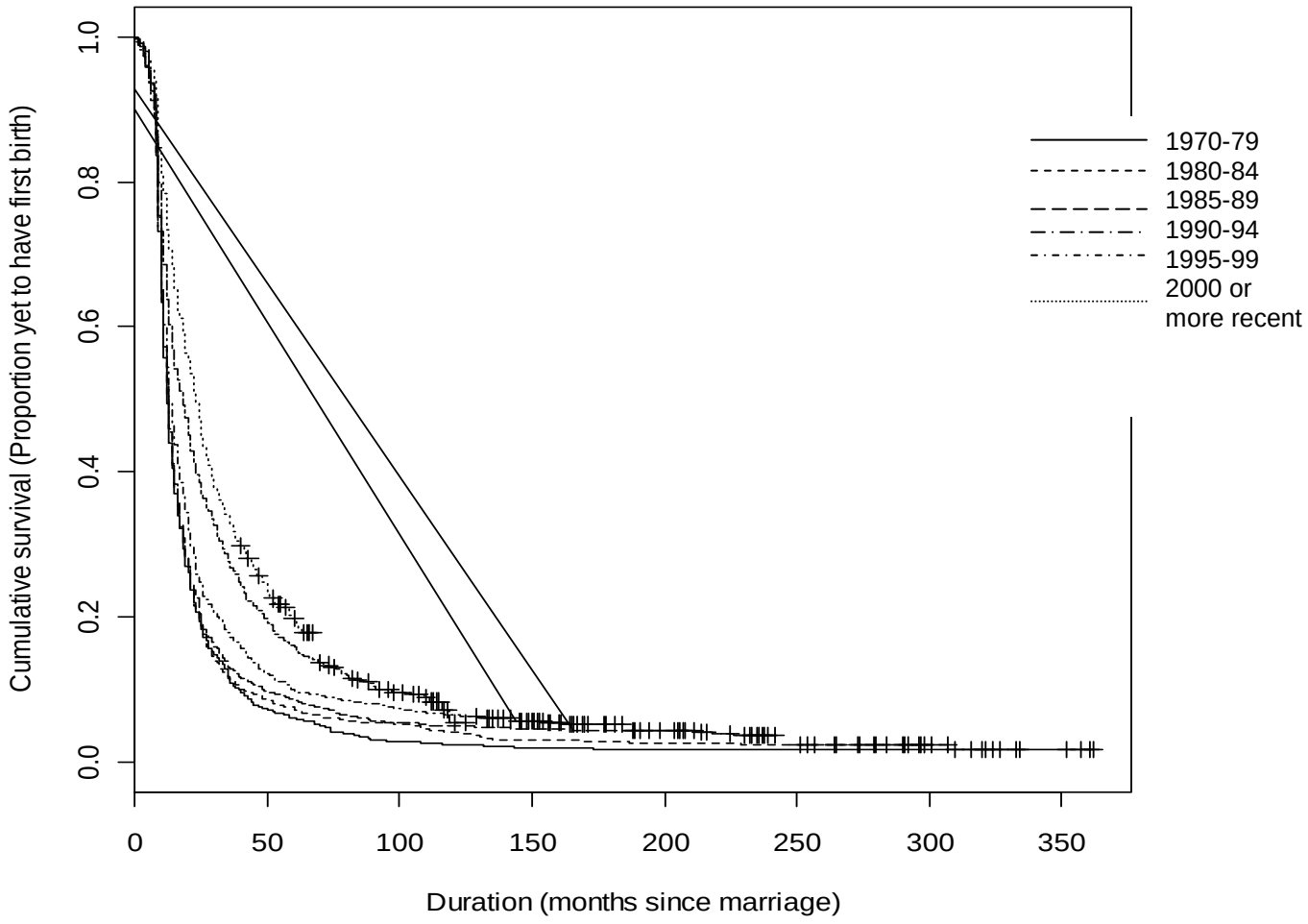


Table 3.6.1 indicates a longer first birth interval among women who had used contraception before or during the interval between marriage and first birth than among those who had not. This is not necessarily indicative of widespread contraceptive failure, rather that contraceptive behaviour during the interval cannot be measured exactly. The proxy variable of 'ever use' cannot capture (for example) discontinuation to become pregnant - although the expected pattern of longer birth intervals among women who are potential contraceptive users is observed.

3.6.2 Regression modelling results

A number of variables were found to have significant interactions with the duration variable, indicating time dependent effects. These variables were the current contraceptive method (contraceptive confidence level), abortion ratio (propensity to use induced abortion), marriage cohort and previous method discontinued. The final regression model (all covariates included) is presented in Table 3.6.4. Since many of the variables of interest to this analysis are included in at least one interaction and the effects are time dependent, cumulative hazards, estimated monthly hazards and associated survival curves are presented to clarify interpretation.

Table 3.6.4: Parameter estimates for piecewise constant hazard model for duration of first birth-interval.

		Variable	Parameter estimate ($\hat{\beta}$)		Standard error (β)	$e^{\hat{\beta}}$	95% confidence interval for $e^{\hat{\beta}}$	
		Duration						
		0-8months	-2.058	* *	0.156	0.13	0.09 -	0.17
		9-11 months	-0.746	* *	0.127	0.47	0.37 -	0.61
		12-17 months	-0.294	*	0.149	0.75	0.56 -	1.00
		18-23 months	-0.364		0.193	0.69	0.48 -	1.01
		24-29 months	-0.667	* *	0.248	0.51	0.32 -	0.83
		30-35 months	-0.759	*	0.309	0.47	0.26 -	0.86
		36-41 months	-0.724	*	0.352	0.48	0.24 -	0.97
		42-71 months	0.555		0.357	1.74	0.87 -	3.51
		72 months or more	1.736	* *	0.604	5.67	1.74 -	18.54
		Contraceptive confidence (ref= Modern reversible,						
a	b	**Moderate)**						
		Non-use (unobserved)	-1.501	* *	0.447	0.22	0.09 -	0.54
		Natural method (Low confidence)	0.950		0.636	2.59	0.74 -	8.99
		Permanent method (High confidence)	0.161		0.905	1.17	0.20 -	6.92
a	b	**Abortion ratio (ref= None)**						
		Low	3.212	*	1.387	24.83	1.64 -	376.35
		Medium	1.815	* *	0.714	6.14	1.52 -	24.89
		High	-0.499		0.418	0.61	0.27 -	1.38
		Marriage cohort (ref 1970-						
a	b	**79)**						
		1980-84	-0.135		0.531	0.87	0.31 -	2.47
		1985-89	-1.062		0.548	0.35	0.12 -	1.01
		1990-94	-1.488	* *	0.531	0.23	0.08 -	0.64
		1995-99	-2.203	* *	0.575	0.11	0.04 -	0.34
		2000 or more recent	0.261		0.399	1.30	0.59 -	2.84
		Age at marriage (ref <19)						
		20-24	0.215	* *	0.038	1.24	1.15 -	1.34
		25-29	0.213	* *	0.078	1.24	1.06 -	1.44
		30-34	0.148		0.199	1.16	0.79 -	1.71
		35 or older	-0.782		0.434	0.46	0.20 -	1.07
		Highest educational level						
	b	**(ref Secondary or lower)**						
		Higher	0.330	*	0.132	1.39	1.07 -	1.80
		Residence (ref Urban)						
		Rural	0.099	*	0.043	1.10	1.01 -	1.20
		Cont.						

	Variable	Parameter estimate ($\hat{\beta}$)			Standard error (β)	$e^{\hat{\beta}}$	95% confidence interval for $e^{\hat{\beta}}$
	Region (ref Chisinau)						
	North	0.053			0.053	1.05	0.95 - 1.17
	Centre	0.137	*		0.058	1.15	1.02 - 1.28
	South	0.163	*	*	0.059	1.18	1.05 - 1.32
a b	**Previous method discontinued (ref= None)**						
	Modern	1.318	*	*	0.453	3.74	1.54 - 9.08
	Natural	2.811	*	*	0.679	16.63	4.39 - 62.92
	Separated prior to birth (ref=No)						
	Yes	-2.784	*	*	0.194	0.06	0.04 - 0.09
	Has used contraception by start of interval (ref=No)						
	Yes	-0.632	*	*	0.046	0.53	0.49 - 0.58
	Interaction						
	Contraceptive method x Abortion use						
	Non-use x Low	0.621	*	*	0.122	1.86	1.47 - 2.36
	Non-use x Medium	0.613	*	*	0.111	1.85	1.49 - 2.29
	Non-use x High	0.332	*	*	0.128	1.39	1.08 - 1.79
	Natural x Low	0.197			0.130	1.22	0.94 - 1.57
	Natural x Medium	0.028			0.126	1.03	0.80 - 1.32
	Natural x High	-0.035			0.155	0.97	0.71 - 1.31
	Permanent x Low	0.930	*	*	0.248	2.53	1.56 - 4.12
	Permanent x Medium	0.594	*	*	0.228	1.81	1.16 - 2.83
	Permanent x High	0.318			0.273	1.37	0.80 - 2.35
	Contraceptive method x Previous method discontinued						
	Non-use x Modern	0.255	*		0.103	1.29	1.05 - 1.58
	Non-use x Natural	0.433	*	*	0.112	1.54	1.24 - 1.92
	Natural x Modern	0.078			0.125	1.08	0.85 - 1.38
	Natural x Natural	0.129			0.116	1.14	0.91 - 1.43
	Permanent x Modern	0.003			0.226	1.00	0.64 - 1.56
	Permanent x Natural	0.686	*		0.309	1.99	1.08 - 3.64
	Marriage cohort x Educational level						
	1980-84 x Higher	-0.042			0.169	0.96	0.69 - 1.34
	1985-89 x Higher	-0.190			0.168	0.83	0.59 - 1.15
	1990-94 x Higher	-0.402	*		0.165	0.67	0.48 - 0.92
	1995-99 x Higher	-0.433	*	*	0.169	0.65	0.47 - 0.90
	2000 or more recent x Higher	-0.459	*	*	0.170	0.63	0.45 - 0.88

Cont.

Variable		Parameter estimate ($\hat{\beta}$)			Standard error (β)	$e^{\hat{\beta}}$	95% confidence interval for $e^{\hat{\beta}}$		
Duration specific effects									
Method x Duration									
Non-use	0-8months	0.950	*		0.456	2.59	1.06	-	6.32
Natural	0-8months	-1.062			0.644	0.35	0.10	-	1.22
Permanent	0-8months	-0.388			0.920	0.68	0.11	-	4.12
Non-use	9-11 months	0.745			0.453	2.11	0.87	-	5.12
Natural	9-11 months	-0.983			0.641	0.37	0.11	-	1.31
Permanent	9-11 months	-0.692			-0.916	0.50	3.01	-	0.08
Non-use	12-17 months	0.806			0.455	2.24	0.92	-	5.46
Natural	12-17 months	-1.064			0.643	0.35	0.10	-	1.22
Permanent	12-17 months	-0.632			0.923	0.53	0.09	-	3.24
Non-use	18-23 months	0.581			0.461	1.79	0.72	-	4.41
Natural	18-23 months	-1.253			0.650	0.29	0.08	-	1.02
Permanent	18-23 months	-0.656			0.940	0.52	0.08	-	3.28
Non-use	24-29 months	0.508			0.473	1.66	0.66	-	4.20
Natural	24-29 months	-1.380	*		0.661	0.25	0.07	-	0.92
Permanent	24-29 months	-0.436			0.968	0.65	0.10	-	4.31
Non-use	30-35 months	0.375			0.491	1.45	0.56	-	3.81
Natural	30-35 months	-1.184			0.674	0.31	0.08	-	1.15
Permanent	30-35 months	0.203			0.990	1.23	0.18	-	8.53
Non-use	36-41 months	0.288			0.507	1.33	0.49	-	3.60
Natural	36-41 months	-1.246			0.689	0.29	0.07	-	1.11
Permanent	36-41 months	-0.569			1.083	0.57	0.07	-	4.73
Non-use	42-71 months	-0.123			0.500	0.88	0.33	-	2.36
Natural	42-71 months	-1.120			0.689	0.33	0.08	-	1.26
Permanent	42-71 months	-0.415			1.062	0.66	0.08	-	5.29
Abortion ratio x Duration									
Low	0-8months	-3.138	*		1.390	0.04	0.00	-	0.66
Medium	0-8months	-1.824	*		0.721	0.16	0.04	-	0.66
High	0-8months	0.704			0.429	2.02	0.87	-	4.69
Low	9-11 months	-3.378	*		1.389	0.03	0.00	-	0.52
Medium	9-11 months	-1.676	*		0.718	0.19	0.05	-	0.76
High	9-11 months	0.535			0.424	1.71	0.74	-	3.92
Low	12-17 months	-3.073	*		1.390	0.05	0.00	-	0.71
Medium	12-17 months	-1.785	*		0.720	0.17	0.04	-	0.69
High	12-17 months	0.551			0.428	1.73	0.75	-	4.01
Low	18-23 months	-3.210	*		1.394	0.04	0.00	-	0.62
Medium	18-23 months	-1.704	*		0.725	0.18	0.04	-	0.75
High	18-23 months	0.359			0.442	1.43	0.60	-	3.41
Low	24-29 months	-3.091	*		1.401	0.05	0.00	-	0.71
Medium	24-29 months	-1.821	*		0.736	0.16	0.04	-	0.68
High	24-29 months	0.484			0.460	1.62	0.66	-	4.00
Low	30-35 months	-3.238	*		1.410	0.04	0.00	-	0.62
Medium	30-35 months	-2.347	*	*	0.754	0.10	0.02	-	0.42
High	30-35 months	0.278			0.488	1.32	0.51	-	3.44
Low	36-41 months	-2.893	*		1.421	0.06	0.00	-	0.90
Medium	36-41 months	-1.847	*		0.761	0.16	0.04	-	0.70
High	36-41 months	0.281			0.521	1.32	0.48	-	3.68
Low	42-71 months	-3.137	*		1.428	0.04	0.00	-	0.71
Medium	42-71 months	-1.058			0.764	0.35	0.08	-	1.55
High	42-71 months	0.455			0.486	1.58	0.61	-	4.09

Variable		Parameter estimate ($\hat{\beta}$)		Standard error (β)	$e^{\hat{\beta}}$	95% confidence interval for $e^{\hat{\beta}}$
Marriage cohort x Duration						
1980-84	0-8months	0.197		0.549	1.22	0.42 - 3.57
1985-89	0-8months	1.363	*	0.566	3.91	1.29 - 11.85
1990-94	0-8months	1.910	* *	0.550	6.75	2.30 - 19.85
1995-99	0-8months	2.631	* *	0.596	13.89	4.32 - 44.66
2000 or more recent	0-8months	-0.139		0.431	0.87	0.37 - 2.03
1980-84	9-11 months	-0.020		0.541	0.98	0.34 - 2.83
1985-89	9-11 months	0.864		0.559	2.37	0.79 - 7.10
1990-94	9-11 months	1.244	*	0.543	3.47	1.20 - 10.06
1995-99	9-11 months	1.695	* *	0.590	5.45	1.71 - 17.31
2000 or more recent	9-11 months	-0.940	*	0.420	0.39	0.17 - 0.89
1980-84	12-17 months	0.039		0.547	1.04	0.36 - 3.04
1985-89	12-17 months	1.172	*	0.565	3.23	1.07 - 9.77
1990-94	12-17 months	1.410	* *	0.549	4.10	1.40 - 12.01
1995-99	12-17 months	1.761	* *	0.594	5.82	1.82 - 18.64
2000 or more recent	12-17 months	-0.630		0.424	0.53	0.23 - 1.22
1980-84	18-23 months	0.142		0.561	1.15	0.38 - 3.46
1985-89	18-23 months	0.835		0.581	2.30	0.74 - 7.20
1990-94	18-23 months	1.478	* *	0.563	4.38	1.45 - 13.22
1995-99	18-23 months	1.744	* *	0.608	5.72	1.74 - 18.83
2000 or more recent	18-23 months	-0.615		0.445	0.54	0.23 - 1.29
1980-84	24-29 months	0.167		0.585	1.18	0.38 - 3.72
1985-89	24-29 months	1.057		0.603	2.88	0.88 - 9.38
1990-94	24-29 months	1.121		0.590	3.07	0.97 - 9.75
1995-99	24-29 months	1.705	* *	0.630	5.50	1.60 - 18.91
2000 or more recent	24-29 months	0.086		0.471	1.09	0.43 - 2.74
1980-84	30-35 months	-0.085		0.620	0.92	0.27 - 3.10
1985-89	30-35 months	1.013		0.633	2.75	0.80 - 9.52
1990-94	30-35 months	1.025		0.619	2.79	0.83 - 9.38
1995-99	30-35 months	1.968	* *	0.651	7.16	2.00 - 25.64
2000 or more recent	30-35 months	-0.090		0.520	0.91	0.33 - 2.53
1980-84	36-41 months	-0.330		0.650	0.72	0.20 - 2.57
1985-89	36-41 months	0.546		0.673	1.73	0.46 - 6.46
1990-94	36-41 months	1.081		0.673	2.95	0.79 - 11.02
1995-99	36-41 months	2.127	* *	0.642	8.39	2.38 - 29.53
2000 or more recent	36-41 months	0.676		0.676	1.97	0.52 - 7.40
1980-84	42-71 months	-0.460		0.647	0.63	0.18 - 2.24
1985-89	42-71 months	0.546		0.673	1.73	0.46 - 6.46
1990-94	42-71 months	1.081		0.642	2.95	0.84 - 10.37
1995-99	42-71 months	0.676		0.553	1.97	0.67 - 5.81
2000 or more recent	42-71 months	-		-	-	- - -

Cont.

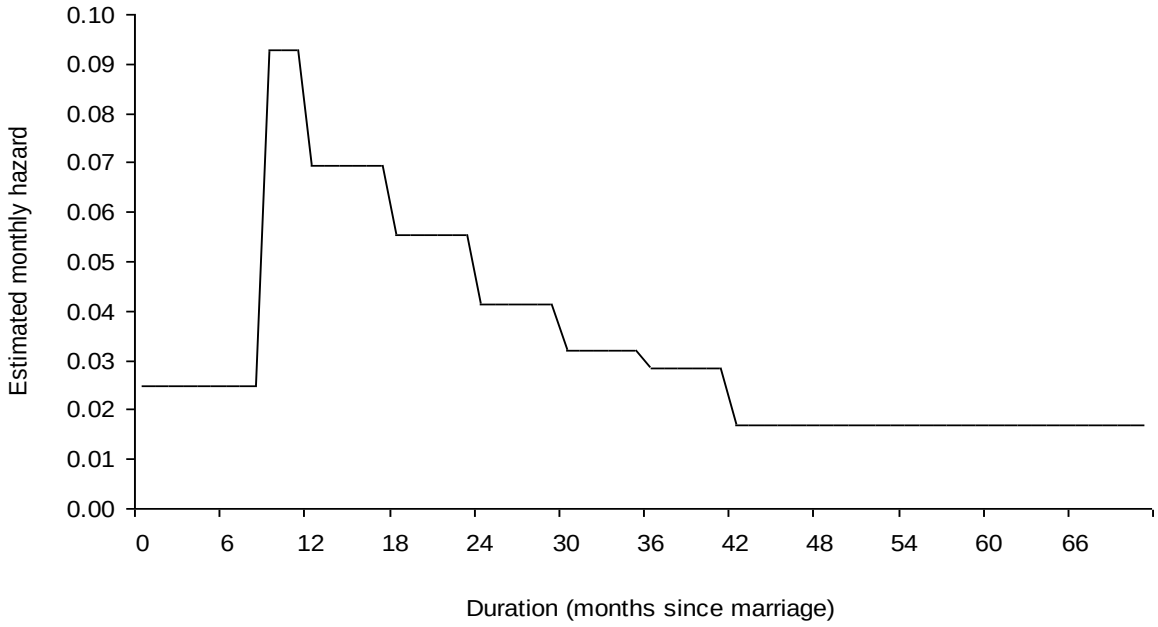
Variable		Parameter estimate ($\hat{\beta}$)		Standard error (β)	$e^{\hat{\beta}}$	95% confidence interval for $e^{\hat{\beta}}$	
Previous method discontinued x Duration							
Modern	0-8 months	-1.275	* *	0.460	0.28	0.11 -	0.69
Natural	0-8 months	-2.985	* *	0.684	0.05	0.01 -	0.19
Modern	9-11 months	-1.270	* *	0.457	0.28	0.11 -	0.69
Natural	9-11 months	-2.889	* *	0.681	0.06	0.01 -	0.21
Modern	12-17 months	-1.372	* *	0.460	0.25	0.10 -	0.62
Natural	12-17 months	-2.798	* *	0.683	0.06	0.02 -	0.23
Modern	18-23 months	-1.135	*	0.468	0.32	0.13 -	0.80
Natural	18-23 months	-2.700	* *	0.689	0.07	0.02 -	0.26
Modern	24-29 months	-1.188	*	0.483	0.30	0.12 -	0.79
Natural	24-29 months	-2.508	* *	0.698	0.08	0.02 -	0.32
Modern	30-35 months	-0.754		0.498	0.47	0.18 -	1.25
Natural	30-35 months	-2.625	* *	0.715	0.07	0.02 -	0.29
Modern	36-41 months	-1.470	* *	0.528	0.23	0.08 -	0.65
Natural	36-41 months	-2.564	* *	0.723	0.08	0.02 -	0.32
Modern	42-71 months	-0.894		0.508	0.41	0.15 -	1.11
Natural	42-71 months	-1.740	*	0.724	0.18	0.04 -	0.73

Notes:

** denotes significance at 5% level (p<0.01)
* denotes significance and 1 % level (p<0.05)
a denotes duration dependent effect (non-proportional hazard)
b denotes component in two-way interaction
No parameter estimate is possible for the term in 42-71 period for the 2000 or more recent marriage cohort as this period is censored by the survey date.

The underlying hazard distribution from the final model is presented in Figure 3.6.5. The hazard of first birth is low in the 9 months following marriage - which indicates a low level of premarital conception. Premarital sexual activity is relatively rare in Moldova due to social pressure and taboos (Sobotka 2003, Anderson *et al* 1994). The hazard of first birth peaks in the 9-11 month period indicating that entry into motherhood following marriage is rapid among Moldovan women. After this, the hazard of first birth gradually declines - indicating that the probability of a very long first birth interval is low.

Figure 3.6.5: Estimated hazard distribution of first birth



Research hypothesis 1: Contraceptive confidence

The cumulative probability of first birth after 36 months ($\Lambda(36) = 1 - (\prod_{t=0}^{36}[1 - h(t)])$) is presented in Table 3.6.5, by different contraceptive methods (contraceptive confidence). These probabilities are disaggregated by abortion ratio, due to a significant interaction (see Table 3.6.1). Across all levels of abortion ratio, the proportion of women to have had a first birth is generally lower for natural method users than among modern reversible or modern permanent method users.

Table 3.6.5: Cumulative 36 month hazard of first birth by current contraceptive and abortion ratio.

Current contraceptive (Contraceptive confidence)	Abortion ratio			
	None	Low	Medium	High
Non-use (unobserved)	0.717	0.876	0.868	0.804
Natural method (Low)	0.874	0.911	0.876	0.864
Modern reversible method (Moderate)	0.909	0.912	0.905	0.905
Modern permanent method (High)	0.860	0.972	0.942	0.910

The probability of first birth is lowest among women who are current non-users. Contraceptive non-use should be associated with 'natural' fertility conditions and more rapid progression to births than use of any contraceptive method. Two potential explanations for this effect are considered; a) the use of induced abortion as a mechanism for delaying first birth (implying overall a high propensity to use induced abortion among current non-users) or b) contraceptive non-use resulting from low fecundability. Testing these explanations is hampered by a lack of information regarding contraceptive use during the first birth interval. Using information at available at time of survey as a proxy, Table 3.6.6 presents the mean number of abortions and the proportion of women infecund by current contraceptive method. The mean number of lifetime abortions is not higher for women currently using no method than for all other contraceptive methods - in fact it is lower. Contraceptive non-use is associated with a considerably higher proportion infecund at survey than other contraceptive methods. This effect is robust to age standardisation (older women are more likely to be both non-users and also infecund, Lyons-Amos *et al.* 2011). This suggests that the long birth intervals observed among current non-users indicate self-selection of low fecundability women to contraceptive non-use at the date of survey.

Another significant result is the high number of abortions reported by permanent method users in Table 3.6.6. This suggests the use of permanent methods may result

from numerous contraceptive failures, consistent with the findings of Zavier and Padmadas (2000).

Table 3.6.6: Mean number of lifetime abortions and percentage of women reporting infecundability *by current contraceptive method for a) un-standardised and b) age standardised samples*

a)

Current contraceptive method (Contraceptive confidence)	**Mean number of lifetime abortions**	**Percentage of women reporting infecundability**	**Number of women**
Non-use (Unobserved)	0.99	44.9%	2001
Natural method (Low)	1.06	3.4%	1174
Modern reversible method (Moderate)	1.09	26.1%	245
Modern permanent method (High)	1.42	1.5%	1957

b)

Current contraceptive method (Contraceptive confidence)	**Mean number of lifetime abortions**	**Percentage of women reporting infecundability**	**Number of women**
Non-use (Unobserved)	1.08	50.0%	2001
Natural method (Low)	1.13	3.7%	1174
Modern reversible method (Moderate)	1.14	27.9%	245
Modern permanent method (High)	1.47	1.6%	1957

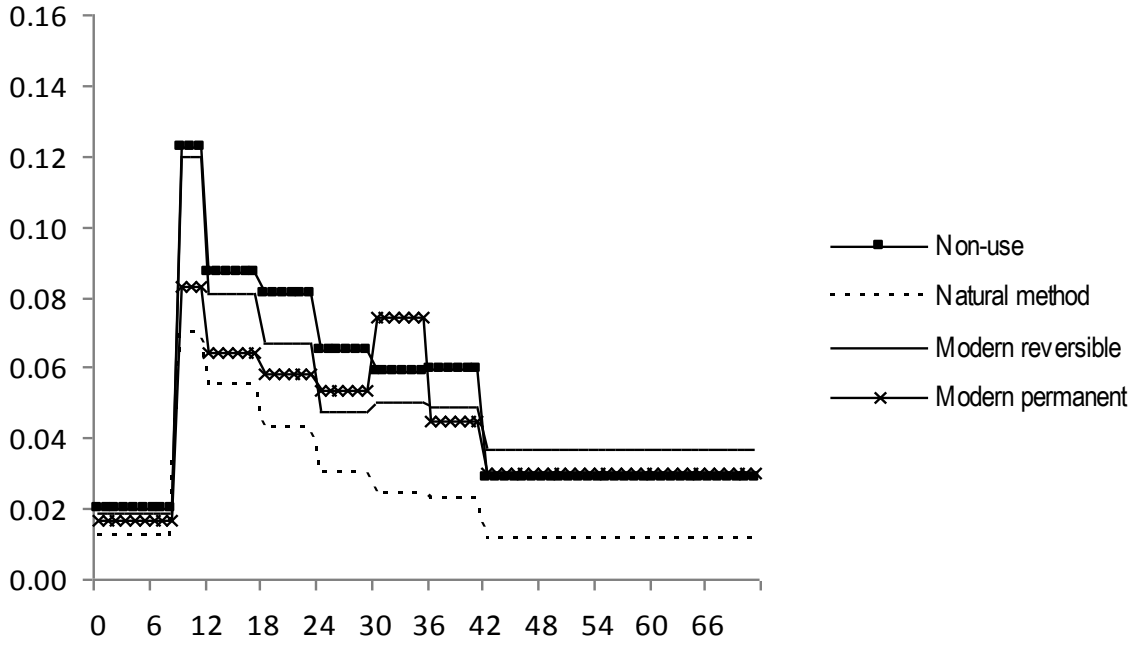
Figure 3.6.6 provides the estimated hazard distribution for current contraceptive method, and Figure 3.6.7 displays the associated estimated survival plots. Women with moderate or high contraceptive confidence (modern reversible or permanent method) generally make the most rapid transition to motherhood, indicated by consistently high hazard of first birth (Figure 3.6.6-c and -d) and the rapid fall in the

proportion yet to have first birth (Figure 3.6.7-c and -d). Women with low contraceptive confidence (natural method users) have a slower transition to motherhood, with a lower hazard of first birth across time periods. Women with unobserved contraceptive confidence (current non-users) have the slowest transition to motherhood across all abortion propensities, reflected in the low monthly hazard of first birth (Figure 3.6.6), and the high proportions of women yet to become mothers at later durations (Figure 3.6.7). These results support Research Hypothesis 1, since they indicate that women with a low level of confidence in their contraceptive method have a slower transition to their first birth than women with a moderate contraceptive confidence.

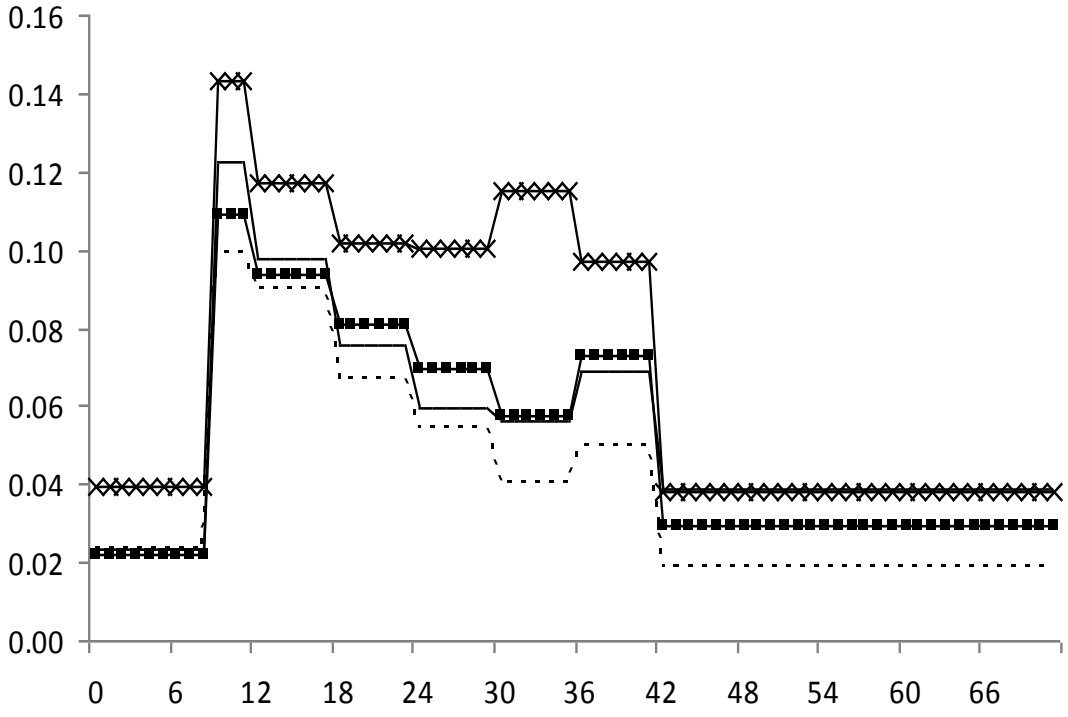
In the final model, the two-way interaction between the level of contraceptive confidence and previous method discontinued was significant at the 5% level. This interaction allowed the effect of contraceptive switching to be held constant when evaluating the effect of contraceptive confidence (to control for misspecified contraceptive confidence). Estimated hazard plots are presented in Appendix C and survival curves in Appendix D. The effect of a discontinuation is to raise the hazard of first birth - although the effect is only substantial for women who are current non-users, natural method users or permanent method users (see appendices C and D, plots –b to –d).

Figure 3.6.6 Estimated monthly hazard of first birth for current contraceptive given a) no abortion use, b) low abortion use, c) medium abortion use and d) high abortion use.

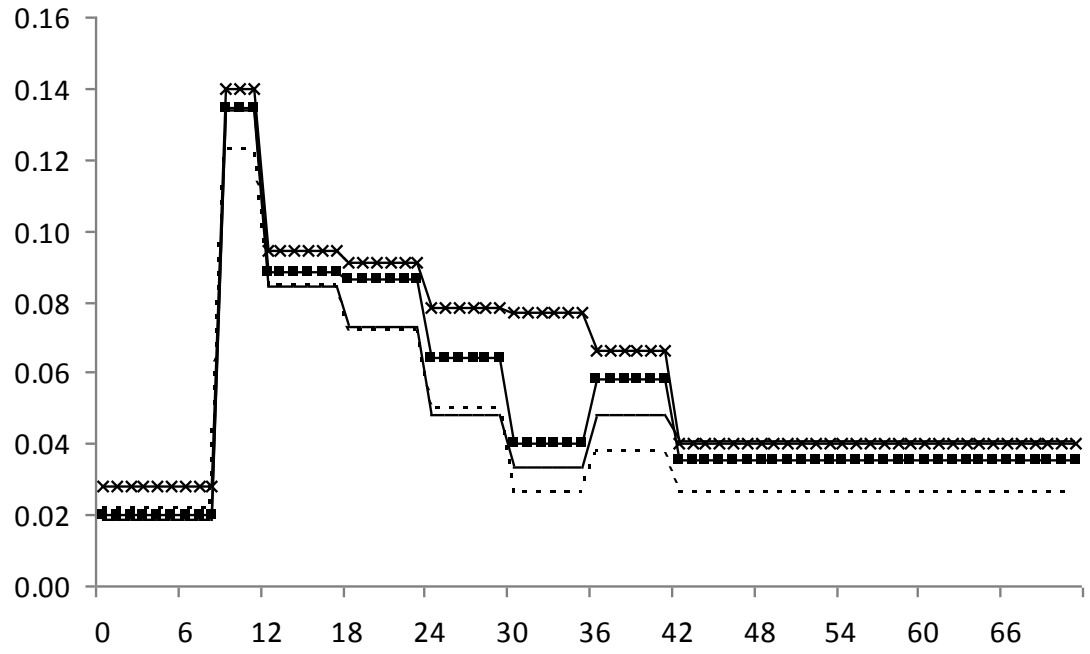
a)



b)



c)


0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
6
12
18
24
30
36
42
48
54
60
66

d)

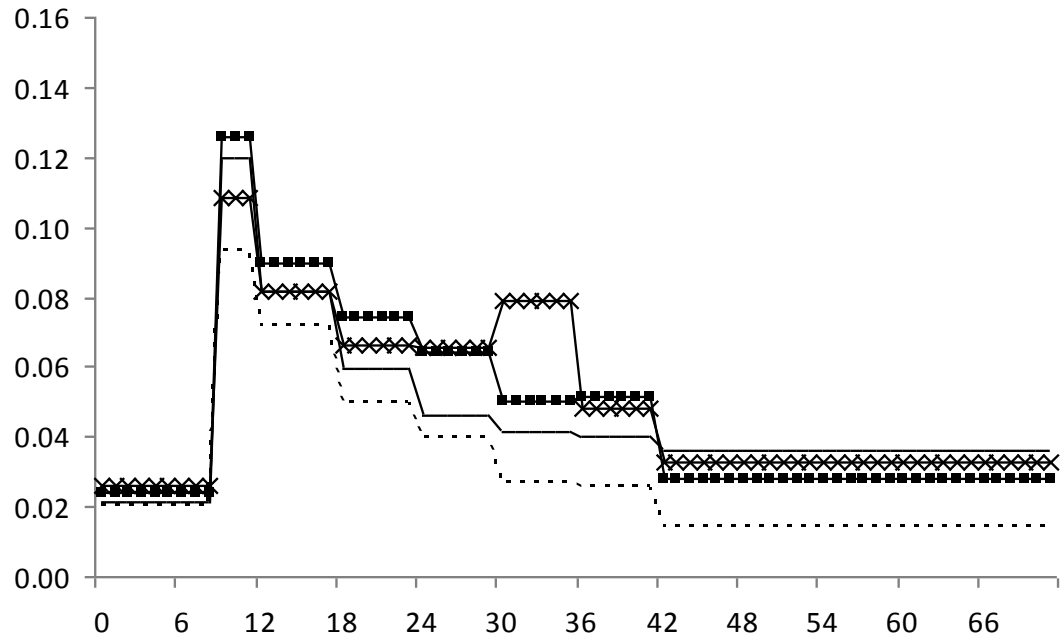
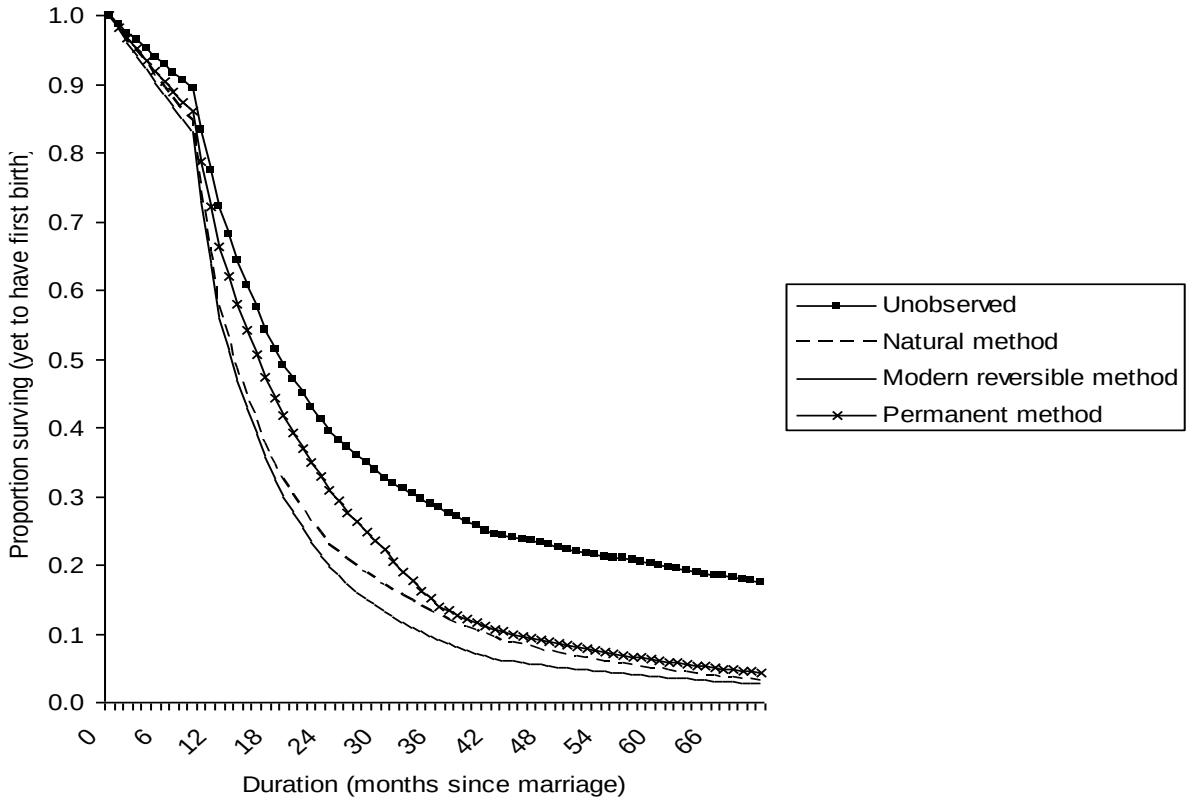
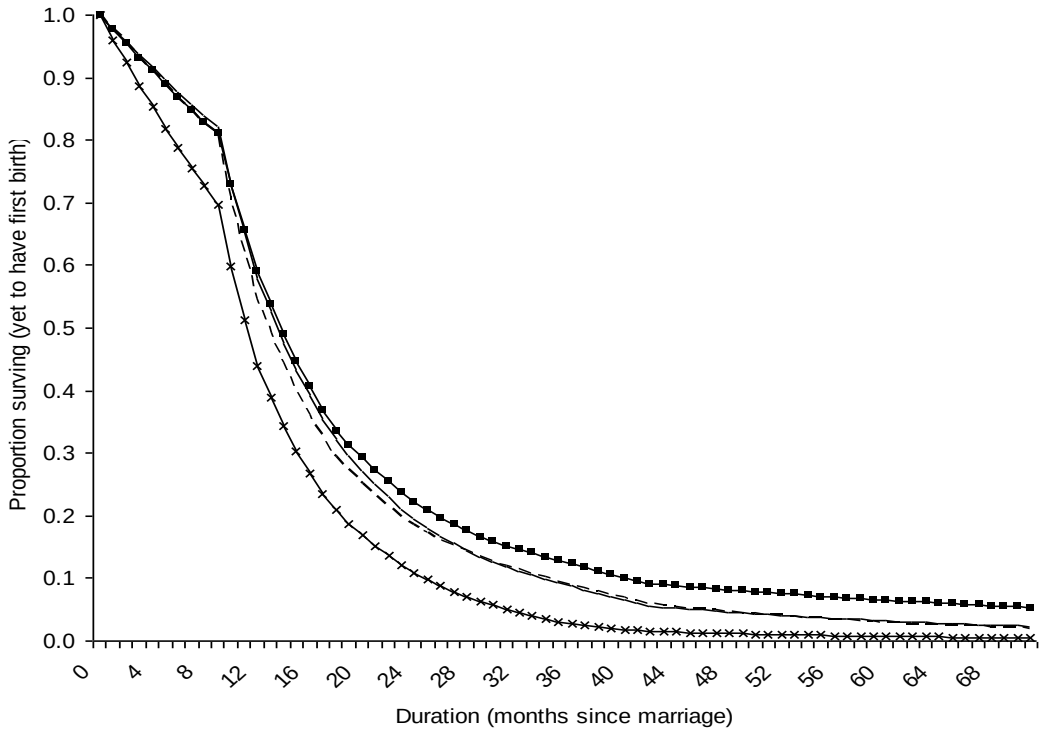

0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
0
6
12
18
24
30
36
42
48
54
60
66

Figure 3.6.7 Estimated survival curves for current contraceptive method given a) no abortion use, b) low abortion use, c) medium abortion use and d) high abortion use

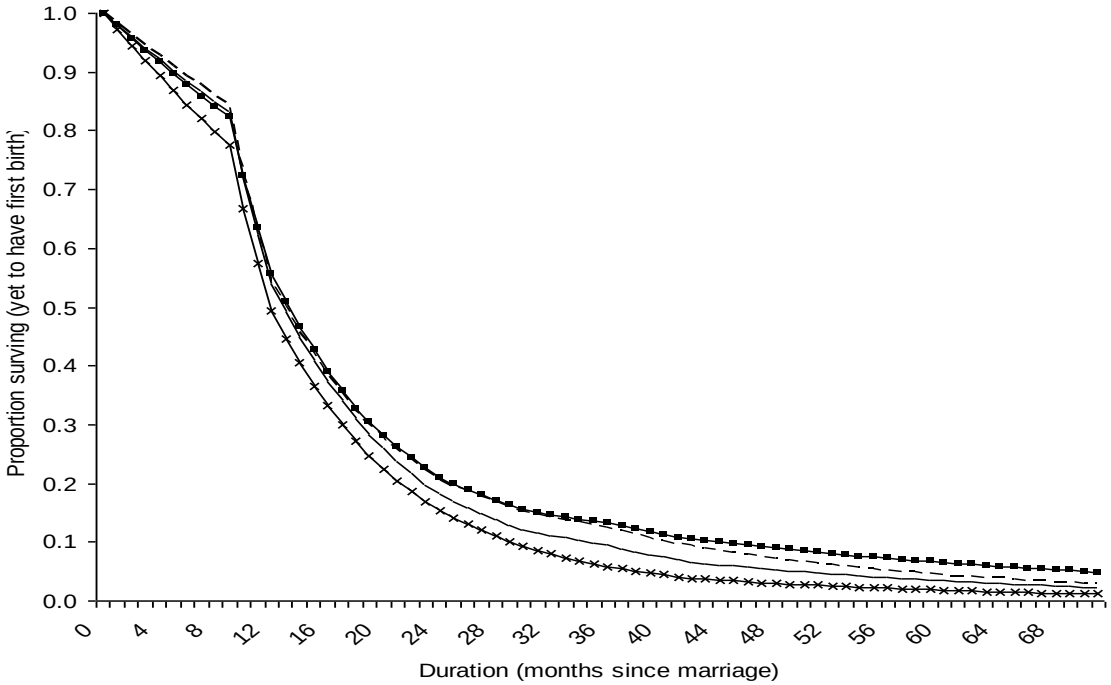
a)



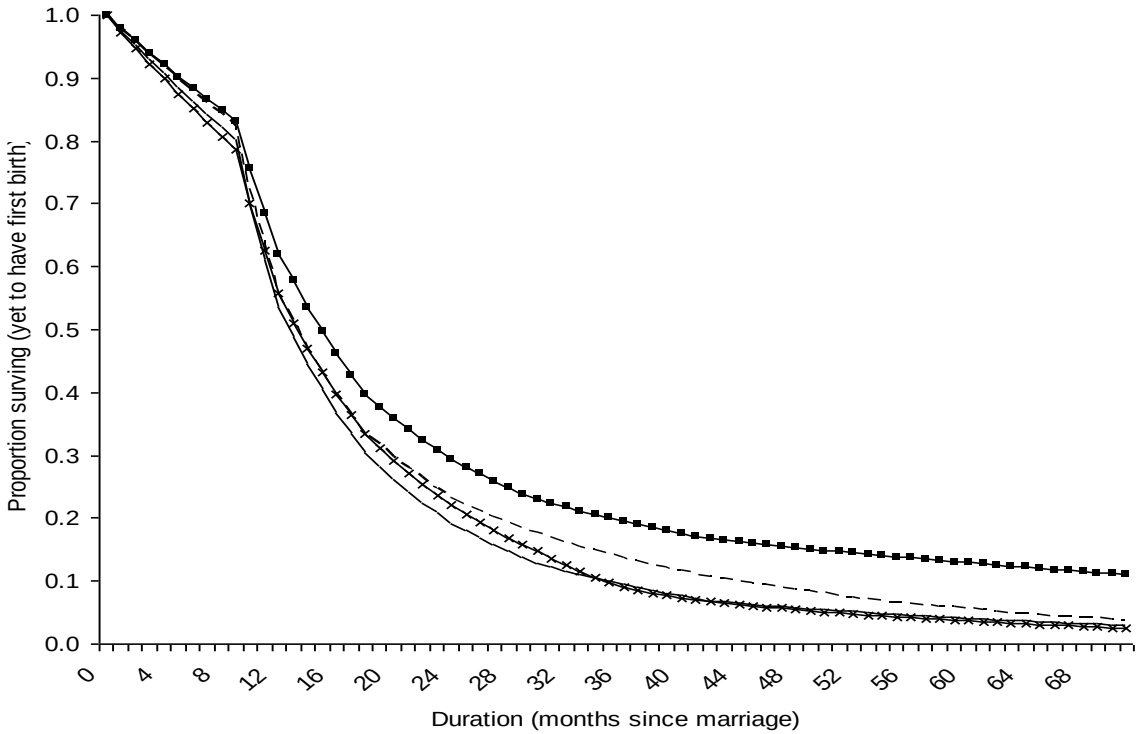
b)



c)


Proportion surving (yet to have first birth)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
Duration (months since marriage)

d)


Proportion surving (yet to have first birth)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
4
8
12
16
20
24
28
32
36
40
44
48
52
56
60
64
68
Duration (months since marriage)

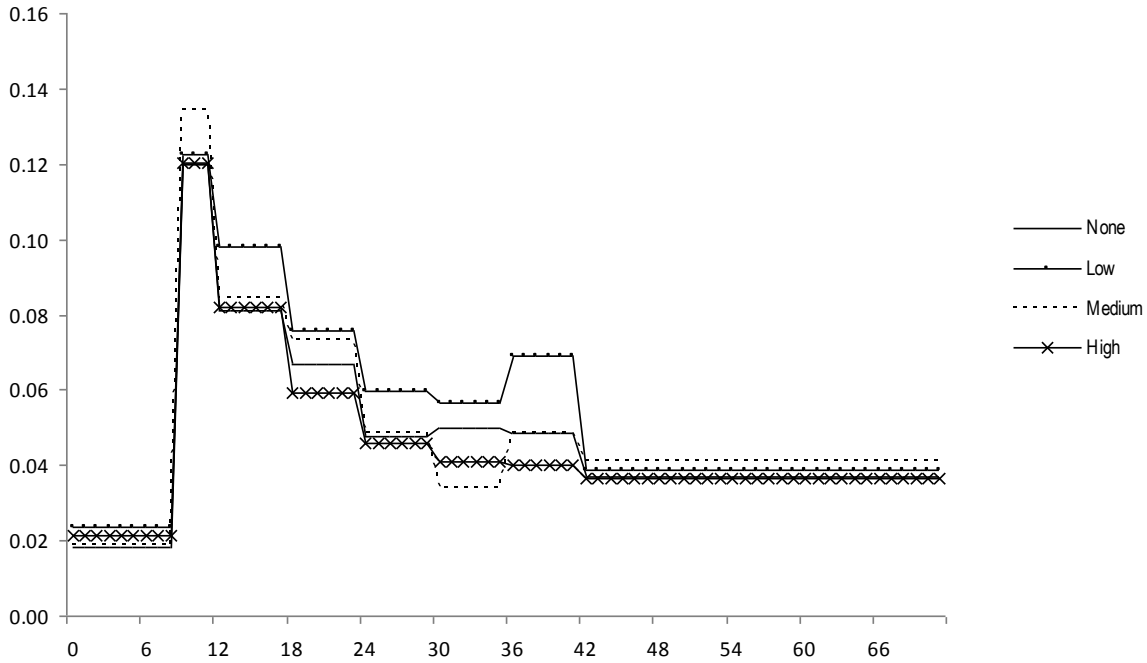
Research hypothesis 2: Induced abortion

The estimated monthly hazard of low contraceptive confidence women (natural method users) and associated survival curve are presented in Figure 3.6.8, disaggregated by abortion ratio.

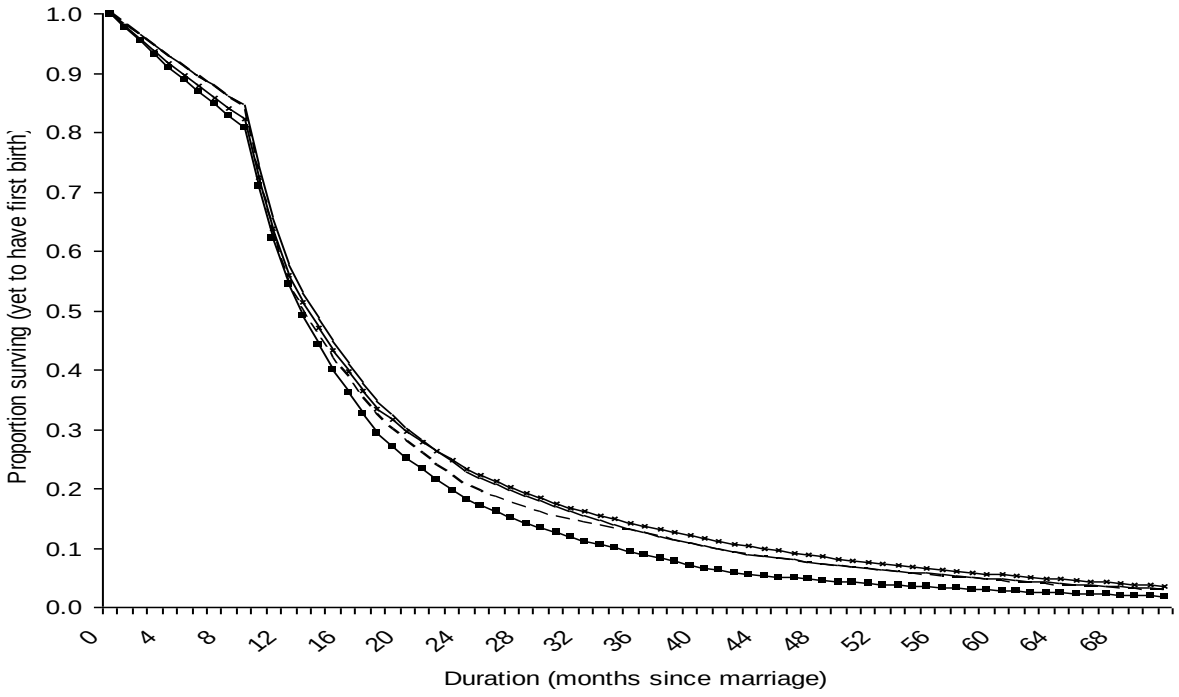
Women with low, medium and high abortion ratios all have higher hazards of first birth higher than women who have not used abortion (Figure 3.6.8-a). This is reflected in a more rapid transition to first birth (Figure 3.6.8-b). However, for high abortion ratios the increase in the hazard of first birth attenuates - women with a low and medium propensity to use induced abortion have a higher hazard and more rapid progression to first birth (Figure 3.6.8). These results support the second research hypothesis to some extent- as abortion does increase the speed of the transition to motherhood - although a very high propensity to use induced abortion is associated with a slower entry into motherhood.

Figure 3.6.8: The effect of abortion ratio on the timing of first birth for low contraceptive confidence (natural method users) by a) the estimated monthly hazard of first birth by abortion ratio and b) the estimated survival curve for first births by abortion ratio

a)



b)



Temporal effects

Marriage cohort is used to examine the changes in fertility behaviour in Moldova. Overall, more recent cohorts have a much longer time from marriage until first birth. Interactions between marriage cohort and variables of wealth index and educational level and job type were considered to test the hypotheses of 'crisis' and 'adjustment' on Moldovan fertility behaviour. The predictor variable 'asset wealth' was not significant and therefore not selected for the final model. This analysis therefore finds no evidence of a crisis effect.

Education was significant in the final model, providing some evidence of the adjustment effect. Under the adjustment hypothesis, more highly educated women have a different motivation to alter their fertility behaviour than less educated women for the post 1991 marriage cohorts. Table 3.6.7 presents the cumulative hazard of first birth at 36 months by cohort and educational level. The estimated hazard plots for marriage cohorts by each educational level are presented in Figure 3.6.9, with the associated survival curves presented in Figure 3.6.10.

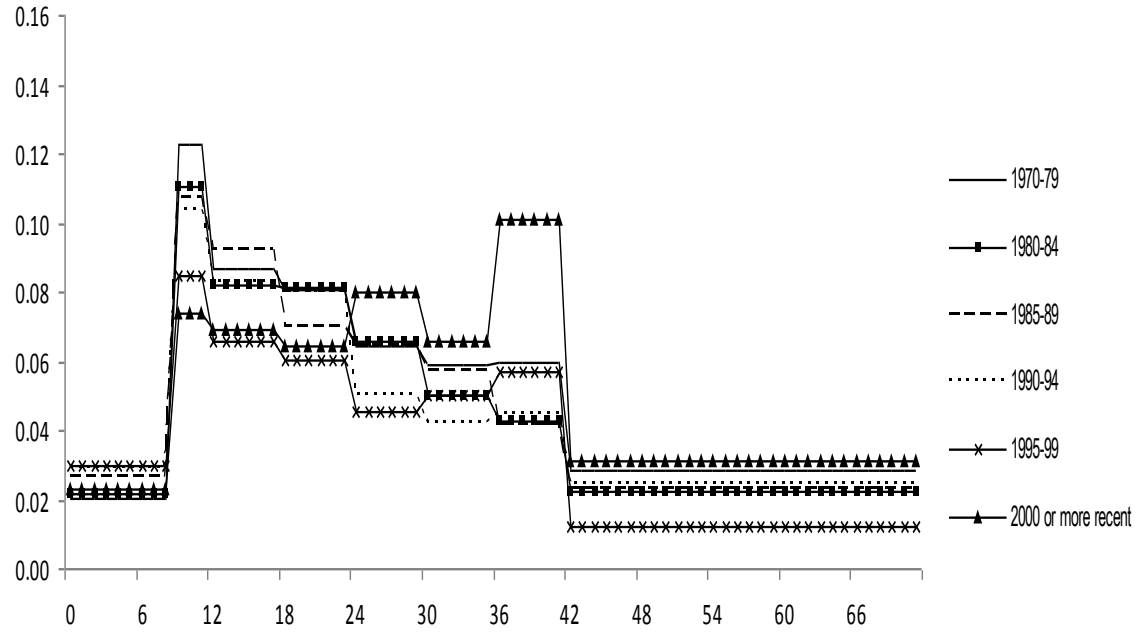
Examining Table 3.6.7 it is evident that in the pre-independence marriage cohorts (1970-79, 1980-84, 1985-89) the cumulative hazard among women with higher education is greater than among women with secondary or lower education, indicating more rapid progression to first birth. However, post-independence (1990-94, 1995-99, 2000 or more recent) this pattern is reversed, as women with a higher education have a longer interval between marriage and first birth than women with secondary or lower education. This is reflected in the downward shift of the hazard of first birth among women with higher education (Figure 3.6.9—b) compared to women with secondary or lower education (plot –a).

Table 3.6.7: Cumulative hazard of first birth at month 36 by marriage cohort and educational level.

Marriage cohort	**Educational level**	
	Secondary or lower	Higher
1970-79	0.909	0.948
1980-84	0.898	0.937
1985-89	0.905	0.924
1990-94	0.887	0.874
1995-99	0.851	0.827
2000 or more recent	0.887	0.863

Figure 3.6.9: Estimated monthly hazard of first birth by marriage cohort given a) secondary or lower education and b) higher education

a)



b)

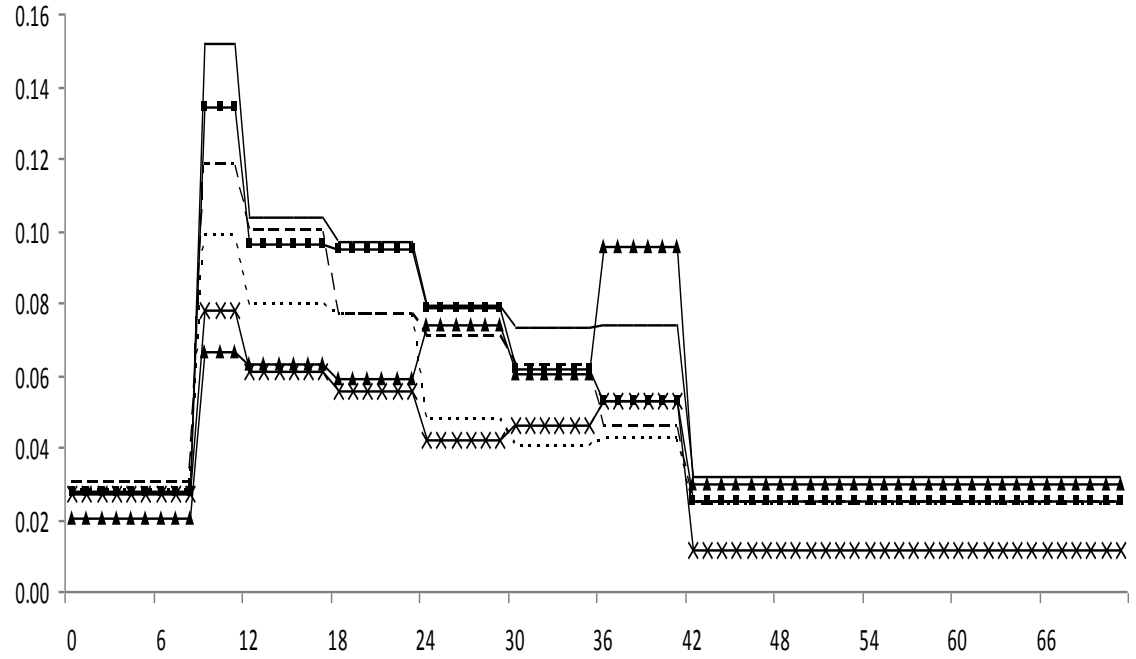
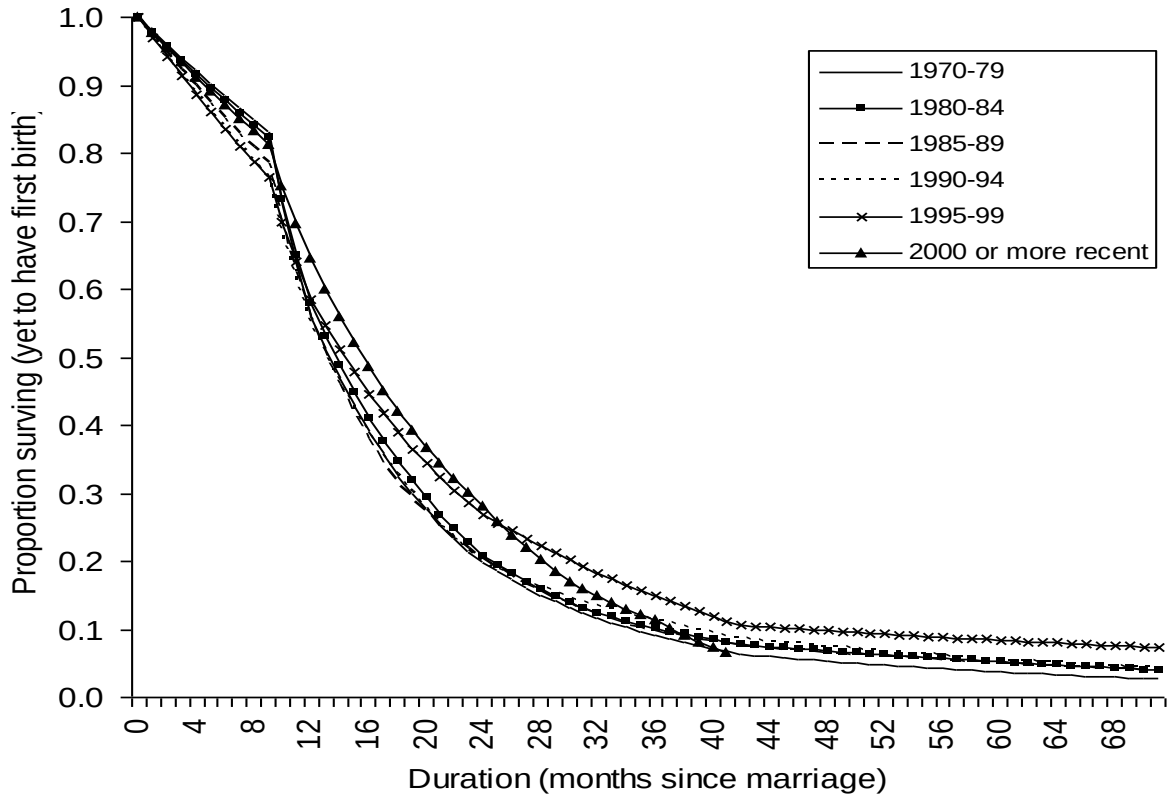
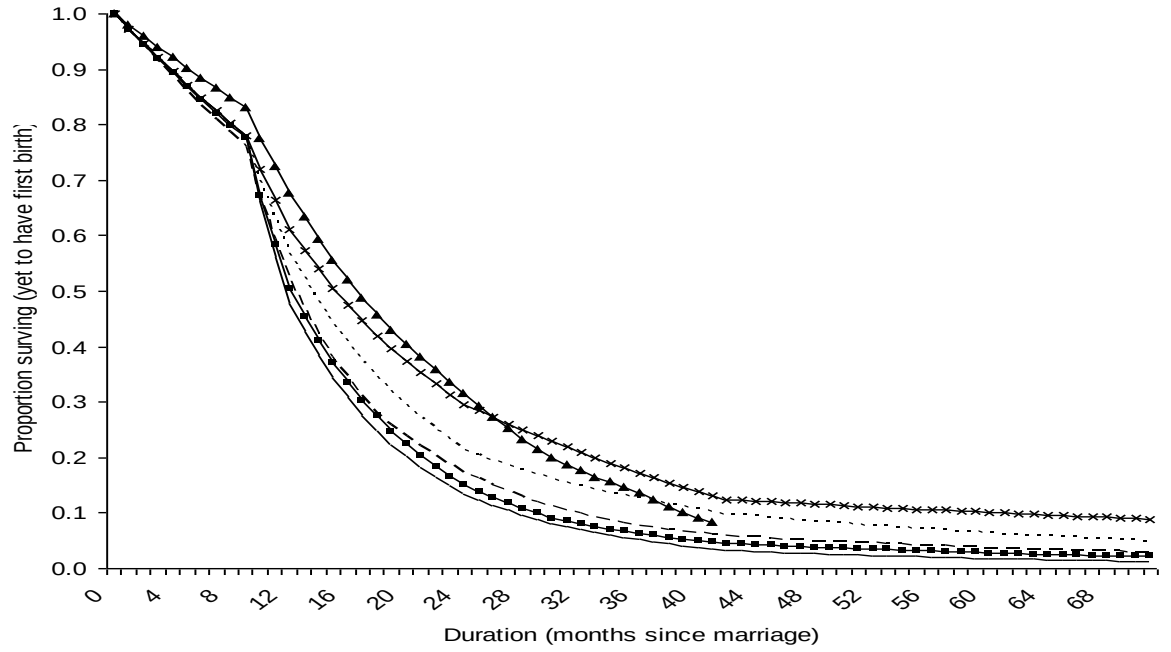


Figure 3.6.10: Survival curve by marriage cohort given a) secondary or lower education and b) higher education

a)



b)



Control variables

The effect of other covariates within the model can be examined directly from the regression model in Table 3.6.4, since the control variables are not involved in interactions and are not time dependent. The effects of the exponentiated estimated β coefficients can be interpreted as approximate hazard ratios due to the low monthly hazard of first births (less than 10%).

Compared to the baseline (age under 20), the hazard of first birth is 24% higher than among women 20-24 and 25-29. There are no other significant effects of age on the hazard of first birth.

Women in rural areas have hazard of first birth 10% higher than women in urban areas. This is indicative of a more rapid transition into motherhood in rural areas resulting from a shorter interval between marriage and first birth. Additionally, women in the north, centre and south regions have hazard of first birth 5%, 15% and 18% higher respectively than women in Chisinau.

For women who separated from their spouse, the odds of first birth are significantly lower than among women whose marriages remained intact, with a 94% reduction in the hazard of birth. For women who had used contraception, the hazard of first birth was 47% lower than among women who started using contraceptive only after first birth.

3.7 Summary and conclusions

Conclusions

The aim of this analysis was to examine the influences on the first birth timing of Moldovan women. The analysis tested the contraceptive confidence hypothesis, which states that women using less effective contraceptive methods space their births in order to achieve a desired completed family size. The hypothesis was

extended to the first birth interval. This analysis also incorporated the key role of induced abortion in Moldova. It was hypothesised that a high propensity to use induced abortion should increase the confidence of natural method users, facilitating a compression of the first birth interval. The analysis also investigated the influences of economic factors on the timing of first births in Moldova. In particular, the analysis tested the validity of the crisis and adjustment explanations.

The first research hypothesis stated that the first birth interval should be longer among women with low contraceptive confidence (natural method users) than among modern method users. The results of the modelling partially supported this hypothesis, as the hazard of first birth was higher among modern reversible method users than among natural method users. The implication of this is that women with low contraceptive confidence have a longer first birth interval than women with moderate contraceptive confidence. However, the specification of the high level of contraceptive confidence is problematic, and although there is some indication that permanent method users have a rapid transition to first birth, the effect is small and should be interpreted with some caution. Overall, the conclusion is that there is some support for the contraceptive confidence hypothesis, but that this is limited by data constraints.

The second research hypothesis extended the conventional contraceptive confidence hypothesis to examine the importance of induced abortion. Higher propensity to use induced abortion should be associated with higher contraceptive confidence and a shorter birth interval. Women with no abortion history had the lowest hazard of first birth and hence the longest wait until first birth. The use of induced abortion was associated with a higher hazard of first birth - indicating a quicker entry into motherhood. However this trend was not monotonic - women with the highest abortion ratio had a lower hazard of first birth than women with low and medium abortion ratios. Therefore, the conclusion is that results from regression modelling support this hypothesis, although only partially.

The results indicate a clear postponement effect among post-independence marriage cohorts. There is no significant interaction between the cohort of marriage and asset wealth, which would have indicated the suppression of first birth due to economic crisis. Therefore, this analysis concludes that there is no evidence for the crisis effect or, at the very least, that the effect was homogenous across economic strata. Women with a higher educational level were more likely to have a birth rapidly following marriage during the Socialist (pre-1991) marriage cohorts when compared to women with 'secondary or lower' education. However, in the post-independence era, women with higher education have increasingly lengthy intervals between marriage and first birth. This pattern is consistent with increasing adjustment, and a greater convergence on a Westernised fertility regime in Moldova - at least among the more highly educated women. In many Western countries, non-marital childbearing is increasingly common. However, Moldovan women still experience high marriage rates and first birth is almost universal (Sobotka 2003) – although the timing does vary by educational attainment. This indicates that while marriage is not a barrier to career progression in Moldova, entry into motherhood still entails some withdrawal from the labour force - perhaps reflecting the removal of state childcare facilities post-independence. While this has less of an impact on women with lower educational attainment, women who are more highly educated find the disruption to career progression more significant.

Discussion

The major aim of this analysis was to establish whether the contraceptive confidence hypothesis applied to first births in Moldova. Broadly, the results support the existence of the contraceptive confidence effect, since natural method users have a longer duration between marriage and first birth than modern (reversible) method users. The persistence of natural methods in Moldova means that this is pertinent to variation in Moldovan first birth timing in a modern context. Additionally, establishing the effect of contraceptive confidence on first birth intervals is a substantial advance on previous work (e.g. Ní Bhrolchaín 1988, Keyfitz 1980) which was unable to control for external influences - which this analysis does explicitly.

There are caveats to the conclusions. In particular, the behaviour of permanent method users is inconsistent, since the highest level of contraceptive confidence does not exhibit the shortest birth intervals. This perhaps indicates the problems in measuring the level of contraceptive confidence from method used at survey - in particular, the high number of abortion experienced by permanent method users could indicate the use of permanent method due to contraceptive failure consistent with Zavier and Padmadas (2000). Additionally, the behaviour of non-users at survey is difficult to explain. The very slow progression to first birth among this group has been attributed to sub-fecundability, an effect which is robust to age standardisation. However, the lack of any information pertaining to the first birth interval is a severe limitation in explaining this behaviour. Therefore, it is not possible to completely explain the patterns of first birth in Moldova via the contraceptive confidence hypothesis, although there is partial support for this conclusion.

Induced abortion is a key component of the fertility control regime in Moldova, and interacts strongly with the fertility patterns of natural method users. However, evidence from the analysis indicates a dichotomous relationship between abortion ratio and birth intervals. Although the extension of the contraceptive confidence hypothesis to incorporate the effect of induced abortion builds on previous theory (e.g. Ní Bhrolchaín 1988, Keyfitz 1980), the results do not correspond exactly with the expected relationship. Two explanations are possible. Firstly, the variable measuring abortion ratio could be misspecified. The MDHS did not collect a propensity to use induced abortion at time of marriage, and it is therefore difficult to assess whether the abortion ratio is accurately capturing the information required. The second explanation is that the effect of abortion truly is dichotomous: the contrast in examining the effect of abortion on first birth interval among natural method users is simply a contrast between women who are prepared to use induced abortion and those who are not. Often recourse to one abortion is associated with an increased likelihood of subsequent abortions due to rationalisation processes

(Westoff 2005). This is also the case in Moldova, where the progression ratio from first to second abortion is 40.9% (author's calculations, MDHS 2005).

Chapter 4: The effect of contraceptive confidence on inter-birth intervals in a setting with high levels of induced abortion

Abstract:

Contraceptive confidence is a concept that considers the interval between births as a cyclical process, with each cycle representing the time from a pregnancy and resultant birth until the next pregnancy. The contraceptive confidence hypothesis is that natural method users space births, while modern method users adopt a stopping strategy (Keyfitz 1980, Ní Bhrolchaín 1988). The hypothesis to date has been tested in historic Western settings but not accounted for the role of induced abortion and has not been extended to post-Socialist settings. The analysis uses the birth-history module of the Moldova 2005 DHS, using a sample of 4733 parity 1 women. A piecewise constant hazard repeated-events model is employed to examine the effect of contraceptive method and abortion on inter-birth intervals. The model controls for proximate determinants of fertility and socio-economic factors. The results show that women with low contraceptive confidence have longer birth intervals than women with high contraceptive confidence. That said, the limitations to the measurement of contraceptive confidence are important. Abortion use is associated with a longer interval between births, but not consistent with stopping behaviour.

Notes:

The findings from this paper were presented at 2009 British Society for Population Studies Annual Meeting, University of Sussex.

4.1: Introduction

The contraceptive confidence hypothesis is that women with low contraceptive confidence (natural method users) space births to achieve their desired family size, while women with high confidence (modern method users) adopt a stopping strategy (Keyfitz 1980, Ní Bhrolchaín 1988). At the start of the European fertility transition, women used natural contraceptive methods through their entire reproductive span to space their births and reduce their fertility. Technological innovations increased contraceptive efficacy and allowed women to use modern methods to prevent further births and complete their fertility in a shorter period. The contraceptive confidence hypothesis explains the compression of inter-birth intervals associated with improved contraception (Keyfitz 1980, Ní Bhrolchaín 1988).

The study of contraceptive confidence has so far been limited to Western settings during the European fertility transition (e.g. Ní Bhrolchaín 1988, Hionidou 1998). In Moldova, the prevalence of natural contraception is intractably high, accounting for 24% of all contraceptives used by currently married women (Moldova Demographic and Health Survey MDHS 2005). Despite this, there has been little research aimed at understanding how women or couples manage natural method use in the post-Socialist context. This analysis therefore aims to fill this research gap by examining differential fertility patterns and the effect of contraceptive confidence on fertility timing in Moldova.

Existing literature has tested only considered contraceptive confidence to be a function of the efficacy of contraceptive methods (Keyfitz 1980). However, abortion accounted for a large proportion of the European fertility reduction at the start of the 20th century. Szreter *et al.* (2003) estimate that as much as 50% of the decline in European fertility may have been due to abortion use. In Moldova, use of induced abortion is a key component of fertility control - natural contraceptive methods are used in combination with induced abortion to prevent unwanted childbearing (Agadjanian 2002, Westoff 2005, 2000). This behaviour is particularly common among older, parous women. This analysis considers the interactive effect of

abortion and contraceptive method on inter-birth intervals. In particular, the effect of abortion use on the contraceptive confidence of natural method users is considered. This not only extends the contraceptive confidence hypothesis to account for modern fertility control behaviours, but also provides an insight into potential revisions of the contraceptive confidence hypothesis in historic European contexts, where the effect of induced abortion has been ignored.

The remainder of this chapter is structured as follows. Section 2 examines the theoretical influence of contraceptive confidence on inter-birth intervals, and formalises the research hypotheses of this paper. Section 3 outlines the data used for this analysis. Potential explanatory variables for this analysis are examined in Section 4 and the methodology and modelling strategy are outlined in Section 5. Results from descriptive analysis and regression modelling are presented in Section 6. Section 7 summarises the main findings, draws conclusions and discusses potential implications.

4.2: Theoretical motivation and research hypotheses

This section considers in detail how contraceptive confidence can influence inter-birth intervals, and provides historical evidence for the contraceptive confidence effect. From this, the first research hypothesis is derived. The extension of the contraceptive confidence hypothesis to incorporate induced abortion is also considered, with the second research hypothesis also presented.

4.2.1 The effect of contraceptive confidence on birth timings

The effect of contraceptive confidence was first proposed by Keyfitz (1980). The hypothesis explains the effect of the efficacy of contraception on the interval between births. *Ceteris paribus*, women using a less effective contraception are expected to have a longer interval between births than women using a more effective contraceptive. The interval between births comprises a fixed component (gestational period and postpartum infecundability) and a variable component

(waiting time to conception). This is summarised in Equation 4.1 (Keyfitz and Caswell 2005, p.400), presented below.

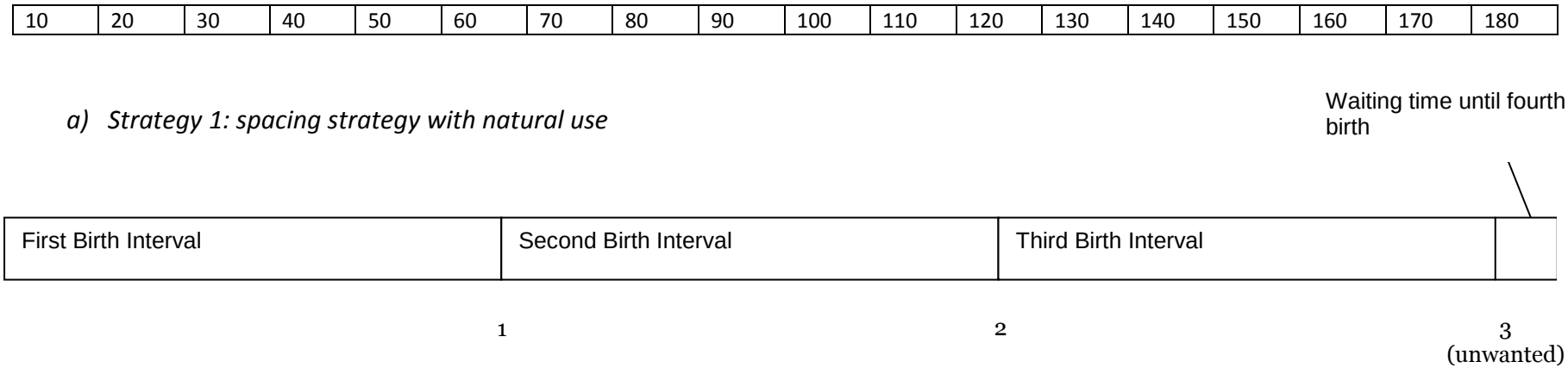
$$L = \frac{1}{p} + C$$

Equation 4.1

In equation 4.1, L is the inter-birth interval, p denotes the average[6] monthly probability of conception, and C is the constant period of infecundability following birth. Using a contraceptive reduces the value of p, hence increasing the expected length of time between births. More effective contraceptive methods reduce p by a greater amount than less effective methods. For women who practise near perfect contraception $p \approx 0$ and the length of the following birth interval tends to infinity. The implications of different levels of contraceptive efficacy on L are explored in Figure 4.2.1

[6] Fecundability tends to decline with age (Braun, 1980; Larsen and Vaupel, 1993), but in this instance fecundability is set at the population average value.

Figure 4.2.1: Comparison of family limitation strategies, contraceptive confidence hypothesis



Birth intervals calculated using equation 4.1

Each segment (top) refers to 10 months of exposure

 Denotes period of no method use (p =0.070, L = 32.3)

 Denotes period of natural method use (p =0.025, L = 58.0)

 Denotes period of IUD use (p =0.003, L = 351.3)

'Birth interval' refers to the period between births observed in the reproductive window
'Waiting time until birth' refers to period from the last birth to a future but unrealised birth.

C =18, comprising 9 months of gestation and 9 months postpartum infecundability.

Figure 4.2.1 explores the fertility timing strategy available to a hypothetical woman who exhibits the fertility characteristics at population average levels (equation 4.1). The woman marries at age 25, experiences menopause at age 40 and desires 2 children. Three potential birth spacing strategies are explored.

Under strategy 1 (plot a), the women uses withdrawal to space her births. Her monthly probability of conception is 0.025 (Hatcher et al. 2004) and hence the mean birth interval is 58 months. The total completed family size is 3 children. This is a spacing strategy.

Under strategy 2 (plot b), the woman has two births rapidly, and then uses IUD (the most common modern method in Moldova). For IUD use following the second birth (p =0.003, Hatcher et al. 2004) the expected waiting time to next birth is 351.3 months. The woman does not have another birth, since this is later than her age at menopause. She therefore has 2 births in total - employing a stopping strategy using a modern contraceptive.

Under strategy 3 (plot c) a stopping strategy using withdrawal is considered. The total completed family size is 4 children, substantially exceeding the desired level. Natural method users adopting a stopping strategy will experience larger completed family sizes than modern method users on average. Significantly, this strategy also performs worse on average than strategy 1, indicating that when only ineffective contraceptive methods are available, birth spacing is the best means of limiting fertility.

It should be noted that these conclusions are based purely on the assumption that the interval between births is a realisation of population average parameters. Clearly, in reality there will be some variation in the parameters in equation 4.1 for individual women – for example some women are more fecund than others. Additionally, the random nature of the birth process means realised completed

family size of natural method users could be very low, or the realised completed family size for modern method users higher.

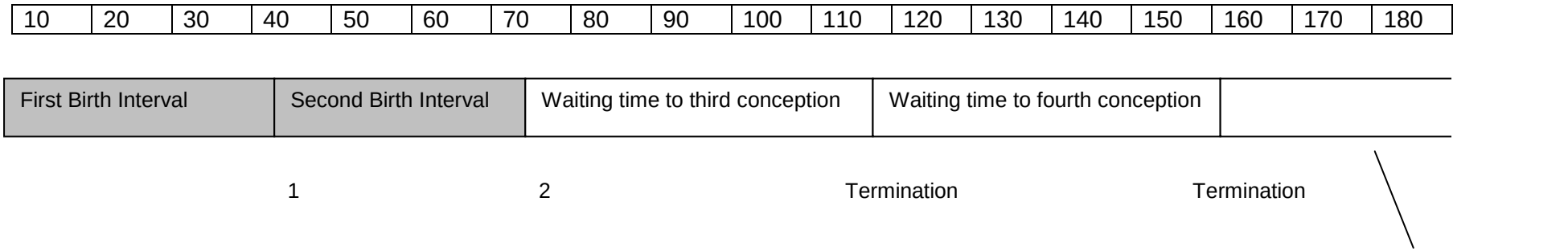
Several authors have compared birth spacing strategies in historical populations. Hionidou (1998) finds Mykoniati women during the early 20th century used natural methods to space births. The introduction of stopping behaviour was preceded by the availability and uptake of modern contraceptive methods - consistent with the contraceptive confidence hypothesis. Santow (1995) cites penitential and legal records, which describe the act of withdrawal in an effort to prevent conception. Fisher and Szreter (2003) describe the dynamics of natural method use among working class couples in 20th century Britain, finding evidence of limited completed family size due to birth spacing. Van de Walle (2000) provides evidence from 16th century French short stories, where withdrawal is used to reduce completed fertility. The effect of contraceptive confidence is also evident in a modern context, Padmadas *et al.* (2004) finding that the duration between births is compressed among the users of permanent methods. Contraceptives therefore could have a demonstrable effect on birth spacing behaviour in both an historical and modern context. This investigation therefore tests the hypothesis in the Moldovan setting:

Hypothesis 1: Natural method users have longer inter-birth intervals than modern method users.

4.2.2 The role of induced abortion in the Moldovan fertility control regime

Keyfitz and Caswell (2005) demonstrate that the use of abortion combined with even a moderately effective contraceptive can have a significant impact in reducing fertility. Widespread availability and acceptability of induced abortion increases the confidence of women in their ability to control their childbearing. This effect is demonstrated in Figure 4.2.2. A natural method user can achieve a family size of 2 children is she is prepared to terminate 2.7 pregnancies.

Figure 4.2.2: Stopping strategy under the regime of natural contraception and abortion



Notes:

Birth intervals calculated using equation 4.1

Each segment (top) refers to 10 months of exposure

- ☐ Denotes period of no method use (p =0.070, L = 32.3)
- ☐ Denotes period of natural method use followed by induced abortion (p =0.025, L = 43.0)

'Birth interval' refers to the period between births observed in the reproductive window
'Waiting time until conception' refers to period from the last birth (conception) to the next conception within the reproductive window which is terminated.

C =3, the gestational period interrupted by induced abortion

Induced abortion combined with natural methods was widely used in historical settings (Szreter *et al.* 2003). Pitkänen (2003) estimates 2000-2500 abortions occurred annually compared to 70,000 births per annum in Finland during the 1930s, although if illegal procedures are included this estimate may be as high as 20,000 abortions. Abortion combined with natural method use was the preferred method for birth control among the Finnish working classes.

The use of induced abortion to control unwanted fertility is common in the former Soviet Union and post-Socialist states (Agadjanian 2002, Popov 1991, Popov et al. 1993, Sobotka 2003, Westoff 2005). Anderson *et al.* (1994) find that there is no significant under-estimation of abortion in Estonia due to social-desirability bias in reporting. Agadjanian (2002) finds that abortion and contraception are perceived as complementary elements of fertility control. The synergy between natural method use and induced abortion is also present in Moldova, where 33% of abortions result from the failure of natural methods (Westoff 2005).This is particularly prevalent among older women, who are more likely to use natural contraceptives (Agadjanian 2002, Lyons-Amos *et al.* 2011).

The availability and acceptability of induced abortion provides a mechanism where natural method users can achieve fertility patterns close to those of a modern method user - effectively increasing their contraceptive confidence by using induced abortion to control their fertility. Therefore, the second research hypothesis proposed is:

Hypothesis 2: Natural method users who make use of induced abortion have shorter birth interval than natural method users who use only contraception.

4.3. Data

Data are drawn from the 2005 Moldova Demographic and Health Survey. This analysis uses the birth history module. The date of birth is collected to the nearest

month as well as whether the child was a twin and whether the child had died. The date of survey is also available, which is used as the date of censoring for open birth intervals.

The MDHS dataset included a module on abortion not available in all DHS datasets. This module asked women to provide information on the number of induced abortions they had had, as well as the total number of pregnancies. The availability of this information allows the estimation of the proportion of pregnancies which ended in induced abortion.

There are a number of limitations of the data used in the present analysis. Firstly, the analysis is constrained to use proxy variables for information not collected directly by the MDHS. For example, the proxy variable of current contraceptive method may not reflect accurately contraceptive use during a birth interval, due to contraceptive switching.

Secondly, the MDHS did not collect marriage histories. This means that determining whether a woman was married or not during a birth interval is reliant on information derived from the length of marriage variable. Finally, information may only be available for some birth intervals. An example of this is the duration of breastfeeding. Breastfeeding postpartum is an important determinant of the birth interval length (Davis and Blake 1956, Bongaarts 1978). However, the duration of breastfeeding is available only for the 4 most recent births, and only if those births occurred with the 5 years prior to the survey.

Analysis sample

The original MDHS sample comprises 7440 women. Since this analysis focuses on the interval between births, 2568 women who are nulliparous at interview are excluded. Childbearing in Moldova is confined mostly within marriage (Sobotka 2003), hence women who had premarital births were excluded, as their birth spacing behaviour is complicated by the date of union formation being after their first child. The analysis

sample for this study therefore comprises 4733 ever-married women of at least parity 1. The majority of women contribute more than one birth (as shown in Figure 4.3.1), and 9442 inter-birth intervals in total (which may either end in birth or right-censored at survey). The distribution of inter-birth intervals in the analysis sample is presented in Figure 4.3.2.

Figure 4.3.1: Distribution of number of inter-birth intervals per respondent, MDHS 2005

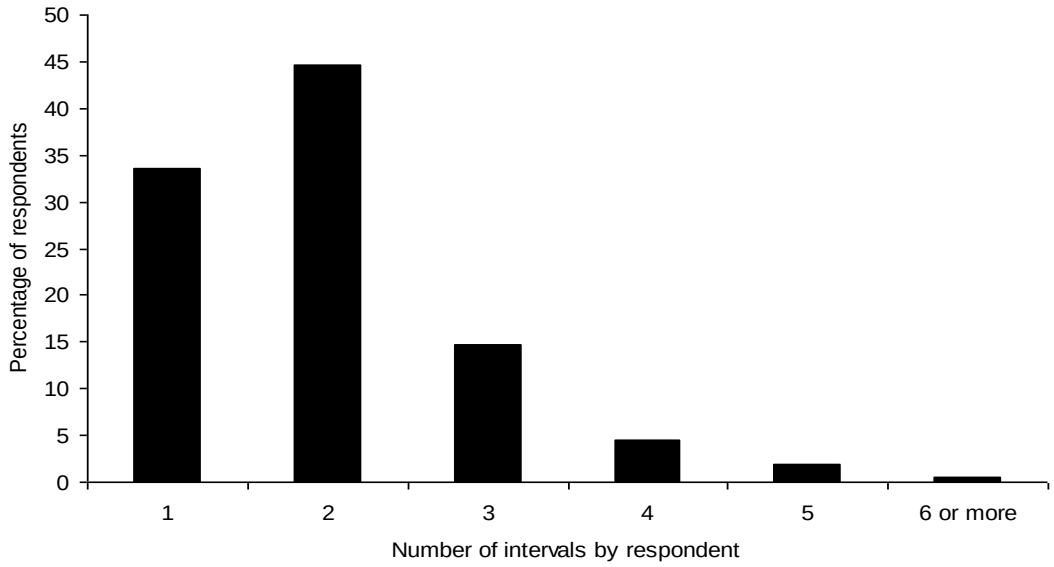
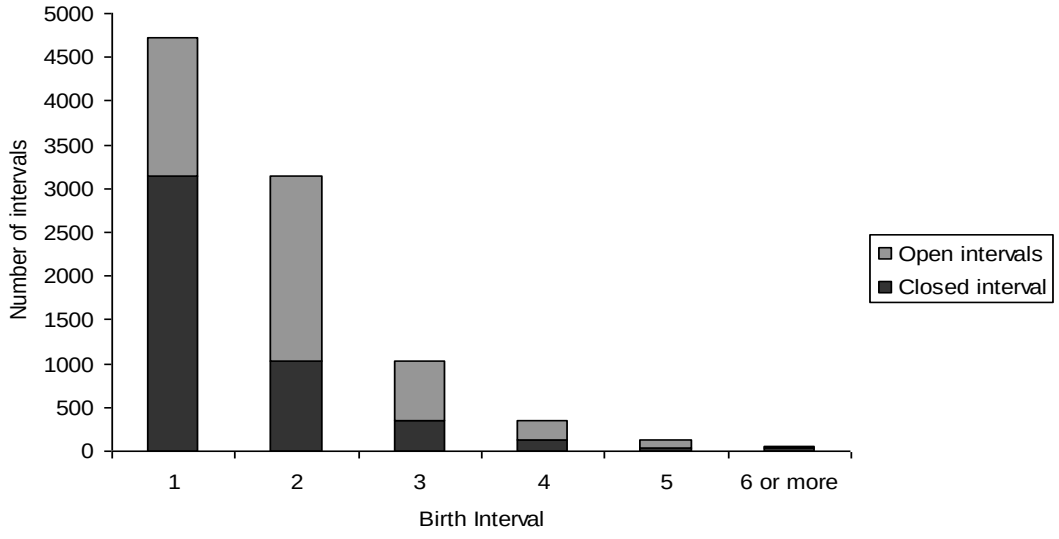


Figure 4.3.2: Distribution of birth intervals in analysis sample (open and closed)



4.4. Explanatory variables

Explanatory variables for this analysis are considered in this section. Current contraceptive method (4.4.1) and abortion ratio (4.4.2) are important proxy variables used to test the research hypotheses. Variables used to control for confounding influences are considered in 4.4.3.

4.4.1: Current contraceptive method

Current contraceptive method is used as a proxy for contraceptive confidence, consistent with Ní Bhrolchaín (1988). Women currently using natural methods are said to have low contraceptive confidence, users of modern reversible methods to have moderate contraceptive confidence and women using permanent methods to have high contraceptive confidence. Non-users at survey are said to have their contraceptive confidence unobserved.

There are a number of issues associated with this measure of contraceptive confidence. Firstly, there is a lack of correspondence between the current contraceptive method and the method used during a given birth interval, due to possible method switching. This limitation is highlighted by Ní Bhrolchaín (1988) and is a particular issue for permanent method users (Zavier and Padmadas 2000). To reduce the effect of contraceptive switching, this analysis incorporates a measure of the previous contraceptive method discontinued. An interaction between the current contraceptive method and the previous method is able to capture the most recent change in the measured level of contraceptive confidence. An additional problem with the use of the current contraceptive method is that the inter-birth interval can depend on whether a contraceptive is being used for stopping behaviour. For effective method users, inter-birth intervals should be short but the final (open) birth interval should be long (Hionidou 1998, Keyfitz 1980). An interaction between current contraceptive method and parity overcomes this problem.

There are further limitations in the measurement of contraceptive confidence. The current contraceptive measure assumes that contraceptive confidence is a fixed measure. In reality, confidence is likely to wax with longer durations of successful use and wane following contraceptive failure. It is assumed therefore that the current contraceptive reflects the average contraceptive confidence across the reproductive life course.

Reverse causality between birth interval and contraceptive method is an additional problem. This analysis assumes that the inter-birth interval is a function of contraceptive confidence. Reverse causality could occur where a short interval between birth prompts a switch to a more effect method of contraception (Zavier and Padmadas 2000). The resulting pattern of birth spacing is consistent with the contraceptive confidence hypothesis - effective method users have short inter-birth intervals and a long final birth interval. This makes it difficult to determine whether contraceptive confidence is influencing birth spacing, or whether birth spacing is influencing contraceptive method. Endogeneity is an additional problem which occurs when both the inter-birth interval and contraceptive method are correlated due to another factor –for example, fecundability.

4.4.2: Abortion ratio

The propensity to use induced abortion is estimated by the ratio of abortions and total pregnancies. The abortion ratio is categorised as 'None', Low (0.00-0.39 of pregnancies aborted), Medium (0.40-0.59) and High (0.60-1.00). The reporting of abortion in the post-Socialist setting is accurate, with no evidence of systematic downward bias (Anderson *et al.* 1994). Abortion in post-Socialist republics is more likely to be used by older women at the end of their reproductive careers to prevent further unwanted births (Westoff 2000, 2005, Sobotka 2003). This association is particularly strong for natural methods users who use abortion to prevent further birth after attaining their desired completed family size (Agadjanian 2002).

The potential issues of reverse causality and endogeneity are a concern for calculating the abortion ratio. While the abortion ratio is intended to capture a propensity to use induced abortion, it is plausible that short inter-birth intervals could precipitate greater abortion use, particularly at higher parities (Westoff 2000, 2005, Sobotka 2003, Agadjanian 2002). The issue of endogeneity (higher abortion use and inter-birth intervals are correlated with, for example, fecundability) is of little concern, since the use of abortion as a spacing mechanism is not prevalent in a post-Socialist context (Agadjanian 2002).

4.4.3 Control variables

Controls for the proximate determinants of fertility are included in the regression model (Davis and Blake 1956, Bongaarts 1978). These are age, contraceptive use, breastfeeding, parity and child death. The probability of birth is lower among older women due to lower fecundability (Van Bavel 2003). The parity at first contraceptive use has a clear effect on the probability of conception. This variable is included in addition to current contraceptive to measure the onset of contraceptive use rather than contraceptive confidence.

Breastfeeding extends the postpartum infecund period and overall inter-birth interval, as noted in Equation 4.1. This effect has been exploited in historical populations to space births and reduce fertility (e.g. Hionidou 1998). Unfortunately, the duration of breastfeeding is not available for each birth interval in MDHS. Therefore, the 'ever use of LAM' (Lactational Amenorrheic Method) is used as a proxy for determining the use of breastfeeding postpartum, with the expectation that women who have used LAM should have longer inter-birth intervals than those who have not.

Coital frequency is a key determinant of birth intervals but data are not available from the MDHS. This analysis therefore attempts to control for the effect of coital frequency through two mechanisms. Firstly, the random effects (ν_j) in regression

models are widely used to capture systematic variations in coital frequency at the woman level (e.g. Leite and Gupta 2007,Steele and Curtis 2003, Steele *et al.* 1996, Steele *et al.* 1999). Secondly, an explanatory variable comprising the duration of marriage at the start of each birth interval is used as a fixed effect. Van Bavel (2003) finds that higher marital durations tend to significantly decrease age specific birth rates by roughly 5% per year of marriage. This decline is attributed to falling coital frequency. The analysis also includes an estimate of spousal separation, which captures the effect of interruption to regular coital activity due to partnership dissolution.

Parity can influence birth intervals through two mechanisms. Firstly, higher parity is associated with contraceptive stopping behaviour. Interactions between current contraceptive method and parity should deal with this issue. Secondly, parity can induce secondary sterility. Braun (1980) notes that the mean birth interval is consistently longer for higher parity women after controlling for age effects. Larsen and Vaupel (1993) find the hazard of conception decreases as parity increases.

The death of older children can influence the length of the inter-birth interval. This can either be due to the reduction of the postpartum period due to the suspension of breastfeeding (Keyfitz and Caswell, 2005) or through couples trying to replace a dead child (Van Bavel 2003). This study controls for both the death of previous sibling (suspension of suckling), and the death of any older child (replacement). Both these variables are constant across duration, but can vary between birth intervals. These controls are consistent with Van Bavel (2003).

A number of socio-economic variables are included. Type of current employment, seasonality of employment and education are key variables as they are measures of motivation for a return to work and hence the strength of the motivation of contraceptive confidence effect (Ní Bhrolchaín 1985, 1986a, 1986b, 1985). Marriage cohort is included to assess the impact of changing macro-socioeconomic conditions on fertility behaviour. As well as affecting the first birth interval (Chapter 3), the effect of changing social conditions is also evident on higher order birth intervals -

for example, Sobotka (2003) notes depressed parity progression in the post-independence period.

Additional control variables (asset wealth index category, urban/rural residence, region of residence, exposure to FP media, knowledge of HIV/AIDS and ethnic group) are included as these were found to be significant by Lyons-Amos *et al.* 2011.

4.5. Methodology

The methodology section describes the regression model employed in this analysis. In particular, the advantage of using a multilevel model for repeated events is considered. The modelling strategy is also described.

4.5.1 Regression model

The response variable for the model is the inter-birth interval, defined as duration in months between births. These are analysed using a piecewise constant hazards model which is a form of discrete time hazards model in which the duration variable comprises pieces of a number of months. The advantage of this model is that it avoids potential misspecification of the underlying hazard distribution (required for parametric models) and the bias of parameter estimates in Cox models which can result from tied failure times (Yamaguchi 1993). Further, the dataset size and computational time is considerably reduced compared to a standard discrete time model, especially when random effects are incorporated (Steele and Curtis 2003, Steele *et al.* 1996, Steele *et al.* 1999).

Let p denote of piece of a number of months (*t*). For piece p the random variable y_{ij} for birth interval (*i*) for woman (*j*) can take two values, where $y_{ij} = 1$ if interval *i* for woman *j* results in birth, and $y_{ij} = 0$ if not. From this probability of birth in piece p for interval (*i*) for woman (*j*), is defined as $\pi_{ij}(p) = \Pr[y_{ij}(p) = 1 | y_{ij}(p-1) = 0]$. It is assumed that $y_{ij}(p = 0) = 0.$ The model takes form of Equation 4.2, presented below.

$$\ln\left[\frac{\pi_{ij}(p)}{1-\pi_{ij}(p)}\right]=\alpha(p)+\boldsymbol{\beta}^{T}\mathbf{x}_{ij}(p)+\nu_{j}$$

Equation 4.2

In equation 4.2 $\alpha(p)$ is a series of dummy variable capturing the baseline hazard , $\boldsymbol{\beta}^{T}$ is a transposed vector of beta coefficients and $x_{ij}(p)$ a vector of explanatory variables for piece *p*. In equation 4.2 α and β are independent, indicating proportional hazards. Interactions between α and β can be specified to detect non-proportional hazards. ν_{j} is the woman (*j*) level random effect which is assumed to follow the Normal distribution $\nu_{j} \sim N\left(0,\sigma_{j}^{2}\right)$. This random effect is included as women may contribute more than one birth interval (see Figure 4.3.1). The hazard of birth in these intervals is likely to be correlated due to unmeasured characteristics (such as fecundability or coital frequency) which if unaccounted for result in underestimated standard errors and the attenuation of β estimates due to selection effects (Box-Steffenmeier and De Boef 2006, Wienke 2003). The effect of ν_{j} on $\pi_{ij}(p)$ is assumed to be proportional, and either raises or lowers $\pi_{ij}(p)$ by a constant value across p .

In contrast to the model presented in Chapter 3, the model presented in Equation 4.2 is specified with an overall intercept. There are two major reasons for this. The model could have been estimated with no overall intercept (allowing a more straightforward derivation of the estimated hazard), with a separate woman (*j*) level effect for each $\alpha(p)$ parameter. However, this implies that woman level characteristics can differ for the same individual at each time interval. This is not a realistic assumption. Secondly, it is more difficult to obtain a convergent solution for a ν_{j} parameter for each $\alpha(p)$ - especially for higher values of *p* where $\pi_{ij}(p)$ is very low.

For the purposes of interpretation, the model is used to estimate the monthly hazard of first birth ($h(t)$), where the hazard of birth is defined as $\pi_{ij}(p)$ divided by the average time until event for piece *p.* The hazards estimated from the model are reported directly, and also used to generate cumulative hazards of birth at month 36 ($\Lambda(36)$), defined as $\Lambda(36) = 1 - \prod_{t=0}^{36}[1 - h(t)]$. Additionally, survival curves are presented, which describes the proportion of women yet to have next birth by month *t* postpartum. Cumulative survival ($S(t)$) is defined as $S(t) = \prod_{t=0}^{t}[1 - h(t)]$. In all calculations, the estimated hazards are median hazards, where the random effect ν_j is set to zero.

4.5.2 Model selection strategy

The model building strategy starts with a null model, which includes the random effect ν_j but includes no duration variable ($\alpha(t)$) or other explanatory variables. This ensures convergence of the random part of the model. The duration variable ($\alpha(t)$) is then added to the model followed by the conceptually important explanatory variables of current contraceptive method (as a proxy for contraceptive confidence) and abortion ratio (propensity to use induced abortion). All other potential explanatory variables are entered into the model using a stepwise modelling procedure and tested for significance at the 5% level using a Joint Wald test.

Once all significant main terms have been determined, pre-specified interactions are added to the model. An interaction between current contraceptive method and induced abortion propensity is considered to detect effects of induced abortion specific to different type of method users - e.g. the relationship between natural method use and induced abortion. An interaction between current contraceptive method and previous method discontinued is included to control for switching behaviour. Finally an interaction between current contraceptive method and parity is included to control for stopping behaviour at higher parities. An interaction between induced abortion propensity and parity is also included to detect stopping behaviour

using abortion.The assumption of proportionality of hazards is then relaxed. Interactions between the variable for duration ($\alpha(p)$) and all other β effects in the model are tested for significance at the 5% level, using a Joint Wald test. The significance of the interaction between time and existing effects is indicative of non-proportionality.

Models are estimated using MLwiN 2.02 (Rasbash *et al.* 2005). Models are initially estimated using Iterative Generalised Least Squares (IGLS) 1st order Marginalised Quasi Likelihood (MQL). This estimation procedure is used during model building as it is highly likely to converge. Once selected, the model is re-estimated using Markov Chain Monte Carlo (MCMC) estimation from 80,000 MCMC samples with a burn-in of 5000 samples. This re-estimation is necessary since 1st order MQL can provide severely downward biased estimates of standard errors and variances particularly when the number of observations per cluster (woman) is small (Browne 2009, Steele *et al.* 1996, Breslow and Clayton 1993). Starting values for the MCMC chains are taken from the initial MQL model.

4.6 Results

The results section presents descriptive analysis in Section 4.6.1, which gives first impressions of the association between inter-birth intervals and key explanatory variables. Results from the modelling are presented in Section 4.6.2, including a discussion of both the random effects and fixed effects on inter-birth intervals.

4.6.1 Descriptive analysis

The analysis sample for the subsequent births model consists of 4733 women, who contributed 9442 inter-birth intervals. This distribution explanatory variable is presented in Table 4.6.1. Variable which are fixed characteristics (they do not vary between intervals for the same woman) and are presented in Table 4.6.1 a while variables which can differ between intervals for the same women are presented in Table 4.6.1 b.

Table 4.6.1: a) Distribution of women and birth intervals by potential explanatory variables (fixed) and b) Distribution of intervals by potential explanatory variables (vary by interval)

a) Distribution of women and birth interval by potential explanatory variables

Variable	Number of women	Number of intervals	Percentage of intervals ending in birth	Kaplan-Meier median survival time
All	4733	9442	49.9	88.0
Current contraceptive method				
Modern reversible (moderate contraceptive confidence)	1816	3470	47.7	94.0
Non-use (Unobserved)	1581	3080	48.7	101.0
Natural method (Low confidence)	1096	2338	53.1	71.0
Permanent method (High confidence)	240	554	56.7	81.0
Abortion ratio				
None	2173	4093	46.9	85.0
Low	882	2239	60.6	66.0
Medium	1063	2112	49.7	97.0
High	615	998	38.4	-[a]
Last method discontinued				
Modern	1052	1909	44.9	100.0
Natural	1054	2041	48.4	70.0
None recorded	2627	5492	52.2	91.0
Highest education				
Less than secondary	32	68	52.9	55.0
Secondary	3741	7831	52.2	80.0
Higher	960	1543	37.8	259.0
Marriage cohort				
1970-79	743	1919	61.3	76.0
1980-84	955	2269	57.9	80.0
1985-89	861	1819	52.7	103.0
1990-94	888	1668	46.8	105.0
1995-99	715	1119	36.1	82.0
2000 or more recently	571	648	11.9	-[a]
Seasonality of employment				
All year	2574	4877	47.2	116.0
Seasonal	532	1286	58.6	68.0
Occasional	91	166	45.2	117.0
Does not work	1536	3113	50.7	69.0
Type of employment				
Not working	1550	3141	50.7	69.0
Professional/technical	1112	1954	43.1	193.0
Clerical/services	606	1052	42.4	164.0
Agricultural	511	1361	62.5	58.0
Household/services	332	694	52.2	91.0
Manual	622	1240	49.8	99.0

Variable	Number of women	Number of intervals	Percentage of intervals ending in birth	Kaplan-Meier median survival time
Ever separated				
No	4171	8335	50.0	84.0
Yes	562	1107	49.2	126.0
Knows how to avoid AIDS				
No	744	1445	48.5	98.0
Yes	1709	3232	47.1	102.0
Never heard of AIDS	94	241	61.0	46.0
Unsure	2186	4524	51.7	81.0
Region of Residence				
North	1390	2670	47.9	100.0
Centre	1160	2624	55.8	67.0
South	942	2112	55.4	69.0
Chisinau	1241	2036	39.0	-[a]
Urbanicity				
Urban	2640	4624	42.9	140.0
Rural	2093	4818	56.6	65.0
Asset wealth index				
Low	1883	3861	52.5	72.0
Medium	1687	3231	47.8	98.0
High	1213	2350	48.4	99.0
Ethnicity				
Moldovan	3494	7111	50.9	81.0
Romanian	109	189	42.3	178.0
Ukrainian	403	740	45.5	135.0
Russian	339	547	38.0	-[a]
Gagauzan	205	474	56.8	64.0
Bulgarian	120	244	50.8	83.0
Other	63	137	54.0	77.0
Ever used breastfeeding as a contraceptive				
Has not heard of method	1443	2980	51.6	83.0
No	1790	3410	47.5	105.0
Yes	1500	3052	50.9	81.0
Mean length of amenorrhea in past 4 birth intervals				
1-2 months	565	981	42.4	61.0
3-5 months	208	338	38.5	79.0
6-8 months	233	395	41.0	66.0
9-11 months	130	235	44.7	58.0
More than one year	167	308	45.8	57.0
None reported	3430	7185	52.3	100.0

b) Distribution of birth intervals by potential explanatory variables

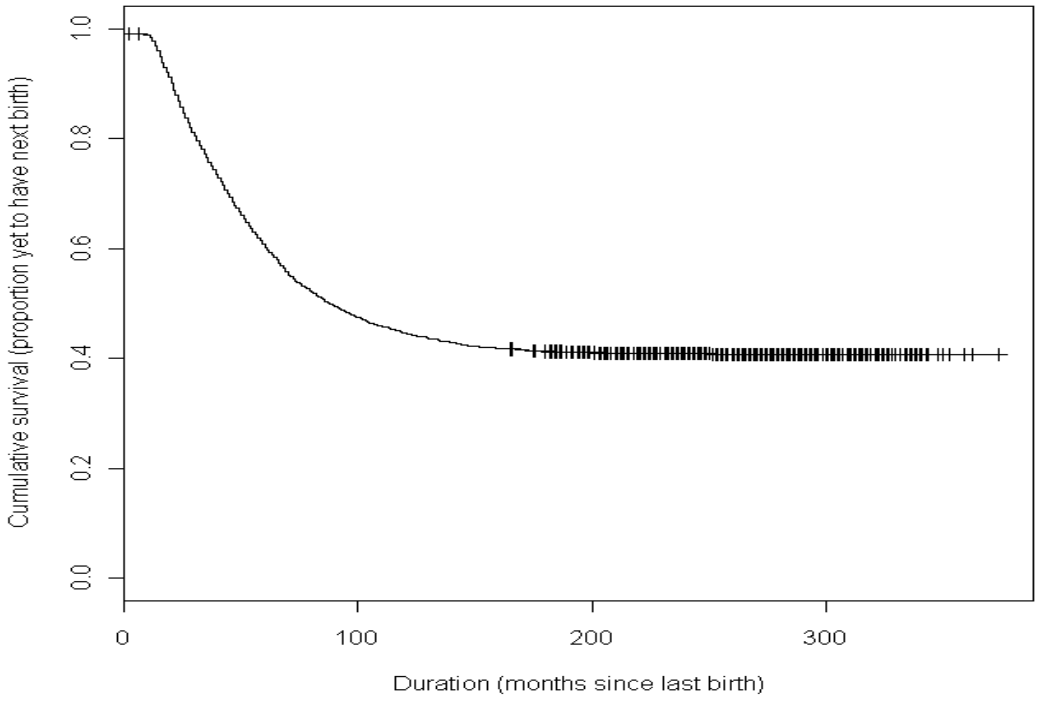
Variable	Number of intervals	Percentage of intervals ending in birth	Kaplan-Meier median survival time
All	9442	49.9	88.0
Separated during interval			
No	9156	51.3	82.0
Yes	286	3.1	-[a]
Has used contraceptive method before or during birth interval			
No	2082	84.5	37.0
Yes	7360	40.1	251.0
Age at interval start			
Less than 19	1366	71.0	54.0
20-24	4458	60.1	67.0
25-29	2479	34.7	-[a]
30-34	901	19.0	-[a]
35 or more	238	11.3	-[a]
Parity (number of previous children)			
1	4733	66.4	55.0
2	2145	32.9	-[a]
3	1036	33.0	-[a]
4	342	36.8	-[a]
5	126	28.6	-[a]
6	36	33.3	-[a]
7 or more	24	50.0	45.0
Previous child died			
No	9148	49.7	88.0
Yes	294	56.1	68.0
Ever had an older sibling die			
No	8917	49.9	183.3
Yes	525	50.1	170.5
Duration of marriage at interval start			
0-4 years	6395	61.7	64.0
5-9 years	2150	28.5	-[a]
10-14 years	714	19.0	-[a]
15-19 years	467	8.4	-[a]
20-24 years	16	6.3	-[a]

Note:
'a' denotes problem in estimating median failure time

In Table 4.6.1 certain strata exhibit a low proportion of intervals ending in failure. This makes the estimation of median survival times problematic, since the median case within the stratum does not experience failure. Where this occurs this is denoted with a superscript 'a.'

The Kaplan-Meier survival distribution for inter-birth intervals is presented in Figure 4.6.1. The survival curve remains high in the period up until 9 months- which reflects extremely low fertility rate in the immediate postpartum period. The cumulative then falls rapidly and levels off - indicating that there is limited progression to higher parities (Sobotka 2003). There are a high proportion of birth intervals which never result in birth – demonstrated by the flattening of the survival curve around month 150.

Figure 4.6.1: Kaplan-Meier distribution for inter-birth intervals



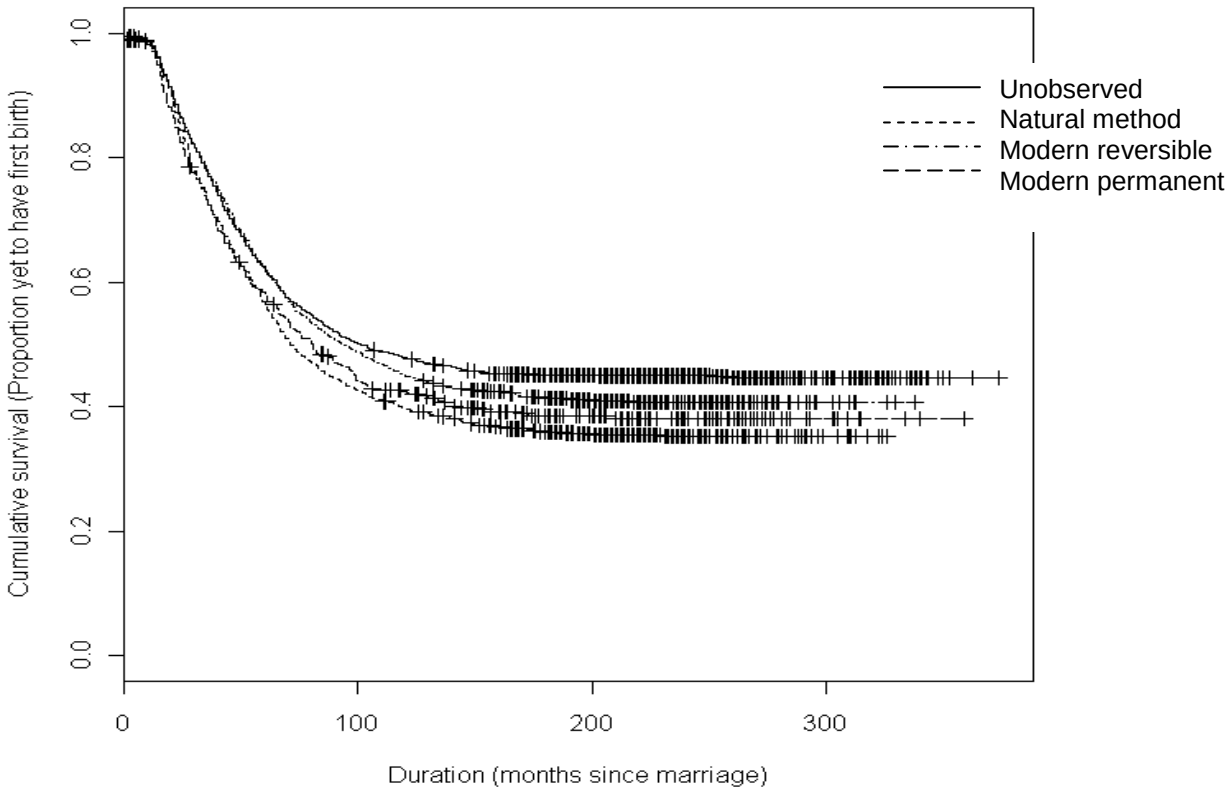
Note:
Median survival time; 88.0 months, 95% confidence interval for median: (82.7, 93.0)
Mean survival time; 183.8, 95% confidence interval for mean (180.2, 187.4)
Number of intervals; 9442
Number of intervals ending in birth (%); 4709 (50.1%)
+ denote censorship occasions

The durations of inter-birth intervals stratified by level of contraceptive confidence are presented in Table 4.6.2 and Kaplan-Meier survival distributions are presented in Figure 4.6.2. Mean survival times are also presented to highlight skewness in the survival distribution. The longest inter-birth interval is found among non-users. In contrast to the contraceptive confidence hypothesis, the shortest average (both mean and median) survival time is found for natural method users, indicating that these women have had the shortest average birth intervals.

Table 4.6.2: Kaplan-Meier estimates of median and mean time to next birth by current contraceptive method

Current contraceptive method (Contraceptive confidence)	Median survival time (95% confidence interval)	Mean survival time (95% confidence interval)
Natural (Low contraceptive confidence)	71.0 (65.5, 76.5)	149.4 (143.3, 155.5)
Modern reversible (Moderate)	94.0(85.6, 124.2)	170.7 (165.2, 176.1)
Modern permanent (High)	81.0 (68.3, 93.7)	168.4 (155.0, 181.9)
Non-use (Unobserved)	101.0 (77.8, 124.2)	195.5 (189.3, 201.7)

Figure 4.6.2: Kaplan-Meier distribution for inter-birth intervals stratified by current contraceptive method



Note:
+ denotes censoring occasions

The descriptive analysis showing the effect of abortion ratio on inter-birth interval is presented in Table 4.6.3 and Figure 4.6.3. For women with a low abortion ratio, the average survival time is shorter than for women with no abortion history. However, for women with a medium or high abortion ratio, the average time until next birth increases - indicating longer inter-birth intervals among these women.

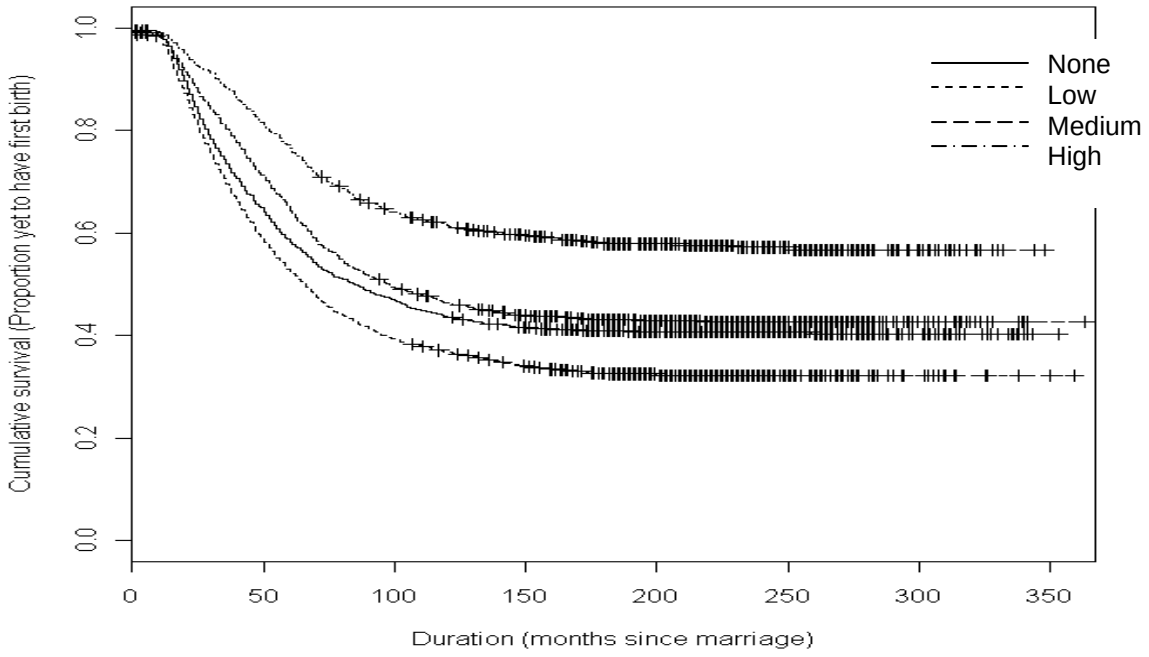
Table 4.6.3: Kaplan-Meier estimates of median and mean time to next birth by abortion ratio

Abortion ratio	Median survival time (95% confidence interval)	Mean survival time (95% confidence interval)
None	85.0 (77.9, 92.1)	172.8 (167.4, 178.2)
Low	66.0 (61.5, 70.5)	150.1 (143.5, 156.7)
Medium	97.8 (4.8, 109.2)	192.0 (184.5, 199.4)
High	-[a]	225.9 (216.5, 235.4)

Note:

'a' denotes problem in estimating median failure time

Figure 4.6.3: Kaplan-Meier survival distribution for inter-birth intervals stratified by abortion ratio



Note:
+ denotes censoring occasions

4.6.2 Regression analysis

The results of the regression modelling are outlined below. These include a description of the random effect capturing the woman level correlation between hazards of birth in different spells, and fixed effects interpreted with the aid of estimated hazards, cumulative hazards and survival curves.

Random effect

The woman level variance from the final model was estimated at 0.141, with a 95% credible interval of 0.076-0.259. The random intercept term specified to control for unobserved influences was therefore significant as the credible interval does not include zero. This indicates that there is a correlation between the hazards of birth for intervals contributed by the same woman. This may be due to factors such as coital frequency and fecundability, which differ systematically between women but are not fully captured by any of the fixed effect terms in the model.

Fixed effects

The final estimated model is presented in Table 4.6.4. This model includes main effects and pre-specified interactions between current method and abortion ratio, current method and parity, abortion ratio and parity, and current method and previous method discontinued. Several time dependent effects were also detected. Current contraceptive method, abortion ratio, marriage cohort, previous method discontinued, previous child death, urbanicity, use of LAM and region of residence were all found to have time dependent effects.

Table 4.6.4 Estimated fixed effects for piecewise hazard regression model for inter-birth intervals

		Variables	$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% credible interval for hazard ratio
		Intercept	-2.747	* *	0.482		
		Months since last births (ref=0-8 months)					
		9-11 months	-1.654		0.884	0.191	0.034 - 1.082
		12-17 months	1.869	* *	0.527	6.479	2.306 - 18.201
		18-23 months	2.016	* *	0.527	7.506	2.673 - 21.074
		24-29 months	2.134	* *	0.534	8.450	2.965 - 24.087
		30-35 months	1.980	* *	0.544	7.246	2.495 - 21.042
		36-41 months	2.058	* *	0.547	7.828	2.678 - 22.881
		42-71 months	4.051	* *	0.503	57.460	21.420 - 154.135
		72 months or more	4.339	* *	0.515	76.598	27.907 - 210.246
		Current contraceptive method (Contraceptive confidence)					
a	b	[ref= Modern reversible (Moderate)]					
		Natural method (Low)	-0.380		0.292	0.684	0.386 - 1.212
		No method (Unobserved)	-0.461		0.254	0.631	0.383 - 1.038
		Permanent method (High)	0.097		0.416	1.101	0.488 - 2.488
		Abortion propensity (ref=No					
a	b	propensity)					
		Low propensity	0.572	*	0.249	1.772	1.088 - 2.888
		Medium propensity	0.190		0.282	1.209	0.696 - 2.100
		High propensity	-0.640		0.464	0.527	0.213 - 1.308
		Age					
		19 or under	0.018		0.049	1.018	0.925 - 1.121
		20-24 (ref)	-	- -	-		
		25-29	-0.192	* *	0.054	0.825	0.742 - 0.917
		30-34	-0.564	* *	0.110	0.569	0.459 - 0.705
		35 or over	-0.727	* *	0.246	0.484	0.299 - 0.783
	b	Marriage Cohort (ref=1979)					
		1980	0.026		0.308	1.027	0.561 - 1.879
		1985	0.244		0.317	1.277	0.686 - 2.376
		1990	0.009		0.344	1.009	0.514 - 1.979
		1995	-0.230		0.423	0.795	0.347 - 1.819
		2000 or more recent	-0.498		0.530	0.608	0.215 - 1.718
a		Parity (ref=1)					
		2	-1.020	* *	0.096	0.361	0.298 - 0.436
		3 or more	-1.122	* *	0.154	0.326	0.241 - 0.441

		Variables	$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% credible interval for hazard ratio
	b	Region of residence (ref=Chisinau)					
		North	-0.292		0.318	0.747	0.401 - 1.392
		Centre	-0.219		0.330	0.803	0.420 - 1.535
		South	-0.520		0.354	0.595	0.297 - 1.191
	b	Urbanicity (ref=Rural)					
		Urban	-0.229		0.244	0.796	0.493 - 1.283
		Educational level (ref=Higher)					
		Less than secondary	0.528	*	0.223	1.695	1.094 - 2.625
		Secondary	0.112		0.062	1.118	0.989 - 1.264
		Work type (ref=Not employed)					
		Professional	-0.434	* *	0.060	0.648	0.575 - 0.729
		Clerical	-0.388	* *	0.068	0.678	0.593 - 0.776
		Agricultural	0.055		0.058	1.057	0.944 - 1.183
		Household	-0.133		0.074	0.875	0.757 - 1.013
		Manual	-0.146	*	0.061	0.864	0.766 - 0.974
		Duration of marriage (ref=0-4 years)					
		5-9 years	-0.558	* *	0.070	0.572	0.499 - 0.656
		10-14 years	-0.879	* *	0.132	0.415	0.321 - 0.537
		15-19 years	-1.980	* *	0.327	0.138	0.073 - 0.262
		20 or more years	-1.765		1.111	0.171	0.019 - 1.510
		Ever had a child died (ref=No)					
		Yes	0.403	* *	0.135	1.497	1.148 - 1.951
	b	Previous child died (ref=No)					
		Yes	0.671		0.538	1.956	0.682 - 5.610
		Wealth category (ref=Low)					
		Medium	-0.117	* *	0.044	0.890	0.817 - 0.969
		High	-0.084		0.049	0.919	0.835 - 1.012
a	b	Previous method discontinued (ref=None)					
		Modern (reversible)	-0.441		0.305	0.643	0.354 - 1.170
		Natural	-0.014		0.278	0.987	0.572 - 1.701
		Used a contraceptive method (ref=No)					
		Yes	-1.176	* *	0.049	0.309	0.280 - 0.339

Continues.

Variables		$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% credible interval for hazard ratio
b Ever used breastfeeding as a method (ref=Yes)						
No		-0.065		0.251	0.937	0.573 - 1.532
Has not heard of method		-0.237		0.258	0.789	0.476 - 1.309
Interaction terms						
Contraceptive confidence x Abortion propensity						
Natural method x	Low propensity	-0.157		0.117	0.855	0.680 - 1.076
Natural method x	Medium propensity	-0.049		0.127	0.952	0.742 - 1.221
Natural method x	High propensity	-0.130		0.195	0.878	0.598 - 1.288
No method x	Low propensity	0.290	* *	0.112	1.337	1.074 - 1.665
No method x	Medium propensity	0.302	*	0.118	1.353	1.074 - 1.705
No method x	High propensity	0.654	* *	0.163	1.923	1.396 - 2.649
Permanent method x	Low propensity	-0.070		0.196	0.932	0.635 - 1.368
Permanent method x	Medium propensity	-0.147		0.208	0.863	0.575 - 1.297
Permanent method x	High propensity	0.387		0.289	1.472	0.835 - 2.596
Contraceptive confidence x Previous method discontinued						
Natural method x	Modern reversible	0.215		0.131	1.240	0.960 - 1.602
Natural method x	Natural	0.369	* *	0.118	1.446	1.147 - 1.824
No method x	Modern reversible	0.300	* *	0.116	1.350	1.076 - 1.694
No method x	Natural	0.234	*	0.118	1.263	1.003 - 1.591
Permanent method x	Modern reversible	0.485	*	0.230	1.624	1.035 - 2.551
Permanent method x	Natural	0.705	* *	0.243	2.023	1.256 - 3.260
Contraceptive confidence x Parity						
Natural method x	Parity 2	0.063		0.111	1.065	0.857 - 1.324
Natural method x	Parity 3	0.203		0.153	1.225	0.907 - 1.655
No method x	Parity 2	0.339	* *	0.105	1.403	1.143 - 1.723
No method x	Parity 3	0.743	* *	0.144	2.102	1.585 - 2.787
Permanent method x	Parity 2	0.021		0.184	1.021	0.712 - 1.465
Permanent method x	Parity 3	0.500	*	0.234	1.649	1.042 - 2.610
Abortion propensity x Parity						
Low propensity x	Parity 2	-0.490	* *	0.104	0.613	0.500 - 0.751
Low propensity x	Parity 3	-0.557	* *	0.126	0.573	0.447 - 0.734
Medium propensity x	Parity 2	-0.408	* *	0.110	0.665	0.536 - 0.824
Medium propensity x	Parity 3	-1.280	* *	0.185	0.278	0.194 - 0.399
High propensity x	Parity 2	-1.389	* *	0.216	0.249	0.163 - 0.381
High propensity x	Parity 3	-0.736		0.424	0.479	0.208 - 1.100

Continues.

Variables		$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% credible interval for hazard ratio
Time dependent effects						
Contraceptive confidence						
Natural method x	9-11 months	0.567		0.476	1.763	0.694 - 4.483
Natural method x	12-17 months	0.234		0.310	1.264	0.688 - 2.322
Natural method x	18-23 months	0.536		0.308	1.709	0.934 - 3.127
Natural method x	24-29 months	0.599		0.310	1.820	0.991 - 3.342
Natural method x	30-35 months	0.496		0.316	1.641	0.884 - 3.048
Natural method x	36-41 months	0.191		0.325	1.211	0.640 - 2.289
Natural method x	42-71 months	0.451		0.299	1.570	0.874 - 2.820
Natural method x	72 months or more	0.460		0.308	1.584	0.866 - 2.895
No method x	9-11 months	0.013		0.455	1.013	0.415 - 2.471
No method x	12-17 months	-0.215		0.274	0.806	0.471 - 1.380
No method x	18-23 months	-0.075		0.273	0.928	0.543 - 1.585
No method x	24-29 months	-0.229		0.278	0.795	0.461 - 1.371
No method x	30-35 months	-0.230		0.282	0.794	0.457 - 1.380
No method x	36-41 months	-0.203		0.284	0.816	0.468 - 1.424
No method x	42-71 months	-0.569	*	0.262	0.566	0.339 - 0.945
No method x	72 months or more	-0.682	*	0.270	0.506	0.298 - 0.858
Permanent method x	9-11 months	-0.060		0.752	0.942	0.215 - 4.114
Permanent method x	12-17 months	0.133		0.441	1.143	0.481 - 2.712
Permanent method x	18-23 months	-0.015		0.448	0.985	0.409 - 2.370
Permanent method x	24-29 months	-0.033		0.454	0.968	0.398 - 2.354
Permanent method x	30-35 months	-0.183		0.467	0.832	0.333 - 2.079
Permanent method x	36-41 months	-0.007		0.462	0.993	0.401 - 2.458
Permanent method x	42-71 months	-0.443		0.432	0.642	0.276 - 1.497
Permanent method x	72 months or more	-0.095		0.444	0.909	0.381 - 2.171
Abortion propensity						
Low propensity x	9-11 months	-0.442		0.451	0.643	0.266 - 1.555
Low propensity x	12-17 months	-0.130		0.267	0.878	0.520 - 1.481
Low propensity x	18-23 months	-0.450		0.267	0.638	0.378 - 1.076
Low propensity x	24-29 months	-0.417		0.270	0.659	0.388 - 1.118
Low propensity x	30-35 months	-0.100		0.275	0.904	0.528 - 1.550
Low propensity x	36-41 months	-0.140		0.279	0.869	0.502 - 1.503
Low propensity x	42-71 months	0.010		0.259	1.010	0.608 - 1.678
Low propensity x	72 months or more	0.193		0.268	1.213	0.717 - 2.052
Medium propensity x	9-11 months	0.106		0.468	1.111	0.444 - 2.781
Medium propensity x	12-17 months	-0.358		0.307	0.699	0.383 - 1.274
Medium propensity x	18-23 months	-0.505		0.304	0.603	0.332 - 1.095
Medium propensity x	24-29 months	-0.521		0.307	0.594	0.325 - 1.084
Medium propensity x	30-35 months	-0.403		0.314	0.668	0.361 - 1.237
Medium propensity x	36-41 months	-0.232		0.315	0.793	0.428 - 1.469
Medium propensity x	42-71 months	0.120		0.290	1.128	0.639 - 1.991
Medium propensity x	72 months or more	0.182		0.298	1.200	0.669 - 2.153

Continues.

Variables		$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% credible interval for hazard ratio
High propensity x	9-11 months	-0.016		0.786	0.985	0.211 - 4.593
High propensity x	12-17 months	-0.200		0.503	0.819	0.306 - 2.193
High propensity x	18-23 months	-0.288		0.500	0.749	0.281 - 1.996
High propensity x	24-29 months	-0.792		0.521	0.453	0.163 - 1.258
High propensity x	30-35 months	-0.051		0.504	0.951	0.354 - 2.553
High propensity x	36-41 months	-0.115		0.506	0.892	0.330 - 2.406
High propensity x	42-71 months	0.260		0.470	1.297	0.516 - 3.259
High propensity x	72 months or more	0.319		0.476	1.376	0.541 - 3.497
Marriage cohort						
1980 x	9-11 months	0.745		0.578	2.106	0.678 - 6.539
1980 x	12-17 months	-0.003		0.341	0.997	0.511 - 1.944
1980 x	18-23 months	-0.058		0.335	0.943	0.490 - 1.818
1980 x	24-29 months	0.077		0.341	1.080	0.554 - 2.107
1980 x	30-35 months	0.221		0.345	1.248	0.634 - 2.455
1980 x	36-41 months	-0.388		0.344	0.678	0.345 - 1.332
1980 x	42-71 months	-0.218		0.323	0.805	0.427 - 1.515
1980 x	72 months or more	-0.516		0.330	0.597	0.313 - 1.141
1985 x	9-11 months	0.365		0.617	1.441	0.430 - 4.834
1985 x	12-17 months	0.096		0.350	1.101	0.555 - 2.185
1985 x	18-23 months	-0.373		0.349	0.689	0.348 - 1.365
1985 x	24-29 months	-0.085		0.353	0.919	0.460 - 1.836
1985 x	30-35 months	-0.178		0.362	0.837	0.412 - 1.701
1985 x	36-41 months	-0.658		0.360	0.518	0.256 - 1.048
1985 x	42-71 months	-0.925	* *	0.335	0.396	0.206 - 0.764
1985 x	72 months or more	-1.148	* *	0.342	0.317	0.162 - 0.620
1990 x	9-11 months	0.461		0.650	1.586	0.444 - 5.666
1990 x	12-17 months	-0.221		0.383	0.801	0.378 - 1.699
1990 x	18-23 months	-0.583		0.380	0.558	0.265 - 1.176
1990 x	24-29 months	-0.478		0.386	0.620	0.291 - 1.321
1990 x	30-35 months	-0.462		0.394	0.630	0.291 - 1.365
1990 x	36-41 months	-1.022	* *	0.395	0.360	0.166 - 0.780
1990 x	42-71 months	-1.086	* *	0.362	0.338	0.166 - 0.686
1990 x	72 months or more	-1.175	* *	0.369	0.309	0.150 - 0.637
1995 x	9-11 months	-0.638		0.955	0.528	0.081 - 3.435
1995 x	12-17 months	-0.172		0.469	0.842	0.336 - 2.112
1995 x	18-23 months	-0.537		0.465	0.584	0.235 - 1.453
1995 x	24-29 months	-0.651		0.474	0.522	0.206 - 1.320
1995 x	30-35 months	-0.147		0.475	0.864	0.341 - 2.189
1995 x	36-41 months	-0.745		0.482	0.475	0.185 - 1.220
1995 x	42-71 months	-1.143	*	0.445	0.319	0.133 - 0.762
1995 x	72 months or more	-1.499	* *	0.466	0.223	0.090 - 0.557
2000 or more recent	9-11 months	-0.603		1.236	0.547	0.049 - 6.169
2000 or more recent	12-17 months	-0.114		0.599	0.893	0.276 - 2.885
2000 or more recent	18-23 months	-0.483		0.601	0.617	0.190 - 2.002
2000 or more recent	24-29 months	-0.273		0.609	0.761	0.230 - 2.512
2000 or more recent	30-35 months	0.074		0.633	1.077	0.312 - 3.723
2000 or more recent	36-41 months	-1.766		0.905	0.171	0.029 - 1.007
2000 or more recent	42-71 months	-2.056	* *	0.698	0.128	0.033 - 0.503
2000 or more recent	72 months or more	(omitted)				

Variables		$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% confidence interval for hazard ratio
Previous method discontinued						
Modern reversible x	9-11 months	0.497		0.502	1.644	0.615 - 4.395
Modern reversible x	12-17 months	0.226		0.327	1.253	0.660 - 2.381
Modern reversible x	18-23 months	0.290		0.328	1.337	0.703 - 2.541
Modern reversible x	24-29 months	0.509		0.330	1.664	0.871 - 3.178
Modern reversible x	30-35 months	0.092		0.340	1.097	0.563 - 2.135
Modern reversible x	36-41 months	0.229		0.341	1.258	0.645 - 2.455
Modern reversible x	42-71 months	0.500		0.313	1.649	0.893 - 3.047
Modern reversible x	72 months or more	0.854	* *	0.319	2.349	1.258 - 4.386
Natural x	9-11 months	0.299		0.483	1.349	0.523 - 3.476
Natural x	12-17 months	-0.345		0.307	0.708	0.388 - 1.292
Natural x	18-23 months	0.004		0.302	1.004	0.556 - 1.815
Natural x	24-29 months	0.324		0.304	1.383	0.763 - 2.507
Natural x	30-35 months	0.172		0.309	1.188	0.649 - 2.175
Natural x	36-41 months	0.092		0.317	1.096	0.589 - 2.042
Natural x	42-71 months	0.444		0.288	1.559	0.888 - 2.740
Natural x	72 months or more	0.934	* *	0.295	2.546	1.427 - 4.540
Previous child died						
Yes x	9-11 months	0.205		0.902	1.227	0.209 - 7.189
Yes x	12-17 months	-0.170		0.583	0.844	0.269 - 2.645
Yes x	18-23 months	0.349		0.561	1.417	0.472 - 4.255
Yes x	24-29 months	0.280		0.571	1.323	0.432 - 4.051
Yes x	30-35 months	-0.163		0.601	0.849	0.261 - 2.760
Yes x	36-41 months	-0.045		0.602	0.956	0.294 - 3.113
Yes x	42-71 months	-0.750		0.565	0.472	0.156 - 1.429
Yes x	72 months or more	-1.178	*	0.591	0.308	0.097 - 0.981
Urbanicity						
Urban x	9-11 months	0.510		0.424	1.665	0.725 - 3.824
Urban x	12-17 months	-0.022		0.270	0.978	0.577 - 1.659
Urban x	18-23 months	-0.130		0.269	0.878	0.519 - 1.487
Urban x	24-29 months	-0.293		0.272	0.746	0.438 - 1.272
Urban x	30-35 months	-0.214		0.275	0.807	0.471 - 1.383
Urban x	36-41 months	-0.082		0.276	0.921	0.536 - 1.583
Urban x	42-71 months	-0.166		0.256	0.847	0.513 - 1.398
Urban x	72 months or more	0.234		0.262	1.263	0.756 - 2.111
Ever used breastfeeding as a method						
No x	9-11 months	-0.635		0.466	0.530	0.213 - 1.321
No x	12-17 months	-0.185		0.278	0.831	0.482 - 1.432
No x	18-23 months	-0.238		0.278	0.788	0.457 - 1.358
No x	24-29 months	-0.187		0.280	0.830	0.479 - 1.436
No x	30-35 months	-0.349		0.284	0.705	0.404 - 1.231
No x	36-41 months	-0.057		0.291	0.945	0.534 - 1.673
No x	42-71 months	-0.087		0.264	0.917	0.546 - 1.540
No x	72 months or more	-0.335		0.270	0.716	0.421 - 1.215

Continues.

Variables			$\hat{\beta}$		SE ($\hat{\beta}$)	Approximate hazard ratio ($e^{\hat{\beta}}$)	95% confidence interval for hazard ratio
	Not heard x	9-11 months	-0.061		0.438	0.941	0.399 - 2.220
	Not heard x	12-17 months	-0.153		0.285	0.858	0.491 - 1.501
	Not heard x	18-23 months	0.077		0.283	1.080	0.620 - 1.880
	Not heard x	24-29 months	0.017		0.287	1.017	0.579 - 1.785
	Not heard x	30-35 months	-0.163		0.292	0.850	0.480 - 1.505
	Not heard x	36-41 months	0.329		0.297	1.390	0.777 - 2.487
	Not heard x	42-71 months	0.061		0.273	1.063	0.623 - 1.814
	Not heard x	72 months or more	-0.394		0.280	0.675	0.390 - 1.168
	<u>Region</u>						
	North x	9-11 months	0.109		0.582	1.116	0.357 - 3.490
	North x	12-17 months	-0.091		0.358	0.913	0.453 - 1.841
	North x	18-23 months	-0.065		0.363	0.937	0.460 - 1.908
	North x	24-29 months	-0.026		0.364	0.974	0.477 - 1.987
	North x	30-35 months	0.142		0.370	1.153	0.558 - 2.383
	North x	36-41 months	0.427		0.371	1.532	0.741 - 3.169
	North x	42-71 months	0.413		0.335	1.512	0.784 - 2.916
	North x	72 months or more	0.369		0.340	1.446	0.742 - 2.819
	Centre x	9-11 months	0.417		0.588	1.518	0.479 - 4.809
	Centre x	12-17 months	0.318		0.368	1.375	0.668 - 2.830
	Centre x	18-23 months	0.790	*	0.370	2.204	1.067 - 4.555
	Centre x	24-29 months	0.477		0.375	1.611	0.773 - 3.357
	Centre x	30-35 months	0.497		0.383	1.644	0.776 - 3.483
	Centre x	36-41 months	0.557		0.387	1.745	0.818 - 3.722
	Centre x	42-71 months	0.644		0.349	1.903	0.960 - 3.775
	Centre x	72 months or more	0.525		0.356	1.691	0.841 - 3.400
	South x	9-11 months	0.630		0.608	1.878	0.570 - 6.180
	South x	12-17 months	0.517		0.392	1.676	0.778 - 3.611
	South x	18-23 months	0.845	*	0.394	2.329	1.076 - 5.037
	South x	24-29 months	0.627		0.397	1.872	0.859 - 4.080
	South x	30-35 months	0.938	*	0.403	2.554	1.160 - 5.623
	South x	36-41 months	0.988	*	0.406	2.685	1.210 - 5.955
	South x	42-71 months	1.051	* *	0.372	2.860	1.378 - 5.933
	South x	72 months or more	0.918	*	0.379	2.505	1.191 - 5.269

Notes:

** denotes significance at 5% level (p<0.01)

* denotes significance at 1% level (p<0.05)

a denotes component in two-way interaction

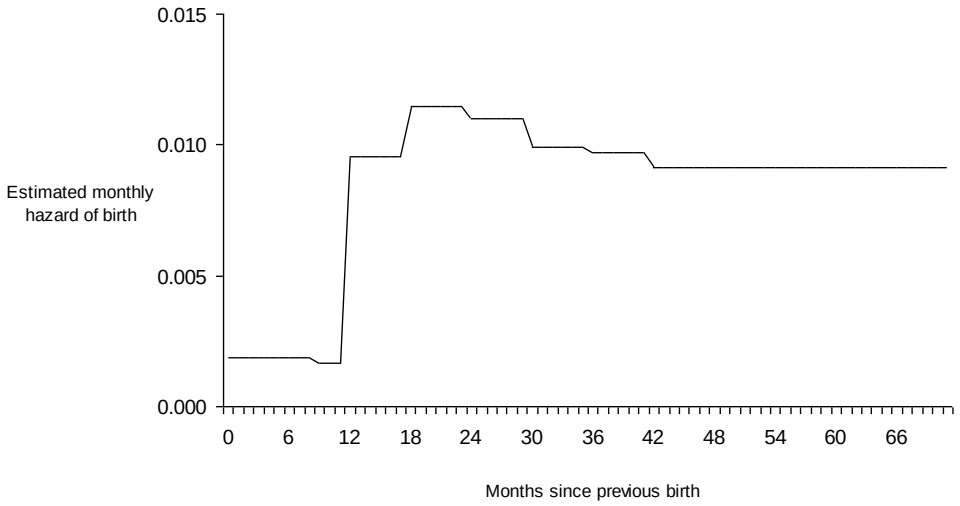
b denotes time dependent effect

Model estimated using 80000 MCMC samples with 5000 burn-in. Starting values for MCMC from 1st order MQL.

No parameter estimates are possible for the term in 42-71 period for the 2000 or more recent marriage cohort as this period is censored by the survey date.

The underlying hazard profile is presented in Figure 4.6.4. Unsurprisingly the hazard of next birth is very low within the first 12 months following the previous birth. Following this, the hazard of birth increases and peaks at 18-23 months. The estimated hazard then decreases - albeit not substantially. It should be noted that the overall hazards are considerably lower than those seen in Chapter 3, indicating that progression beyond parity 1 is relatively rare in Moldova (Sobotka 2003).

Figure 4.6.4: Estimated underlying hazard distribution for inter-birth intervals



Research Hypothesis 1: Contraceptive confidence

The cumulative hazard of birth after 36 months ($\Lambda(36) = 1 - \prod_{t=0}^{36}[1 - h(t)]$) for each current contraceptive method is presented in Table 4.6.5. Current method is interacted with parity to control for stopping behaviour. All other variables are set to baseline values, with the exception of abortion ratio which is set to mean sample proportions

Table 4.6.5: Cumulative 36 month hazard of next birth by current contraceptive for each parity (at mean abortion ratio)

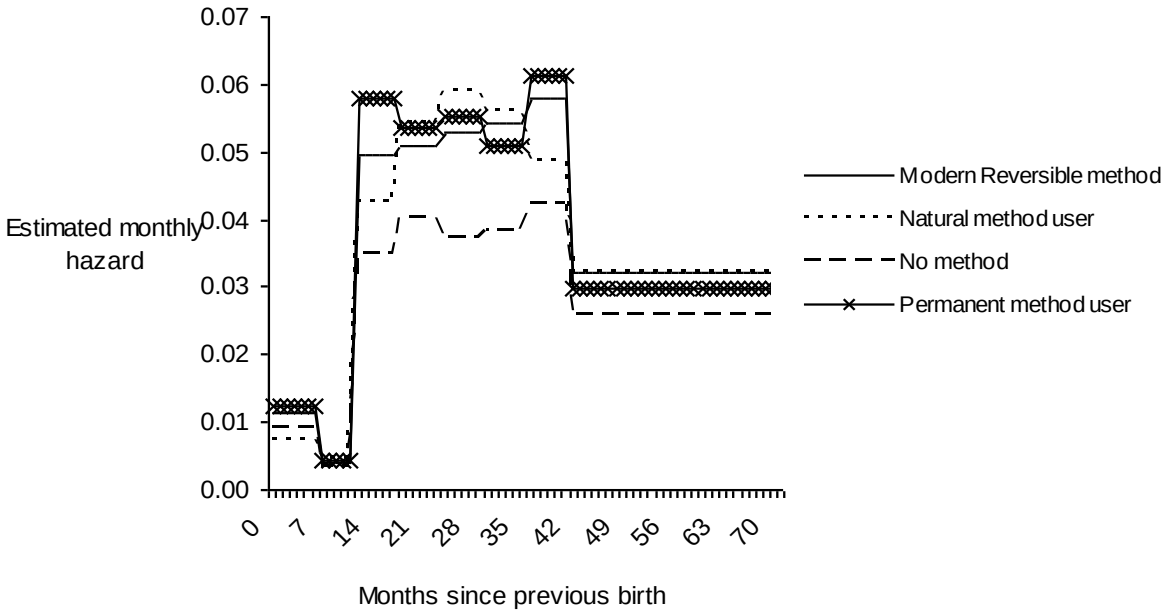
Current contraceptive method (Contraceptive confidence)	Parity		
	1	2	3 or more
Natural method(Low)	0.76	0.37	0.35
Modern reversible (Moderate)	0.76	0.36	0.30
Permanent method (High)	0.78	0.39	0.45
No method (Unobserved)	0.65	0.34	0.38

The cumulative hazard of next birth is generally lowest among women who are current non-users. Non-users have the highest proportion of women infecund of any contraceptive method (41% in the analysis sample - in comparison to 2.1% of natural method users, 1.0% of modern reversible method users and 26.1% of permanent method users reported to be infecund at survey, author's calculations from MDHS 2005). This pattern is robust to age standardisation. However, it is a strong assumption to make that there is no selectivity or reverse causality generating this pattern. The low cumulative hazard of birth among non-users is therefore attributed - albeit cautiously - to low fecundity. The cumulative hazard of birth is highest among women who are current permanent method users. The cumulative hazards for natural and modern reversible method users are lower in comparison.

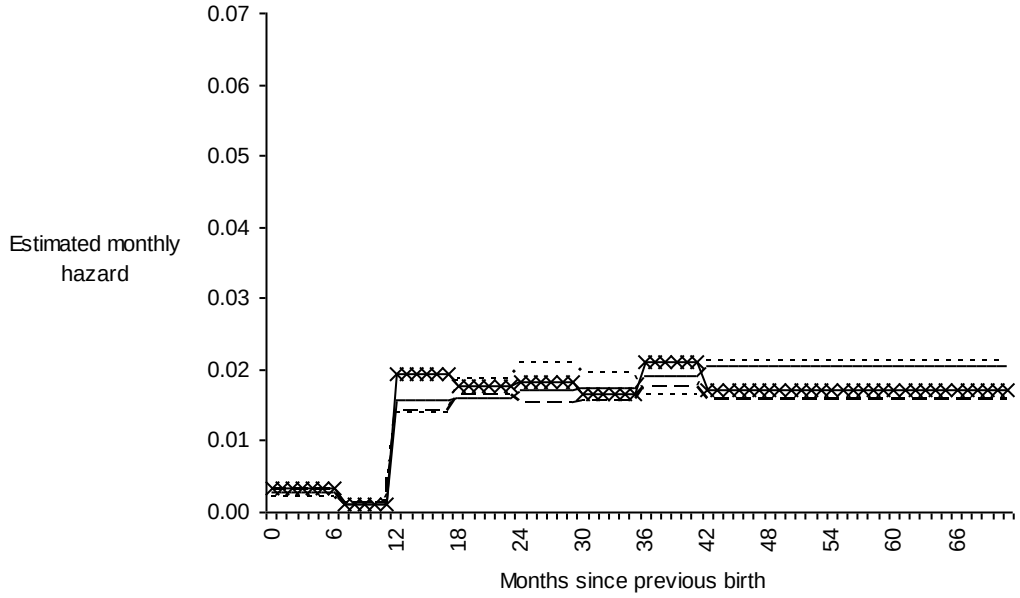
The estimated monthly hazard of birth by current method is presented in Figure 4.6.5, with associated estimated survival plots presented in Figure 4.6.6. The estimated monthly hazard of next birth is the lowest among current non-users. The monthly hazard of next birth is consistently the highest among permanent method users, while the hazards of birth are generally lower for low and moderate contraceptive confidence women. This pattern is also reflected in the survival plots (Fig. 4.6.6).

Figure 4.6.5: Estimated monthly hazard of next birth by level of contraceptive confidence by a) parity 1, b) parity 2 and c) parity 3 at a mean abortion ratio

a)



b)



c)

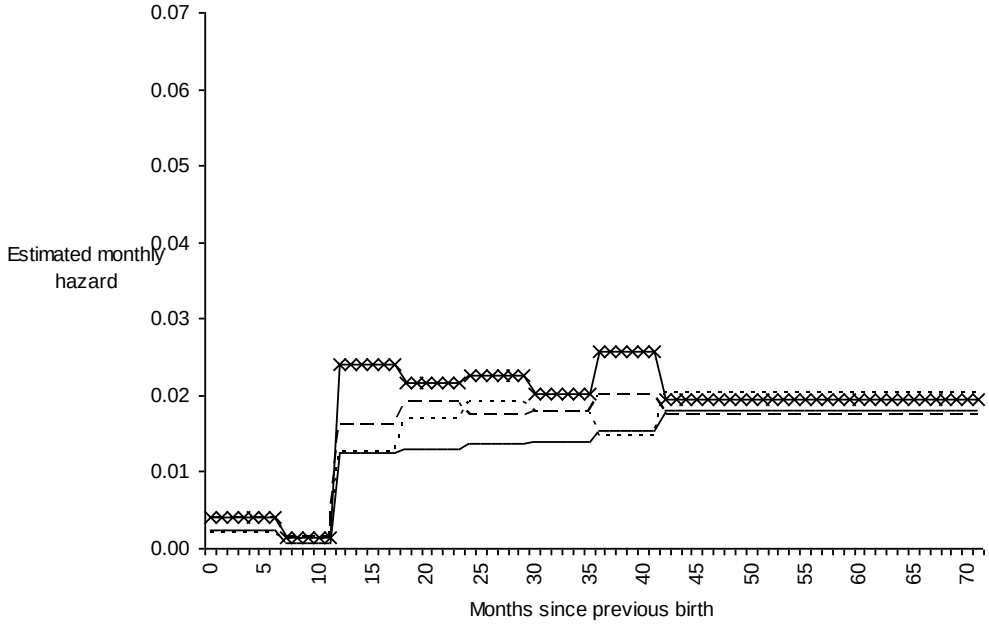
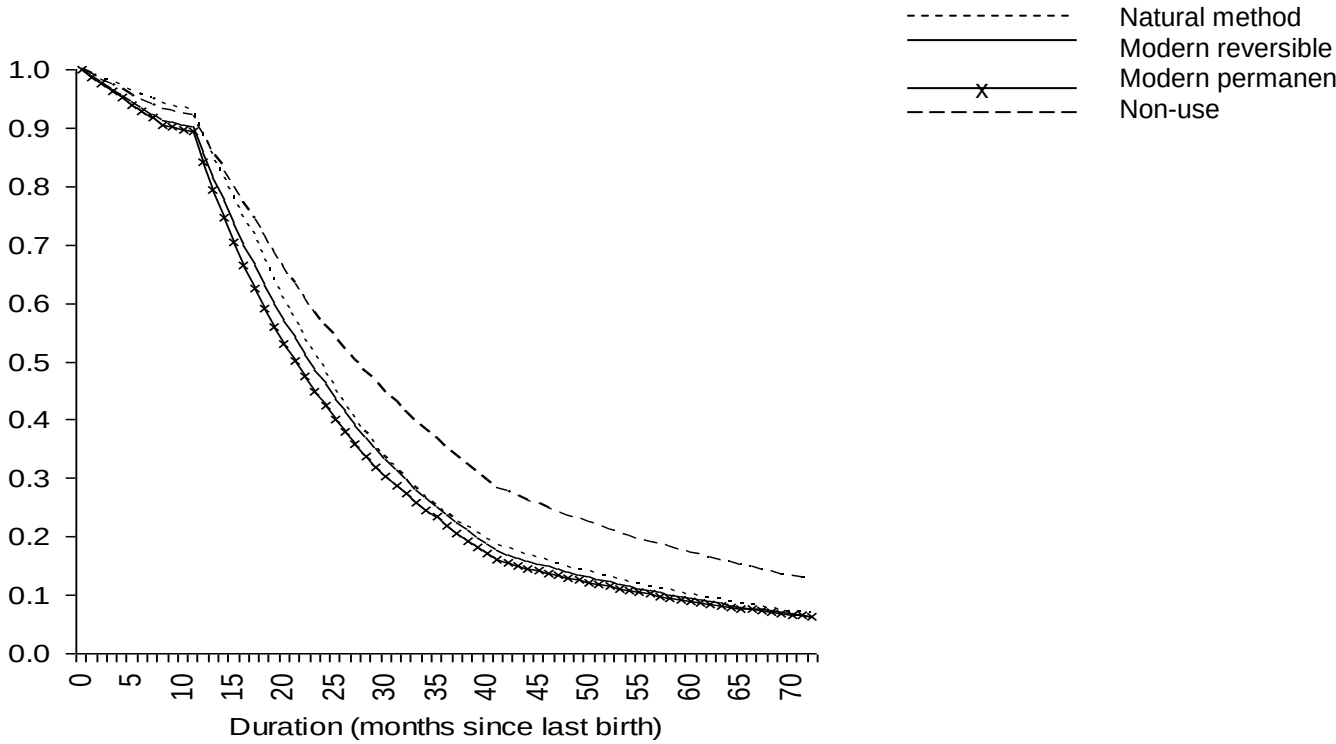
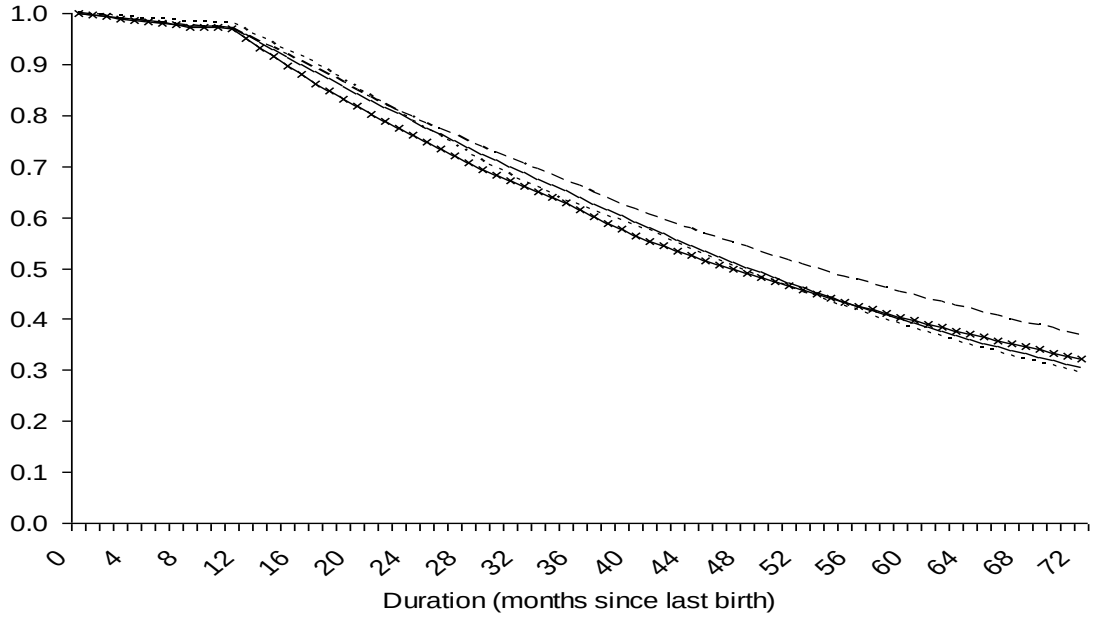


Figure 4.6.6: Survival plots of next birth by level of contraceptive confidence for a) parity 1, b) parity 2 and c) parity 3 at mean level of abortion ratio

a)



b)


1.0
0.9
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0.7
0.6
0.5
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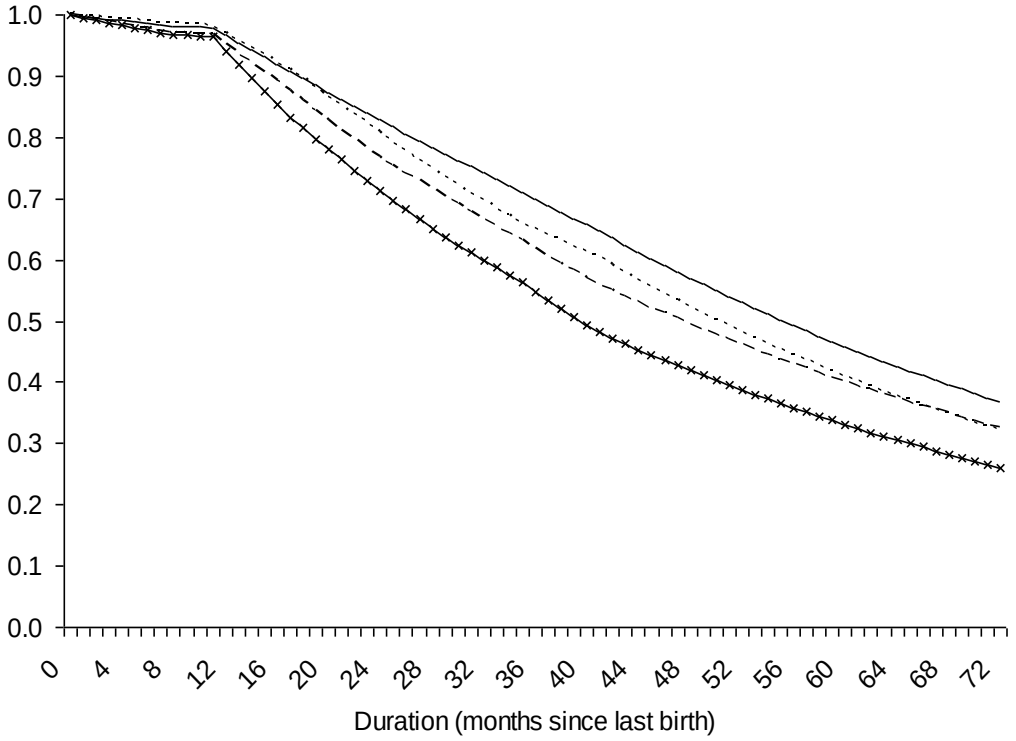
0.2
0.1
0.0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72
Duration (months since last birth)

c)


1.0
0.9
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0.2
0.1
0.0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72
Duration (months since last birth)

Research hypothesis 2: Induced abortion

The estimated cumulative hazards of birth at 36 months postpartum for each level of abortion ratio are presented for a natural method user in Table 4.6.6. The cumulative hazard is higher for no and low abortion propensities and lower among medium and high propensities. This effect is consistent across parities - although the cumulative hazards lowest at higher parities.

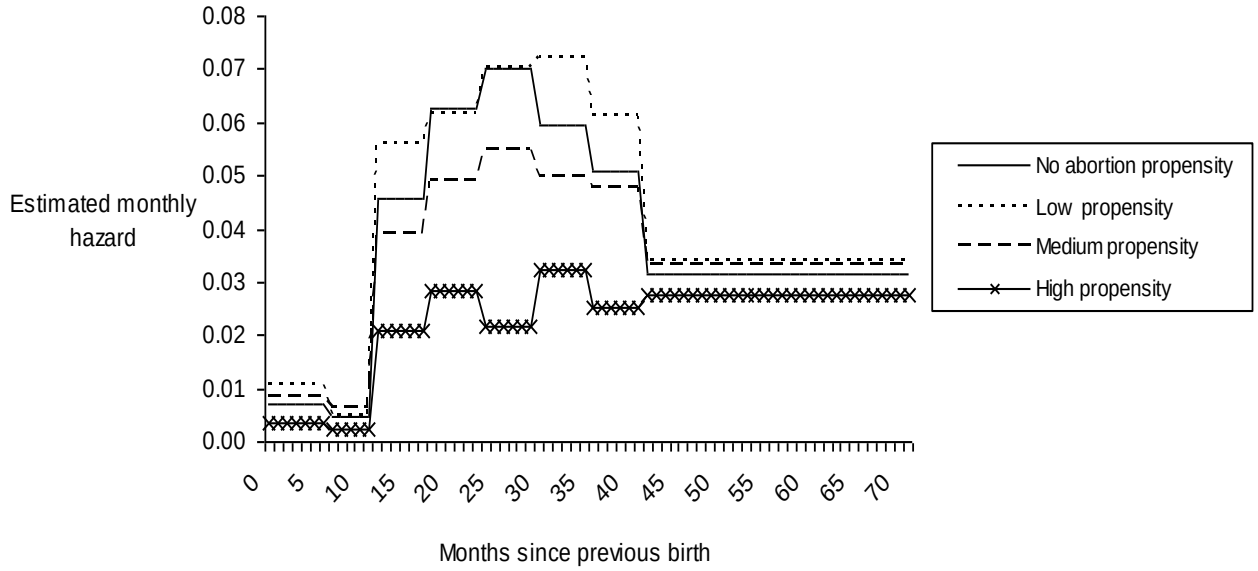
Table 4.6.6: Cumulative 36 month hazard of next birth for natural method users at each level of abortion ratio by parity

Abortion ratio	Parity		
	1	2	3 or more
No abortion propensity	0.80	0.53	0.54
Low propensity	0.83	0.43	0.42
Medium propensity	0.73	0.34	0.17
High propensity	0.50	0.07	0.14

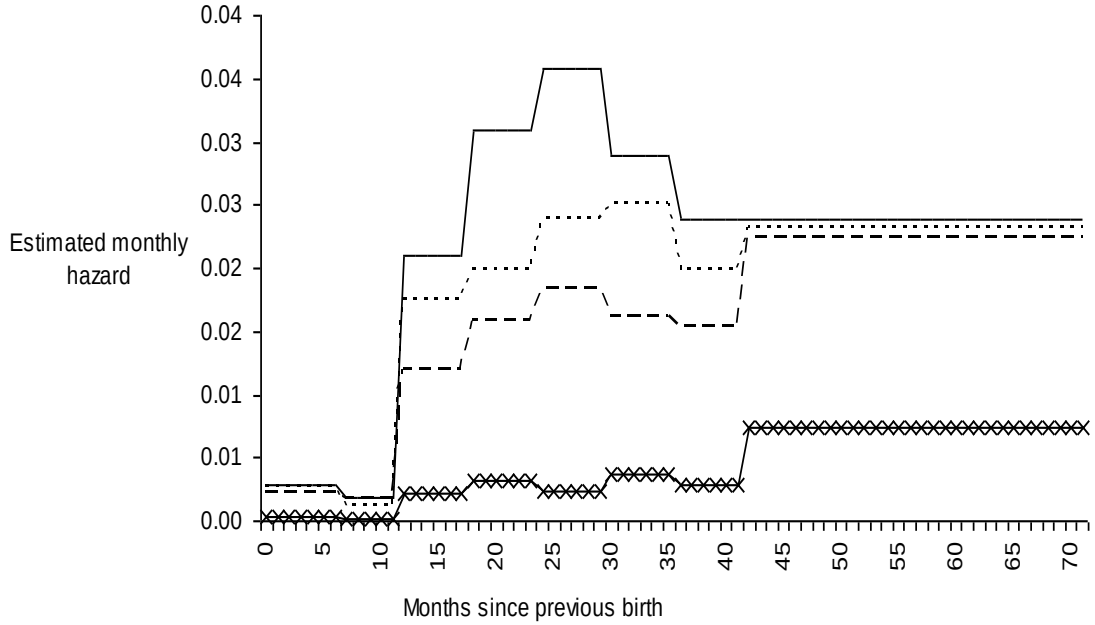
The estimated monthly hazards of next birth for each abortion ratio (by parity) are presented in Figure 4.6.7, and respective survival curves presented in Figure 4.6.8. Figure 4.6.7 shows a downward shift in the hazard of birth with increasing abortion ratio; this pattern is replicated across parities. Similar observations are noted in Figure 4.6.8, with a slower transition to next birth among women with higher abortion ratios.

Figure 4.6.7: Estimated monthly hazard of next birth for natural method user women by abortion ratio at a) parity 1, b) parity 2 and c) parity 3

a)



b)



c)

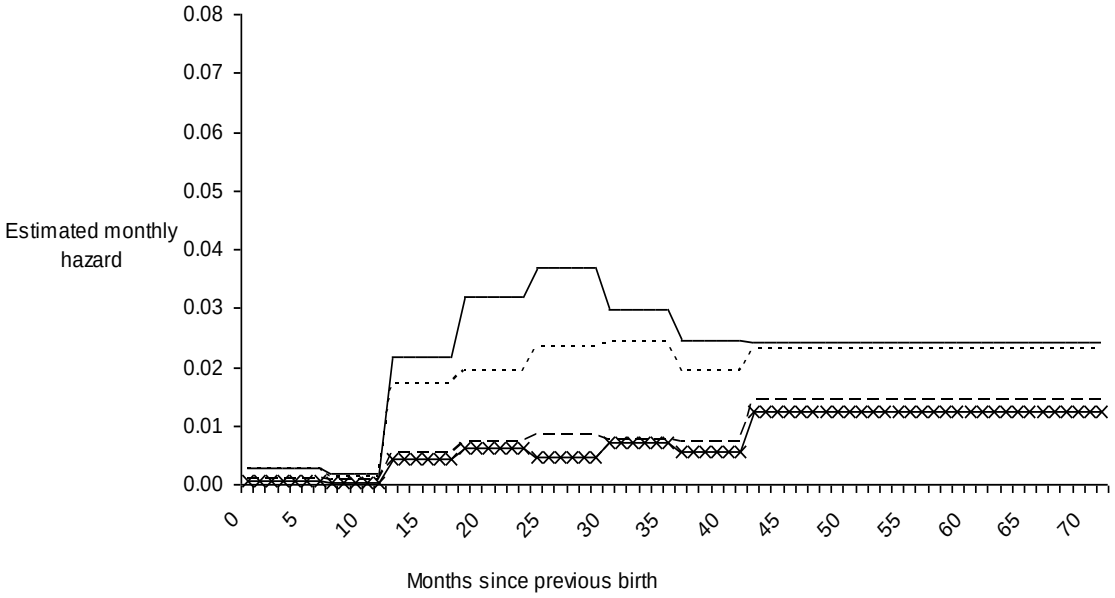
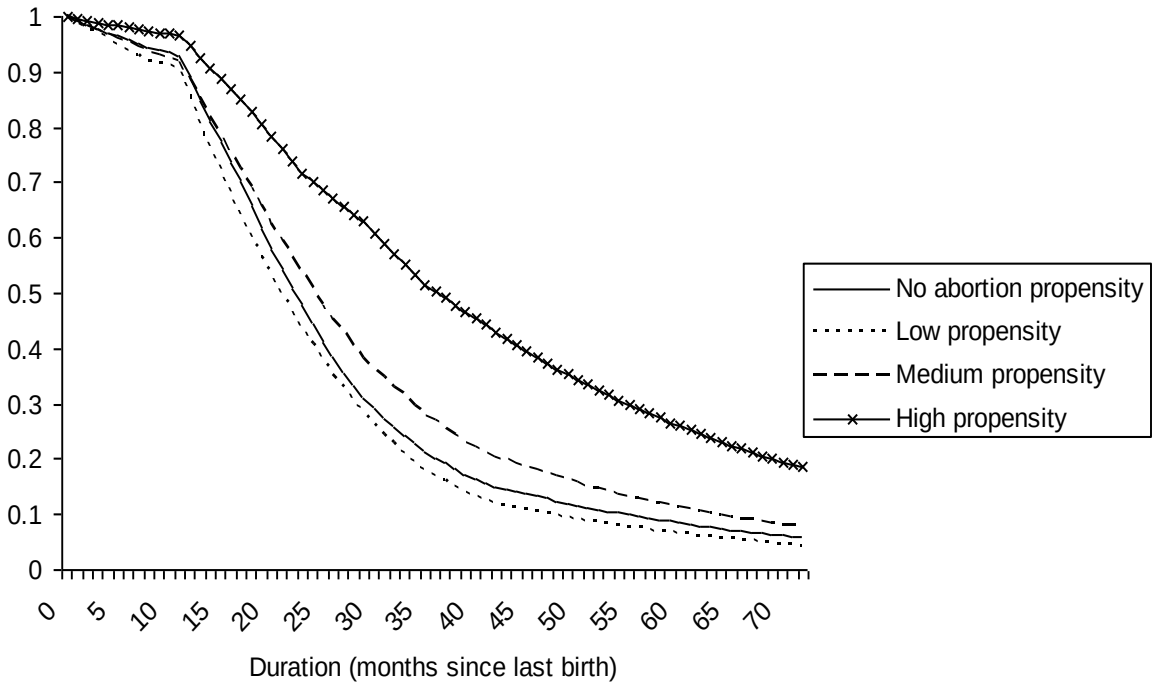
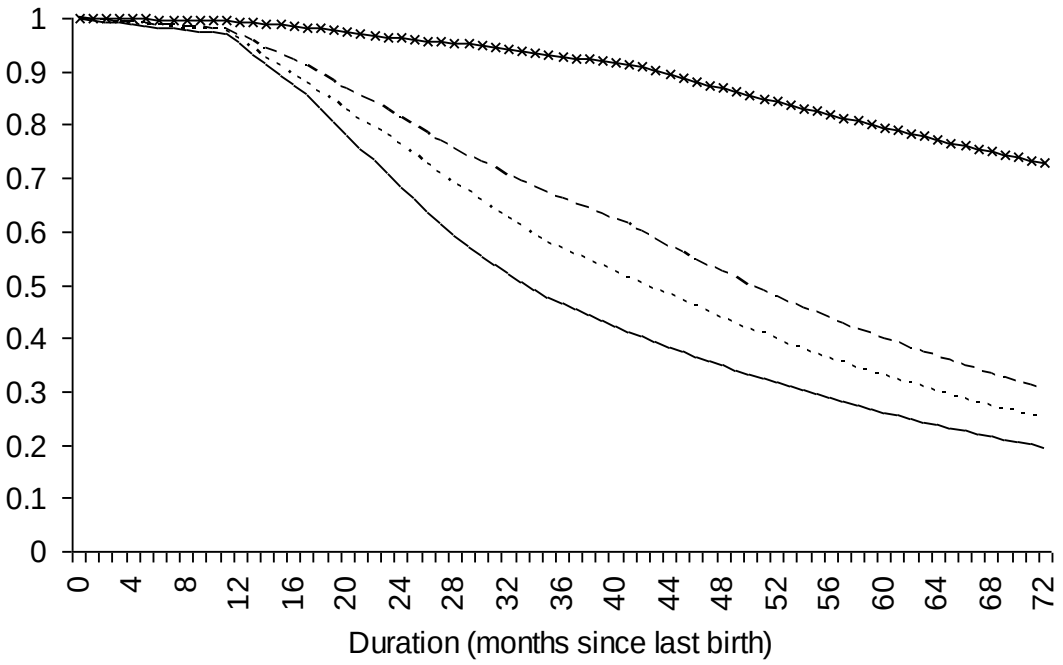


Figure 4.6.8: Estimated survival curve of next birth for natural method user (low contraceptive confidence women) by abortion propensity at a) parity 1, b) parity 2 and c) parity 3

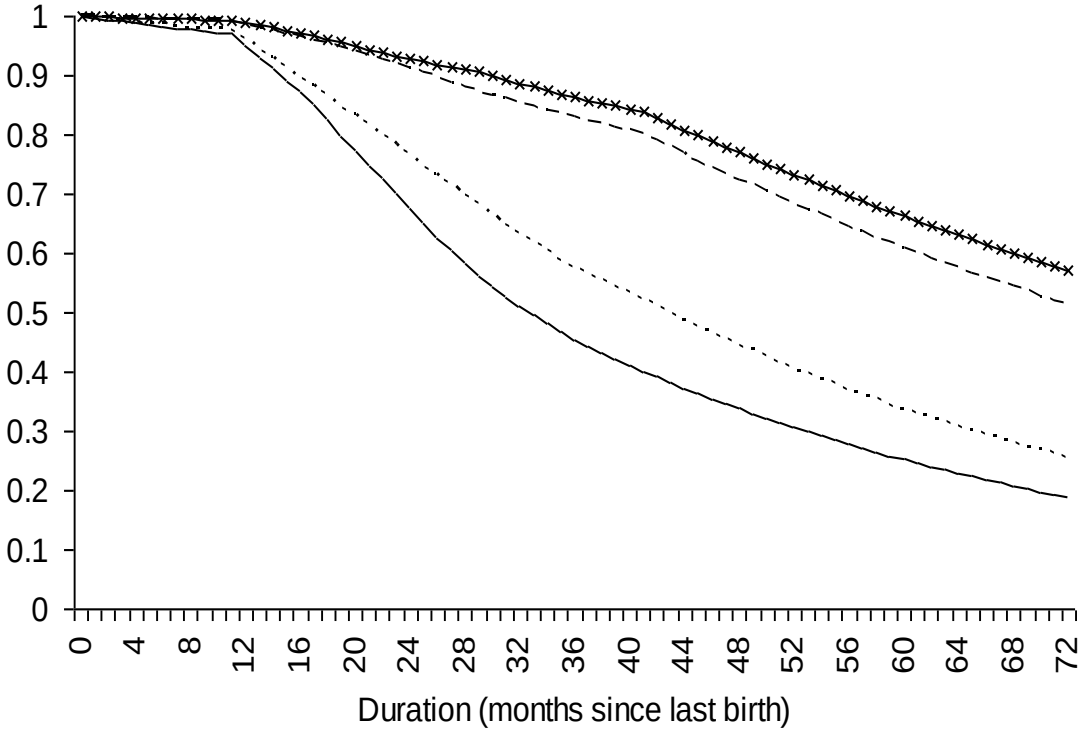
a)



b)


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72
Duration (months since last birth)

c)


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68 72
Duration (months since last birth)

Control variables

To avoid misspecification of contraceptive confidence, an interaction between the current contraceptive and the previous method discontinued is included in the final model (see Table 4.6.4). This accounts for changes in contraceptive confidence due to contraceptive switching. Estimated hazard plots are presented in Appendix E. Women who reported a contraceptive discontinuation have a higher hazard of a birth than women who have not discontinued a method. This pattern applies at all levels of contraceptive confidence. Further, the hazard of birth is higher for women who discontinued a natural method than for women who discontinued a modern method.

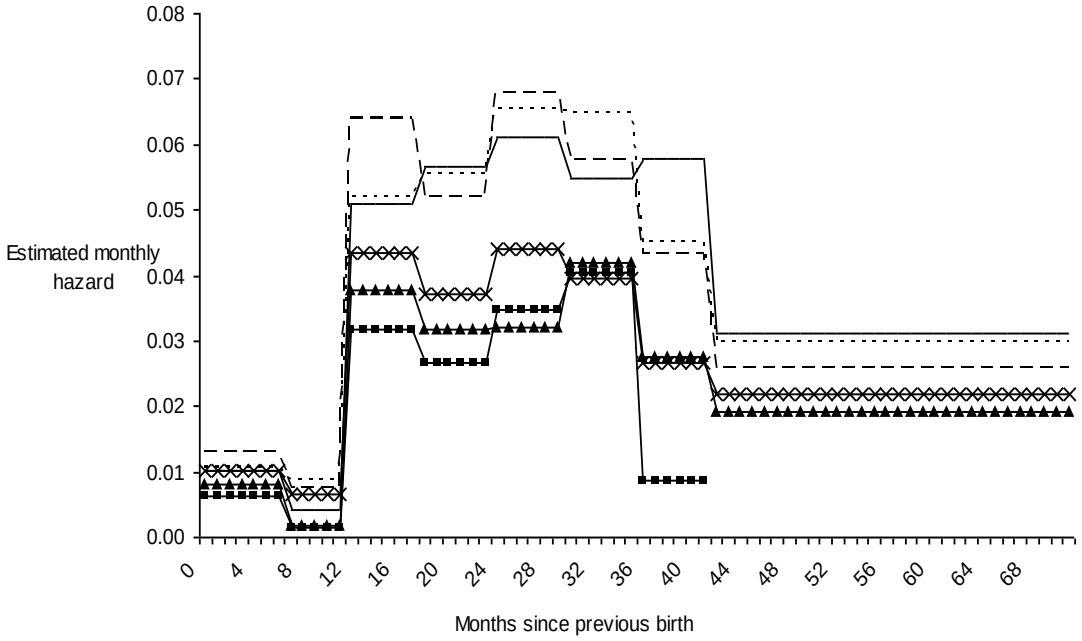
The cumulative hazard of next birth by marriage cohort is presented in Table 4.6.7. The overall probability of birth falls among more recent cohorts, with a substantial drop in the probability of birth in all post 1990 marriage cohorts. The drop is more dramatic for the 1995-99 and 2000 or more recent marriage cohorts, which have estimated cumulative hazards 6% points and 9% points lower than the 1990-94 cohort.

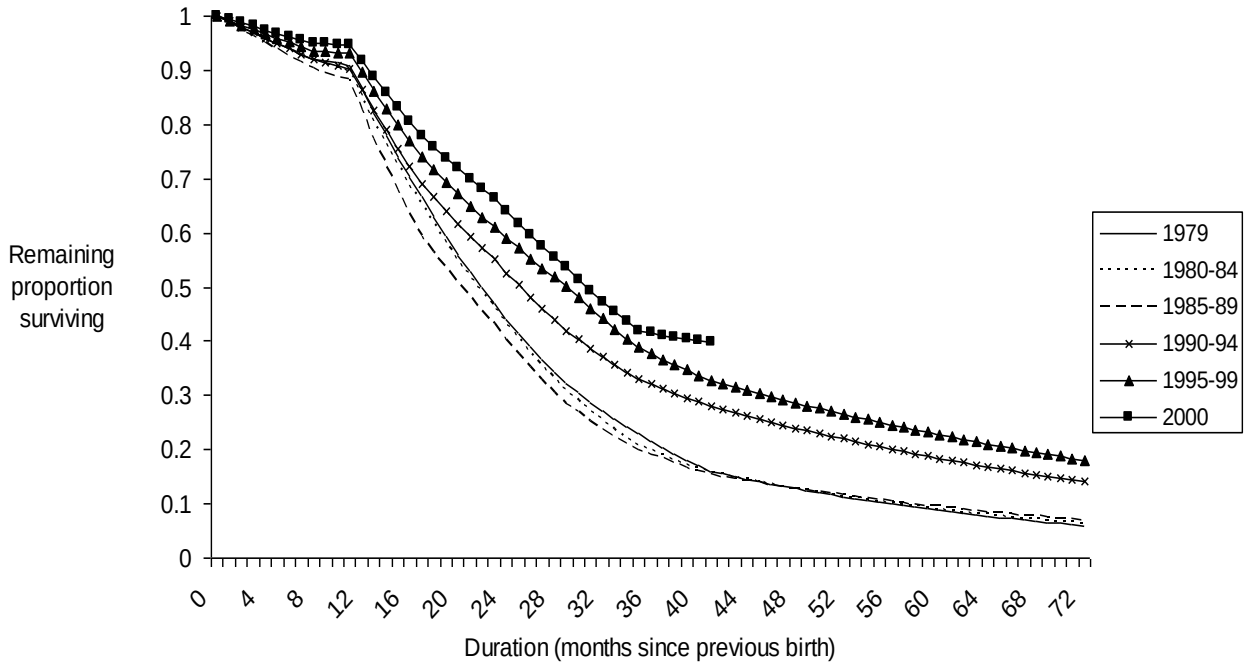
Table 4.6.7: Cumulative 36 month hazard of next birth for each marriage cohort, inter-birth intervals

Marriage cohort	Cumulative hazard of next birth
1970-79	0.78
1980-84	0.82
1985-89	0.81
1990-94	0.68
1995-99	0.62
2000 or more recent	0.59

The effect of marriage cohort on hazard of birth is time dependent, since the interaction between duration and marriage cohort is significant at the 5% level. The estimated monthly hazard plot and associated survival plot are presented in Figure 4.6.9. Among pre-independence marriage cohorts (cohorts 1970-79, 1980-84 and 1985-89) the hazard of birth is consistently high. Further, there is little variation in the hazard between cohorts. In contrast, there is a clear decline in the hazard of birth among the 1990-94, 1995-99 and 2000 or more recent cohorts, which implies increasing durations inter-birth. A downward shift in the hazard of a subsequent birth is interpreted as an overall fall in fertility levels (Timaeus and Moultrie, 2008). This is also reflected in the survival plots (plot –b), where the survival trajectories for the pre-independence cohorts are roughly comparable, while those for later marriage cohorts show an increasing proportion of women yet to have next birth at later durations.

Figure 4.6.9: Effect of marriage cohort on inter-birth intervals indicated by a) estimated monthly hazard of next birth and b) estimated survival plot of next birth by marriage cohort.





The effect of asset wealth on the hazard of birth is significant at the 1% level and the effect is proportional (see Table 4.6.4). Compared to women with a low asset wealth (baseline), women with medium asset wealth have 11% lower hazard of birth. Although marginally non-significant, the estimated hazard of a birth is lower among women of high asset wealth than those in the low group (9%). This is indicative of shorter inter-birth intervals among women with lower levels of wealth, and longer inter-birth intervals with higher wealth.

The effect of type of current employment on the hazard of birth is significant at the 1% level. Women who are in professional or clerical employment have 35% and 32% lower hazards of birth respectively than the reference category of 'not in employment'. Manual workers have hazards of birth 14% lower than women not in employment, significant at the 5% level. There are no other significant effects for employment. The hazard of birth for women with 'less than secondary' education is 69% higher than those with higher education. Although non-significant, it is also noted that women with only a secondary education have an estimated odds ratio of a subsequent birth 12% higher than baseline.

The 15-19 age group does not differ significantly compared to the baseline age-group (20-24). The hazard of birth is lower by 17% for the 25-29 age group, 43% for the 30-34 age group and 52% for the 35 or over age group. The reduction in the hazard of birth is consistent with longer inter-birth intervals among older women (Van Bavel 2003, Braun 1980). The initiation of contraception has a significant effect on the length of the inter-birth interval. From Table 4.6.4, compared to birth intervals before the use of contraception, birth intervals after initiating method-use show a 69% reduction in the hazard of next birth.

Women who have experience of breastfeeding seem to have a generally higher hazard of a subsequent birth (i.e. the next birth occurs more quickly) than women who have never breastfed or have not heard of postpartum infecundability. This effect is time dependent and the hazard plot for the effect of breastfeeding

experience is presented in Appendix F. This result is implausible and indicates the difficulty in measuring breastfeeding status *post hoc*.

The effect of marital duration on the hazard of a subsequent birth is significant at the 1% level and its effect is proportional. Longer marital durations are associated with declining hazard of birth compared to the baseline duration (0-4 years). The hazards of birth are 43% lower for women married 5-9 years, 58% lower for 10-14 years, 86% lower for 15-19 years and 83% lower for women married over 20 years.

The death of an older sibling increases the hazard of birth by 49%. This effect should be interpreted as the effect of replacement fertility (Van Bavel 2003). The effect of the death of the previous sibling is time dependent and increases the hazard of a birth (Appendix G). This effect should be interpreted as the effect of terminating breastfeeding and the resumption of menses (Van Bavel 2003).

Other significant influences controlled for relate to location and region of residence, and both incorporate time dependent effects. These results indicate the variation of fertility behaviour in different regions in Moldova. The effect of urban/rural residence is presented in Appendix H. Living in a rural area increases the hazard of a birth - rural women tend to have shorter intervals between births than women in urban areas. The hazard of a subsequent birth in regions outside of Chisinau is generally higher, indicating more rapid transitions to higher parities in these regions than in the capital (see Appendix I). The hazard distribution for the North region appears to be shifted right compared to that of the other regions, indicating that women in the North appear to be postponing their births, rather than having lower overall fertility (Timaeus and Moultrie, 2008).

4.7 Summary and discussion

Summary

The aim of this analysis was to test the contraceptive confidence hypothesis, allowing for the effect of induced abortion. This was achieved using data from Moldova, a country with widespread use of both natural methods and induced abortions.

The first research hypothesis was that the birth intervals of women using natural methods should be longer than for those using modern methods due to lower contraceptive confidence. The birth intervals of natural method users are substantially longer than those of modern permanent method users, which is consistent with the contraceptive confidence hypothesis. However, there is considerable difficulty in attributing this to the effect of contraceptive confidence alone (see section 4.5.1). Modern reversible and natural method users seem to have comparable birth timing behaviours. This indicates the contraceptive confidence of natural method users is comparable to those of modern reversible method users. The overall conclusion is that evidence for the contraceptive confidence effect exists *prima facie,* although the extent to which this evidence is robust is questionable. The comparison of the birth intervals for natural and modern reversible method users is more secure however and indicates that that – in the context of widespread abortion use – natural method users are able to achieve a level of contraceptive confidence comparable to that of modern reversible method users.

The second research hypothesis was that induced abortion would facilitate a compression of birth intervals, in the same manner as effective contraception. The results do not support this hypothesis. Among natural method users, the longest birth intervals are observed among women with a high propensity to use induced abortion, while lower propensities of abortion use are associated with shorter inter-birth intervals. Increased use of induced abortion therefore seems to be associated with slower progression to next birth. This is different from the effect on fertility

patterns of a stopping contraceptive, such as IUD. This contrasts with other authors (e.g. Agadjanian, 2002, Westoff, 2000) who argue that abortion is used as a stopping method in the post-Socialist context.

Discussion

There are a number of limitations in the measurement of contraceptive confidence which prevent any definite conclusions being drawn. As highlighted in Section 4.4 the measure of contraceptive confidence and abortion ratio suffer from the potential for 1) reverse causality and 2) endogeneity. While these issues have been considered more generally, the implications for the conclusions are now considered in detail.

While the pattern of shorter birth intervals among women who are current permanent method users is consistent with the contraceptive confidence hypothesis (these women are have a high contraceptive confidence), there is the potential that short inter-birth intervals are the trigger for permanent method uptake. This issue has been identified by Zavier and Padmadas (2000).This is of particular significance since the principal difference is between natural method users and permanent method users. That said, there appears to be little effect of reverse causality on the abortion ratio - short inter-birth intervals are not associated with a higher abortion ratio. Therefore, although reverse causation issues weaken the conclusions with respect to contraceptive confidence, the finding that abortion influences contraceptive confidence among natural method users is relatively robust.

Endogeneity of current contraceptive method and inter-birth interval is another potential issue limiting the strength of the conclusions. Potentially, correlation between inter-birth intervals and contraceptive method could result from other factors, such as fecundability. While attempts have been made to control for the effect of these influences (through fixed effects such as parity and random effects in the regression model), the model specified does not account for selection effects on the current contraceptive method but rather includes them as control variables. This may not fully eliminate the endogeneity problem. Endogeneity is less of an issue for

examining the effect of abortion ratio – there is no established evidence that abortion is used to space births in Moldova (Agadjanian, 2002, Westoff, 2000). Overall, while the measurement issues identified tend to weaken the conclusions for the contraceptive confidence hypothesis, the conclusions for induced abortion and associated fertility timing hypothesis are stronger.

Chapter 5: Evaluating natural contraceptive failure and contraceptive discontinuation in Moldova

Abstract

The Republic of Moldova exhibits a fertility rate below the replacement level, similar to the patterns observed in other Eastern-European post socialist countries. Natural method use is widespread in Moldova and is often associated with high failure rates and termination of pregnancies. This study evaluates contraceptive failure rates in Moldova to determine whether seemingly conflicting contraceptive use and fertility patterns could result from unusually effective traditional method use or from other influences such as high abortion rates. Data are drawn from the 5-year contraceptive calendar of the 2005 Moldovan Demographic and Health Survey, which provides monthly information on contraception, pregnancy, births and terminations. A multilevel competing hazard model is used to estimate the monthly probability of contraceptive failure, while accounting for contraceptive switching and abandonment. The model compares contraceptive failure rates for natural and modern method users, while controlling for selected proximate determinants of fertility and relevant socio-economic variables. The model also accounts for repeated spells of contraceptive use and clustering of women within communities. There is a significantly higher hazard of contraceptive failure among natural method users when compared to modern reversible and modern clinical methods, which, in the case of Moldova, is often followed by the use of abortion. Users of modern reversible methods exhibit a high hazard of contraceptive abandonment, suggesting the likelihood of subsequent abortion. The findings suggest that encouraging modern method use could reduce the likelihood of unwanted pregnancies and abortions in Moldova. It is imperative to develop policy strategies to dissuade women from using natural methods and monitor consistency in modern method use. Emphasis should be placed on improving access to modern methods and ensuring adequate quality of care in family planning delivery, and where appropriate educating and providing informed method choices to women and couples.

5.1 Introduction

Over the last 20 years Moldova has experienced low fertility levels. Following independence in 1991, Moldovan fertility fell significantly reaching a Total Fertility Rate (TFR) of 1.3 in 2000, representing the lowest fertility rate ever recorded in Moldova (NCPM and ORC Macro 2006). Since then fertility increased slightly to a TFR of 1.7 in 2005 - which is still below replacement level (NCPM and ORC Macro 2006). Moldova has a high proportion of traditional contraceptive method users: 24% of married women use natural contraceptives. Such methods, however, are generally assumed to be ineffective. For example, Trussell (2008) estimates that the Pearl index failure rate of *coitus interruptus* is in the region of 27 per 100 woman-years of use. The combination of low fertility and ineffective contraception is demographically inconsistent. Theoretically, widespread use of ineffective contraception should be associated with a higher fertility rate.

Previous research shows that widespread natural contraceptive use can be effective in reducing population level fertility rates (Fisher and Szreter 2003, Szreter et al. 2003, Fisher 2000). Further, diligent use of natural methods can be more effective than the inconsistent use of modern contraceptives (Potter et al. 1996, Goldburg and Toros 1994). This study aims to evaluate contraceptive failure rates in Moldova to determine whether the low fertility rate could potentially result from unusually effective traditional method use. The theoretical motivation for this analysis is that if low fertility rates are explained by natural method use – after controlling for other proximate determinants then it is plausible that natural method use in Moldova is highly effective. Understanding the effectiveness of natural method use is important, as natural methods can potentially meet women's reproductive health needs more effectively than modern methods (Gribble 2003). More generally, the study analyses the determinants of contraceptive method continuation, abandonment, switching and failure over time. The analysis contributes not only to a deeper understanding of the dynamics of natural contraceptive use but also to reformulating existing policy strategies.

High failure rates of natural methods can often lead to increased use of abortion (Agadjanian 2003, Sobotka 2003, Westoff 2000; 2005). This, in turn, can have serious maternal health implications. Westoff (2005) estimates that the abortion rate in Moldova could be reduced by 33% if natural method users switched to a modern method. Determining the correlates of method abandonment and switching will help to inform policy decisions on how best to focus family planning efforts to ensure that modern method use is maximised - a public health priority of the Moldovan government (NCPM and ORC Macro 2006). In particular, there is a need for correctly orientating policy efforts in a country where family planning funding is reliant on limited financial resources and international aid (Comendant 2005).

A multilevel competing hazard model is used to estimate the monthly probability of contraceptive failure, while accounting for contraceptive switching and abandonment. The model controls for proximate determinants of fertility (e.g. sexual activity, lactation, fecundity) and socio-economic variables (e.g. education, ethnicity), as well as accounting for repeated spells of contraceptive use by some women and clustering of women within communities. Data are drawn from the 5-year contraceptive calendar of the 2005 Moldovan Demographic and Health Survey (MDHS), which provides monthly information on contraception, pregnancy, births and terminations.

The remainder of this paper is structured as follows. The research hypotheses are outlined in Section 5.2. The contraceptive calendar data and the analysis sample are described in Section 5.3. Important explanatory variables are outlined in Section 5.4. Section 5.5 considers the model employed in this analysis and the modelling strategy. The results are presented in Section 5.6. The conclusions as well as implications for policy and practice are discussed in 5.7.

5.2 Background and Research hypotheses

Moldova exhibits a sub-replacement fertility rate - TFR 1.7 in 2005 (NCPM and ORC Macro 2006) - despite high use of natural methods and high prevalence of abortion

as observed elsewhere in eastern European countries (Sobotka 2003, Avdeev *et al.* 1995, Westoff 2005, 2000). Indeed, in the majority of post-Socialist countries, fertility has been very low since the collapse of Soviet Union, due to macro-economic instability and rapid social change (Witte and Wagner 1995, Sobotka 2003). Before proceeding with a hypothesis linking contraceptive failure rates and fertility, it is worth examining the current low fertility situation in Moldova.

Fertility is determined by proximate determinants including prevalence of marriage, lactational amenorrhea, spontaneous abortion, durability of spermatozoa and ova, and fecundability (Bongaarts 1978). Variation in any of these determinants presents a potential explanation for low fertility in Moldova.

Marriage rates in Moldova are persistently high, and marriage remains an important prerequisite for fertility (Sobotka 2003, Anderson *et al.* 1994). It is therefore implausible that low fertility could be caused by low rates of union formation as observed in northern European countries. Considering the role of lactational infecundability, only 31% of parity 1 women are aware that breastfeeding can prevent further births (author's calculations from MDHS 2005 2005). Further, of those parity 1 women who gave birth within the past year, 59% report discontinuation of breastfeeding before 6 months post-partum (author's calculation, MDHS 2005). This suggests that the influence of lactational infecundability on Moldovan fertility is likely to be small. The other proximate determinants of fertility (spontaneous abortion, durability of spermatozoa and ova, and fecundability) do not vary at a population levels (Bongaarts 1978) and cannot explain cross-national variation in fertility rates. Therefore, the most plausible explanations for low Moldovan fertility seem to be contraception or abortion use.

It is therefore necessary to determine how the observed TFR in Moldova compares with the expected value in the post-Socialist context, given the level of contraceptive use and abortion. If Moldovan fertility is unusually low after controlling for contraceptive and abortion behaviour, this adds weight to the hypothesis that contraceptive use is unusually effective. Poisson regression was used to determine

the expected fertility for the contraceptive prevalence and abortion rate in Moldova. A full report is presented in Appendix J. The standardised residual for Moldova was -0.66, indicating that TFR was 24% below its expected value. Indeed, Moldova had the fourth largest negative residual in the set of countries observed (Armenia, Lithuania and Latvia had larger deviations). The conclusion is that Moldovan fertility is low for the post-Socialist context, even after controlling for contraceptive prevalence and abortion rate.

Moldova has one of the highest prevalence of natural method use in the post-Socialist region, with 24% of married women using a natural method in Moldova compared to 8.7% in Latvia, 9% in Hungary and 15.7% in Bulgaria (Council of Europe 2004, NCPM and ORC Macro 2006). Moldovan fertility should therefore be comparably high - although modelling results suggest that the opposite is true. It is therefore plausible that either Moldovan women are unusually effective in implementing natural contraceptives, or the modern methods used in other countries are some way short of their theoretical effectiveness. Both of these possibilities are evident in historical populations and modern contexts.

5.2.1 Effectiveness of natural method use: an historical review

The use of natural contraception - especially withdrawal - has been associated with the historic fertility decline observed in Western Europe during the 20th Century. Hionidou (1998) examines the importance of natural method use in the fertility transition in Mykonos in the period 1879-1938. The age specific marital fertility rate fell substantially due to the use of natural methods, with fertility in the 20-24 age group falling from 400 per 1000 p.a. in the 1879-88 marriage cohort, to 370 per 1000 (1909-18), to just under 350 in the 1919-28 marriage cohort. The age-specific fertility profile retains a convex shape (indicating non-parity specific fertility control). This is characteristic of the spacing behaviour practised by natural method users (Ní Bhrolchaín 1988, Keyfitz 1980). Additionally qualitative oral histories indicate that fertility control seem to be achieved by the use of natural methods (withdrawal combined with deliberate breastfeeding). This demonstrates that the introduction of

natural methods can substantially reduce fertility, and that widespread natural method use is associated with low fertility at the population level.

Pitkänen (2003) finds similar evidence of the widespread effective use of natural methods in transitional Finland (c. 1900). The Finnish age specific marital fertility profile indicates a convex shape, which characterises parity independent fertility control associated with natural method use. Historic surveys and ethnographic accounts support this finding, showing withdrawal was a widely practiced and accepted method of contraception in early 20th Century Finland. Women reported preferring unwanted pregnancy or abortion following failure of withdrawal than using an 'unpleasant' method (e.g. condom, Pitkänen 2003).

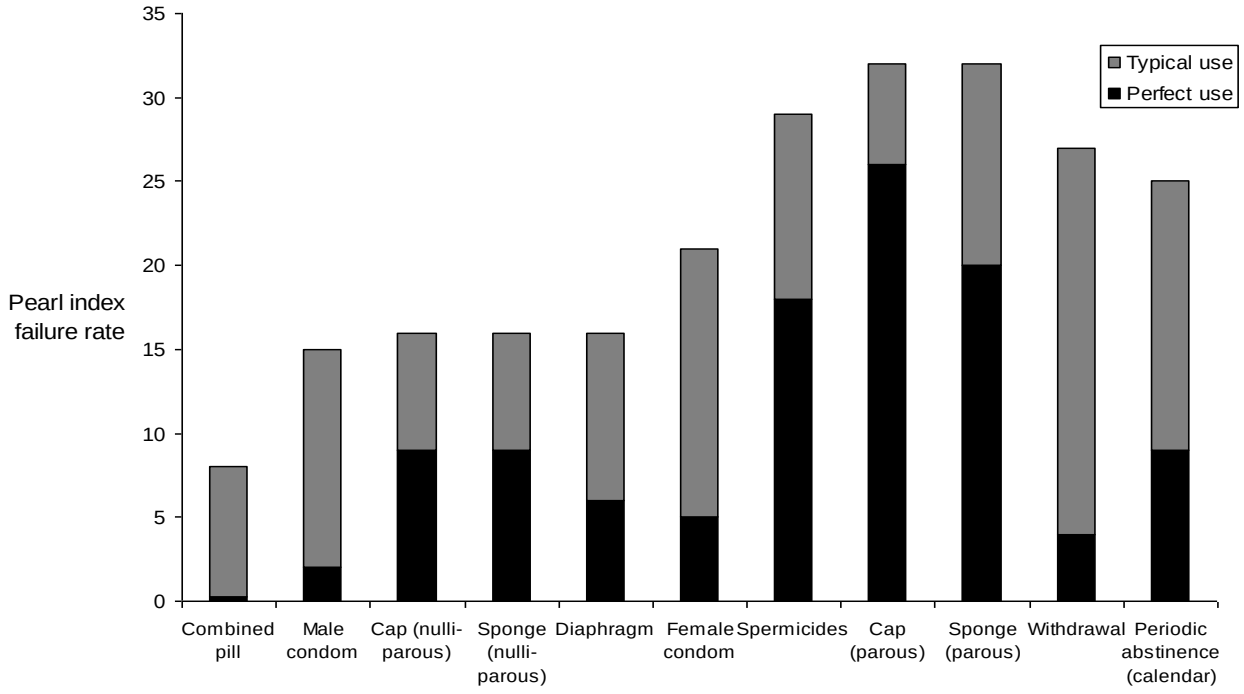
Hinde (2003) uses the 1946 UK census to demonstrate the widespread reduction in fertility die to natural method use. Middle class couples in the 1917-30 marriage cohort had on average only 0.9 children in their first 10 years of marriage, compared to 1.6 children for Artisan (lower middle/skilled working) classes and 2.4 children for unskilled working classes. Childlessness was also very common, with 17% of the 1925 marriage cohort childless. Further, 25% of this marriage cohort had only one child. Hinde concludes that these low fertility levels were due to the use of natural contraception - in particular withdrawal.

Fisher and Szreter (2003) use qualitative data to examine the persistence of natural method use in Britain during the period 1918-1950. This period was characterised by extremely low fertility rates - for example, fertility fell to sub-replacement level in the inter-war period (Hinde 2003). Modal competed family size was 1 child for the 1920-39 marriage cohort, and 2 for the 1940 marriage cohort (Fisher and Szreter, 2003). Further, 12.5% of the 1940 cohort remained childless. Respondents expressed the belief that withdrawal was an effective contraceptive, but that they did not trust modern methods. The failure of natural contraception was attributed to imperfect method application, while failure of modern methods was attributed to method failure. Further, withdrawal was perceived as medically safe, while modern methods were perceived as unhygienic and 'messy' (Fisher and Szreter 2003, p. 279).

5.2.2: Evidence for ineffective modern method use

Modern methods of contraception are characterised by high method effectiveness under ideal use conditions (Trussell 2008). However, their effectiveness relies on correct use; failure rates under incorrect use can be significantly higher. Trussell (2008) shows that user failure rates increase by 13% points for condom use, 4.7% points for pill use, 10% points for diaphragm use and between 5 and 12% points for sponge when compared to method failure rates. The variations in failure rates are summarised in Figure 5.2.1 which demonstrates a clear comparability in user failure rate of natural methods to a large number of modern methods.

Figure 5.2.1: Failure rates for natural and reversible modern contraceptive methods



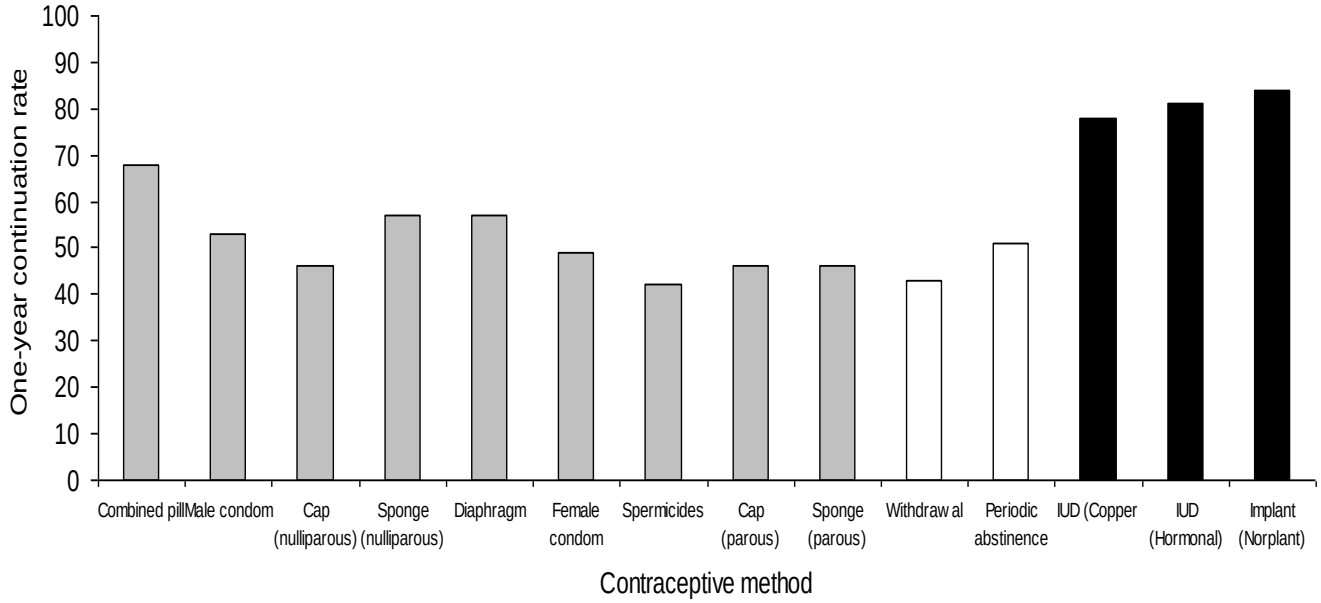
Source: Trussell (2008) in Hatcher *et al.* (2008):

Notes:

Columns sum to provide Pearl index failure rates for method under perfect and typical use conditions. Pearl index failure rate is the number of women per 100 pregnant after 1 year of use

The failure rates of both modern reversible and natural methods are considerably higher than clinically administered methods. Trussell (2008) finds that failure rates for methods which are administered by a medical professional (such as injectables, implants or the IUD) are less than 1%. Indeed, any form of discontinuation is rare for clinical methods. Between 78-81% of IUD users and 84% of implant users were still using their method 1 year after insertion (Trussell 2008). Low clinical method discontinuation was also evident in Steele *et al.* (1996) and Steele and Curtis (2003). These findings are summarised in Figure 5.2.2, which compares the continuation rates of clinical method to modern reversible and natural methods.

Figure 5.2.2: One year continuation rates by method (method type)



Source: Trussell (2008) in Hatcher *et al.* (2008)

Note:

Modern reversible method
Natural method
Modern clinical method

Goldburg and Toros (1994) examine contraceptive use in Turkey, which is demographically similar to Moldova due to the widespread use of natural contraception and induced abortion. Goldburg and Toros report a one-year failure

rate of 14% among withdrawal users. However, pill failure rates are estimated to be as high as 26% for the first year of use. This indicates that in the same population, natural methods can provide superior contraceptive effects than modern methods. Turkish women fail to perceive any contraceptive advantage of modern method use over traditional method use with only 25.6% of natural method users reporting modern contraception as more effective (although this is only a self-report).

Potter *et al.* (1996) examine the consistency of pill use in the United States to evaluate the potential for user failure. Potter *et al.* assert that the rates of pill compliance are often overestimated due to pill 'dumping' and mistiming in dosing. Potter *et al.* exploit the Medication Event Monitoring System (MEMS) to evaluate the extent to which pill dosage is correctly administered. The MEMS electronically logs the time and date when a pill dispenser is opened and a dose of pills is taken. MEMS data is taken as a gold-standard and compared to diaries of pill use completed by women themselves. The results from diary entries and MEMS were inconsistent, with only 45% of women correctly recording their pill use. Consequently the number of women at risk of accidental pregnancy due to missing pills within a menstrual cycle was underestimated by self-report. While diary entries indicating that c.10% of women missed 3 or more pills, the estimate rises to 30-34% from the MEMS. Self-report indicated that women missed on average 1 pill per menstrual cycle - however, the MEMS data indicated that participants missed 2.6 pills per cycle on average. This tended to increase with duration of pill use, with average number of pills missed increasing from 2.2 in the first cycle of use to 3.5 by the third cycle. Potter *et al.* conclude that pill compliance tends to decline over the duration of use, either as a result of fatigue or as women learn an acceptable level of non-compliance. Of particular concern is the level of underreporting of missed contraceptive doses, since women may be unaware that they have missed pill doses.

Based on the evidence available from both historical sources and from contemporary contraceptive use studies, it is evident that natural method use can be effective at a population level – or least as effective as poorly administered modern methods. Given that Moldovan fertility is low controlling for other proximate determinants of

fertility, it can be hypothesised that contraceptive behaviour in Moldova is systematically different to other Eastern European populations. This analysis will test whether this is the case in Moldova. More specifically, the research hypothesis is:

Natural contraceptives and modern reversible methods have comparable efficacy under user conditions. Both reversible and natural methods have higher rates of discontinuation than modern clinical methods.

5.3 Data

Data for this analysis are drawn from the contraceptive calendar schedule of the Moldova Demographic and Health Survey (MDHS). Given the high volume of retrospective data recorded in the calendar format, evidence on the quality of calendar data is considered in detail. The analysis sample is also defined.

5.3.1 Contraceptive calendar data in the MDHS

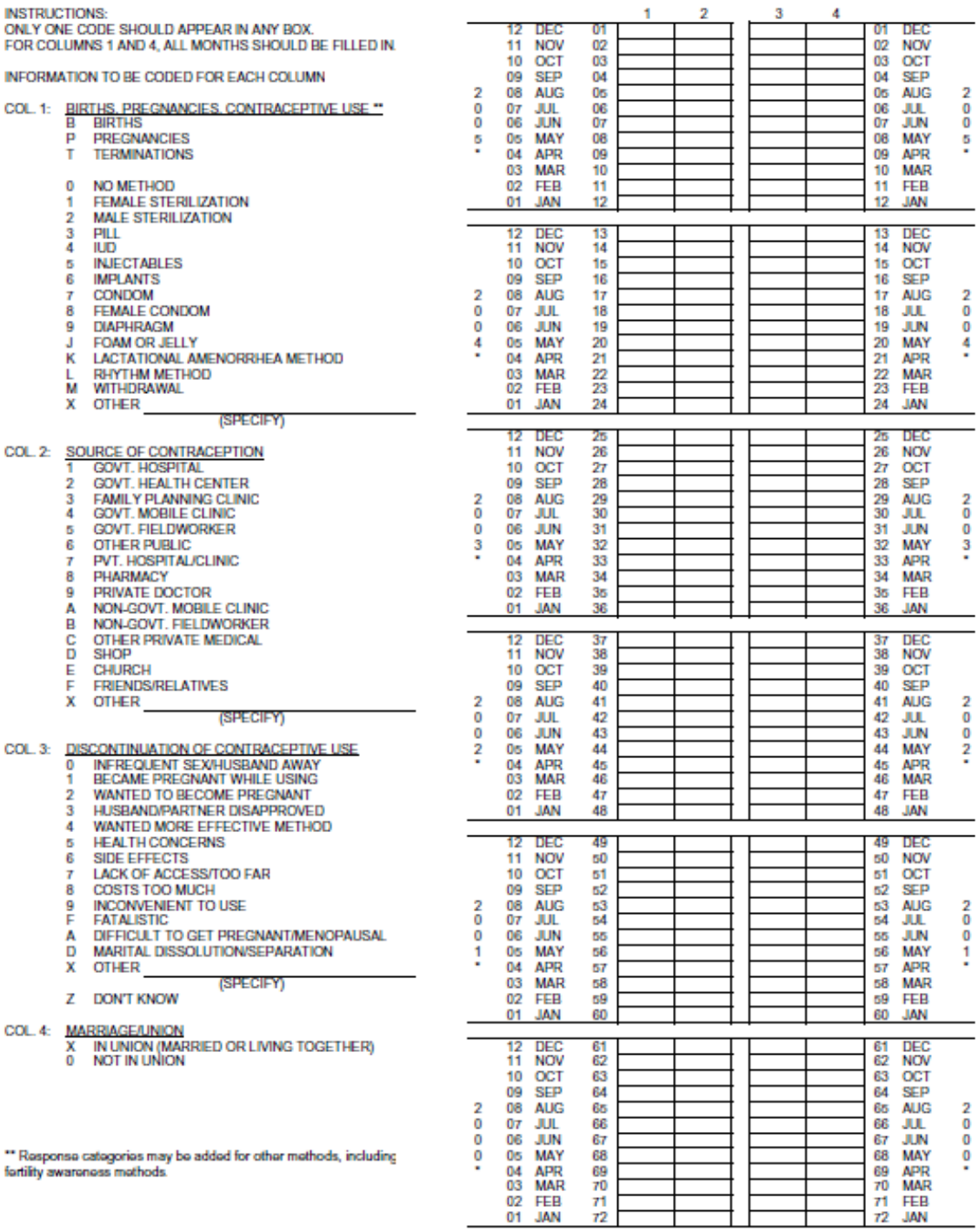
The contraceptive calendar is a retrospective five year history of contraceptive use which collected data from all eligible women in the MDHS. These were classified into five themes:

- Contraceptive use, pregnancies, births and terminations
- Source of contraceptive method
- Reasons for contraceptive discontinuation
- Marriages and unions
- Moves and communities

Each of these themes is recorded in a column of the contraceptive calendar – an example is presented in Figure 5.3.1. This analysis makes use of the 'pregnancies and contraceptive use' and the 'marriages and unions' calendars. The 'pregnancies and contraceptive use' column includes information on the type of contraceptive in use for each month of the calendar, as well as month of pregnancy, birth and abortion.

The column pertaining to the ‘marriage and union’ is a binary variable indicating whether a woman was in union or not in each given month.

Figure 5.3.1: Contraceptive calendar for 2005 Moldova Demographic and Health Survey



INSTRUCTIONS:
ONLY ONE CODE SHOULD APPEAR IN ANY BOX.
FOR COLUMNS 1 AND 4, ALL MONTHS SHOULD BE FILLED IN.

INFORMATION TO BE CODED FOR EACH COLUMN

COL. 1: BIRTHS, PREGNANCIES, CONTRACEPTIVE USE **
- B BIRTHS
- P PREGNANCIES
- T TERMINATIONS

- 0 NO METHOD
- 1 FEMALE STERILIZATION
- 2 MALE STERILIZATION
- 3 PILL
- 4 IUD
- 5 INJECTABLES
- 6 IMPLANTS
- 7 CONDOM
- 8 FEMALE CONDOM
- 9 DIAPHRAGM
- J FOAM OR JELLY
- K LACTATIONAL AMENORRHEA METHOD
- L RHYTHM METHOD
- M WITHDRAWAL
- X OTHER _____ (SPECIFY)

COL. 2: SOURCE OF CONTRACEPTION
- 1 GOVT. HOSPITAL
- 2 GOVT. HEALTH CENTER
- 3 FAMILY PLANNING CLINIC
- 4 GOVT. MOBILE CLINIC
- 5 GOVT. FIELDWORKER
- 6 OTHER PUBLIC
- 7 PVT. HOSPITAL/CLINIC
- 8 PHARMACY
- 9 PRIVATE DOCTOR
- A NON-GOVT. MOBILE CLINIC
- B NON-GOVT. FIELDWORKER
- C OTHER PRIVATE MEDICAL
- D SHOP
- E CHURCH
- F FRIENDS/RELATIVES
- X OTHER _____ (SPECIFY)

COL. 3: DISCONTINUATION OF CONTRACEPTIVE USE
- 0 INFREQUENT SEX/HUSBAND AWAY
- 1 BECAME PREGNANT WHILE USING
- 2 WANTED TO BECOME PREGNANT
- 3 HUSBAND/PARTNER DISAPPROVED
- 4 WANTED MORE EFFECTIVE METHOD
- 5 HEALTH CONCERNS
- 6 SIDE EFFECTS
- 7 LACK OF ACCESS/TOO FAR
- 8 COSTS TOO MUCH
- 9 INCONVENIENT TO USE
- F FATALISTIC
- A DIFFICULT TO GET PREGNANT/MENOPAUSAL
- D MARITAL DISSOLUTION/SEPARATION
- X OTHER _____ (SPECIFY)
- Z DON'T KNOW

COL. 4: MARRIAGE/UNION
- X IN UNION (MARRIED OR LIVING TOGETHER)
- 0 NOT IN UNION

** Response categories may be added for other methods, including fertility awareness methods.

				1	2	3	4			
	12	DEC	01					01	DEC	
	11	NOV	02					02	NOV	
	10	OCT	03					03	OCT	
	09	SEP	04					04	SEP	
2	08	AUG	05					05	AUG	2
0	07	JUL	06					06	JUL	0
0	06	JUN	07					07	JUN	0
5	05	MAY	08					08	MAY	5
*	04	APR	09					09	APR	*
	03	MAR	10					10	MAR	
	02	FEB	11					11	FEB	
	01	JAN	12					12	JAN	
	12	DEC	13					13	DEC	
	11	NOV	14					14	NOV	
	10	OCT	15					15	OCT	
	09	SEP	16					16	SEP	
2	08	AUG	17					17	AUG	2
0	07	JUL	18					18	JUL	0
0	06	JUN	19					19	JUN	0
4	05	MAY	20					20	MAY	4
*	04	APR	21					21	APR	*
	03	MAR	22					22	MAR	
	02	FEB	23					23	FEB	
	01	JAN	24					24	JAN	
	12	DEC	25					25	DEC	
	11	NOV	26					26	NOV	
	10	OCT	27					27	OCT	
	09	SEP	28					28	SEP	
2	08	AUG	29					29	AUG	2
0	07	JUL	30					30	JUL	0
0	06	JUN	31					31	JUN	0
3	05	MAY	32					32	MAY	3
*	04	APR	33					33	APR	*
	03	MAR	34					34	MAR	
	02	FEB	35					35	FEB	
	01	JAN	36					36	JAN	
	12	DEC	37					37	DEC	
	11	NOV	38					38	NOV	
	10	OCT	39					39	OCT	
	09	SEP	40					40	SEP	
2	08	AUG	41					41	AUG	2
0	07	JUL	42					42	JUL	0
0	06	JUN	43					43	JUN	0
2	05	MAY	44					44	MAY	2
*	04	APR	45					45	APR	*
	03	MAR	46					46	MAR	
	02	FEB	47					47	FEB	
	01	JAN	48					48	JAN	
	12	DEC	49					49	DEC	
	11	NOV	50					50	NOV	
	10	OCT	51					51	OCT	
	09	SEP	52					52	SEP	
2	08	AUG	53					53	AUG	2
0	07	JUL	54					54	JUL	0
0	06	JUN	55					55	JUN	0
1	05	MAY	56					56	MAY	1
*	04	APR	57					57	APR	*
	03	MAR	58					58	MAR	
	02	FEB	59					59	FEB	
	01	JAN	60					60	JAN	
	12	DEC	61					61	DEC	
	11	NOV	62					62	NOV	
	10	OCT	63					63	OCT	
	09	SEP	64					64	SEP	
2	08	AUG	65					65	AUG	2
0	07	JUL	66					66	JUL	0
0	06	JUN	67					67	JUN	0
0	05	MAY	68					68	MAY	0
*	04	APR	69					69	APR	*
	03	MAR	70					70	MAR	
	02	FEB	71					71	FEB	
	01	JAN	72					72	JAN	

Source: NCPM and ORC Macro 2006, p. 336

Note: This is the representation of the MDHS contraceptive calendar supplied by ORC Macro. Column 5, 'moves and communities' was omitted from this illustration.

The column containing data on 'reasons for discontinuation,' although potentially useful, was considered to be of too low quality due to concerns expressed in previous demographic work. Strickler *et al.* (1997) make use of the 1995 Morocco DHS Panel Study and the 1992 Morocco DHS to analyse the accuracy of retrospective contraceptive calendar data. The analysis compares the current method reported in the 1992 study to the method recalled by users in the 1995 survey. This study was unique and cannot be repeated for the Moldova DHS due to the lack of an overlapping panel survey. When examining the comparison in status (pregnant, contraceptive non-use, contraceptive use), Strickler *et al.* found that the correspondence was in excess of 80%. When examining the type of method used during a given month 89.2% of months showed agreement. Clinical/permanent methods showed the highest correspondence, with the lowest correspondence observed for reversible methods such as condom. Strickler *et al.* (1997) also analysed the consistency in the number of spells of contraceptive use. Consistency between the two contraceptive calendars was lower in this analysis; the correspondence in number of contraceptive spells was only 41.7%, falling to 28.4% for women with more than 2 contraceptive spells. The reason for discontinuation for non-censored spells was consistent between the two surveys in only 63% of cases. Mistrust of the 'reason for discontinuation' is widespread in demographic literature (Steele *et al.*1999, Steele *et al.* 1996, Zhang *et al.* 1999) and these data are not widely used in individual level analyses of contraceptive discontinuation.

Despite the inherent limitations, the contraceptive calendar represents the highest quality retrospective contraceptive use histories available in contemporary demographic data. For example, Becker and Sosa (1992) found that the use of calendar collection techniques improves the reporting of postpartum contraceptive use significantly over simply asking for event dates. Additionally, as Steele *et al.* (1996) and Zhang *et al.* (1999) point out a large proportion of potential downward bias in the probability of contraceptive failure can be removed by defining discontinuation by the type of method in use in the following month.

5.3.2 Analysis sample

The initial MDHS calendar contains 416,433 woman months of contraceptive data from 7440 women. 15732 months refer to women when they were pregnant, giving birth or having an abortion, and hence these months are deleted. Consistent with Steele *et al.* (1996), Steele *et al*. (1999) and Steele and Curtis (2003) the first spell in the calendar is deleted, as the spell is left truncated (60690 months deleted). 5720 months contributed by women who never had sex, and women who were sterilised before the start of the contraceptive calendar, was also deleted. Spells of permanent method use (male or female sterilisation) are deleted, since the hazard of discontinuation is zero (women cannot abandon a permanent method for example). This violates the assumptions of the hazard model (Steele 2003). Spells of non-use for sexually active women are also removed on these grounds, since the hazard of abandonment – defined as a transition from use to non-use - is zero. 109, 324 months were deleted from the calendar.

Curtis (1996) highlights a potential bias introduced by redundant contraceptive use during the postpartum period. In the MDHS calendar, only the most effective method is recorded. While natural method use is classified as Lactational Amenorrheic Method (LAM) use during this period, all months where a modern method is used are attributed to the modern contraceptive. This spell of modern method use does not account for the infecundability due to breastfeeding however, and the hazard of modern contraceptive failure is therefore downward biased. Curtis (1996) recommends that all contraceptive use information 6 months postpartum is removed from contraceptive calendar data to avoid this bias. 4,404 months of contraceptive information are therefore removed from the analysis sample.

There are few spells of contraceptive use longer than 24 months in duration. Hazards after 24 months of use cannot be estimated precisely and are therefore excluded from the analysis (171,125 months removed – the overwhelming majority of which are event free). This restricts the hazard of discontinuation to events within the first 2 years of contraceptive use. Finally, the last 3 months of the contraceptive calendar

are removed from the analysis sample to adjust for unreported pregnancies leading to a downward bias in estimated failure rates where women are not yet aware that they are pregnant. This is consistent with Steele *et al.* (1996), Steele *et al.* (1999) and Zhang *et al.* (1999). After all necessary deletions, the analysis sample contains a total of 45,859 woman months of contraceptive use information. The selection of the sample is summarised in Table 5.3.1.

Table 5.3.1: Analysis sample, showing number of months deleted

Initial sample (months)		**416,433**
	Months pregnant, giving birth, abortions	15,732
	Months deleted due to omission of first spell	60,690
	Deletion of sterilisation spells	5,720
	Deletion of spells with no method in use	109,324
	Spells 6 months or fewer since last pregnancy	4,404
	Removal of final 3 months of calendar	3,579
	Truncation of spells greater than 24 months	171,125
Analysis sample		**45,859**

5.4 Explanatory variables

Contraceptive type is the most important explanatory variable for this analysis, and is used to test the research hypothesis. The derivation and specification of the contraceptive type is considered in Section 5.4.1. Other control variables, including the proximate determinants of fertility (5.4.2) and socio-economic variables (5.4.3) are also discussed.

5.4.1 Contraceptive type

The type of contraceptive is recorded for each month of the contraceptive calendar for individual methods, e.g. pill, condom, withdrawal. Methods which are not widely used often demonstrate low event frequencies - see Table 5.4.1 – which makes the

precise estimation of hazards difficult. A broader classification, based on the contraceptive type, is employed to avoid small event frequencies. The chosen classification is modern clinical (which includes IUD, injectables), modern reversible (all other modern methods including condom, pill, diaphragm, cap, sponge) and natural (withdrawal, periodic abstinence).

Table 5.4.1: Observed number of terminal events by individual contraceptive method, first 24 months of contraceptive use.

Method	Abandonments	Switches	Failures
Pill[1]	102	84	37
Condom[1]	173	134	71
Foam/jelly/cap[1]	27	23	16
IUD[2]	31	46	23
Withdrawal[3]	139	160	228
Periodic abstinence[3]	27	32	39
All other methods	7	11	6
Total	**506**	**490**	**420**

Note:

1 denotes modern reversible method

2 denotes modern clinical method

3 denotes natural method

Counts refer to aggregated event counts during first 24 months of contraceptive use (events in analysis sample).

5.4.2 Controls for proximate determinants of fertility

The proximate determinants of fertility controlled for in the analysis are those identified by Bongaarts (1978) and Baschieri and Hinde (2007). Specifically, the proximate determinants considered are: lactational amenorrhea, coital frequency and fecundability. The effect of lactation on the probability of conception is accounted for using the method proposed by Curtis (1996), where the first six

months following pregnancy are removed from the analysis sample (see Section 5.3.2).

The effects of coital frequency and fecundibility on the hazard of contraceptive failure are partially captured by the random effect specified at the woman level. Two fixed effects are also employed.

Coital frequency is controlled for using a fixed effect of whether a woman is in union or not. Exposure to sexual activity is a key determinant of the propensity to experience contraceptive failure, since a woman who is not sexually active has a zero probability of contraceptive failure. Sexual activity may also influence other potential routes to discontinuation - for example, women may not maintain contraceptive behaviour if she is not regularly sexually active and hence discontinue. Lyons-Amos *et al.* (2011) find that women who were not sexually active survey were significantly more likely to be non-users when compared to women who were sexually active. The measure of sexual activity is derived from the marriages/unions column of the contraceptive calendar. Months in union are assumed to be equivalent to months of sexual activity, and where a woman reports a month of not in union it is assumed she is not sexually active.

The effect of fecundability is captured through two fixed effects: age and parity. Age is included in the model as a control for the effect of declining fecundability at older ages. This effect is dramatic - the monthly probability of conception halves between the age of 20 and 35 (Larsen and Vaupel 1993). This analysis controls only for the age of the female, since the age of the male partner does not influence the probability of conception (Van Bavel 2003). Age can also influence switching or abandonment. Lyons-Amos et al (2011) find that older women are substantially more likely than younger women to be non-users of contraception. This age variable is included as a time varying covariate, categorised to capture potential non-linear effects.

The effect of higher parity in reducing the likelihood of conception is noted by a number of authors; Braun (1980) and Larsen and Vaupel (1993) identify that the

duration between births (and hence the probability of monthly conception) tends to increase (decrease) among higher parity women. After controlling for a number of other factors (age, marital duration and socio-economic determinants) Van Bavel (2003) finds that higher parity has a robust negative association with fertility. There is also the effect of parity on propensity to switch or abandon contraceptive use. For example, Lyons-Amos *et al.* (2011) find that higher parity women were more likely to use a modern method. Parity clearly varies between spells of contraceptive use since spells may be terminated due to failure (resulting in live birth) or by abandonment with the intention of becoming pregnant. The parity variable for each spell is derived from the 'children ever born' variable on MDHS 2005. Counting backward through the spells of contraceptive use, where the outcome of a pregnancy is a live birth, the number of children ever born is reduced by 1 for all previous contraceptive spells. This process continues until the start of the calendar is reached.

5.4.3 Socio-economic controls

Baschieri and Hinde (2007) argue that once the proximate determinants of fertility are controlled for and correctly specified there should be no residual effect of socio-economic variables on the probability of conception (since all other influences act on fertility only through the proximate determinants). However in their analysis they find that even after controlling for proximate determinants, there are still residual effects of socio-economic influences on the probability of conceiving. This indicates that conventional variables available from DHS data do not capture the effect of proximate determinants completely or that it is not possible to correctly specify the proximate determinants. Additionally, socioeconomic variables may capture other influences on method use e.g. diligence of contraceptive use, Jones *et al*. (1980). This analysis therefore also considers socio-economic control variables.

Educational level is included since it may influence the ability of women to correctly follow contraceptive instructions. It is hypothesised that women with higher educational levels may be better at correctly using a contraceptive method, and be more aware of the consequences of the misuse of methods (e.g. the loss of a

protective effect of a missed pill, Potter *et al*., 1996). Educational level remains constant through the contraceptive calendar and is treated as a time invariant effect.

A wealth index is derived as a proxy variable for household wealth (Filmer and Pritchett, 2001). Wealth may affect discontinuation behaviour through two mechanisms. First, it reflects the economic vulnerability of lower wealth groups, who may be at greater risk to a volatile supply of contraception. Secondly, wealth reflects the motivation to avoid pregnancy. Since the higher wealth groups have a greater opportunity cost of childbearing (due to disrupted female employment), there may be greater diligence of contraceptive use among these women and hence a lower probability of contraceptive failure. Alternatively, the absolute cost of childbearing may be a major incentive for the low wealth groups to avoid pregnancy, with the effect of decreasing the hazard of failure for this group via increased contraceptive diligence.

Wealth index is an adaptation of the index proposed by Filmer and Pritchett (2001). The index for this analysis is based solely on the ownership of household assets, with the scoring factors of water supply and household materials removed (as these variables were nearly homogenous in the MDHS dataset). Respondents are allocated to wealth groups based on their asset score, and these groups divided into low (40%), medium (40%) and high wealth (20%) brackets. Groups are constructed before the derivation of the spells of contraceptive use, so the numbers of months of use within groups do not match this allocation (see Table 5.6.1). Wealth is fixed across the contraceptive calendar, since it is a reflection of long-run economic status (Filmer and Pritchett 2001).

Child death is included due to its potential influence on contraceptive abandonment. Van Bavel (2003) finds that the death of the previous sibling can decrease the interval between births. This can either be as a deliberate effort to replace the lost child or due to the suspension of breastfeeding in the postpartum period, hastening the resumption of menses (Keyfitz and Caswell 2005). Child survival status is derived

from the birth history section of the MDHS. Survival status of the previous child is matched to contraceptive spells via the derived parity measure (see 5.4.2).

Employment is included since it is strongly associated with the motivation of a woman to avoid accidental pregnancy (Ní Bhrolchaín 1988, Keyfitz 1980). Women in professions have a stronger motivation to avoid an accidental pregnancy (and hence use contraception more diligently) than women in less aspirational careers. Similar motivation exists for contraceptive abandonment, as women in professions may be less likely to abandon use. Two variables are employed to measure the effect of employment on the hazard of contraceptive discontinuation. 'Type of employment' is the first variable, which measures the type of job a woman holds. This variable distinguishes between women in a career - who are assumed to have the greatest motivation to avoid pregnancy - and women in manual or household jobs - for whom an accidental pregnancy would be less disruptive. The second variable is the 'seasonality of employment,' which measures the intensity of a woman's engagement with the labour force. Due to a lack of employment history data on the MDHS, type and seasonality of employment are assumed constant throughout the contraceptive calendar.

Induced abortion has a dramatic effect on Moldovan fertility patterns, with systematic differences in the birth spacing patterns of women with different abortion propensities. Abortion represents a fall-back method of birth control in the event of contraceptive failure (Agadjanian 2002, Westoff 2000; 2005). Women with a greater abortion experience may not use contraception as diligently, since they view accidental pregnancy as a less serious outcome. The same rationale applies to contraceptive abandonment; women may be more prepared to abandon contraception and hence become accidentally pregnant given the previous experience of induced abortion. In previous analyses, abortion ratio was used as a measure of abortion propensity. In this analysis the count of abortions (adjusted by pregnancy outcome for each spell) is used. The reason for the differing definition is that chapters 3 and 4 deal with reproductive life course, and hence the censoring of future abortions was problematic. This is not an issue in the present analysis, since

the hazards are relevant to the status at the observed time in the calendar, and the censoring of future abortion is therefore irrelevant.

Religion and ethnicity are two potential measures that may influence contraceptive discontinuations. Religion can be highly influential on the types of contraceptive method available to women (Christopher 2006), as well as the use of abortion. In general the high proportion of women in Moldova affiliated to the Orthodox Church means that there is unlikely to be any significant religious interference in contraceptive choice. The exception to this may be the Roman Catholics who may have stronger objections to modern contraceptives and the use of induced abortion (Santow 1993, 1995, Christopher 2006). Additionally, this group may be more experienced with natural contraceptive use, and so more effective at natural method implementation due to peer network effects (Montgomery and Casterline 1996, Kohler *et al.* 2001). Religion is assumed to be a fixed attribute and does not change over the course of the contraceptive calendar. Ethnic group of the woman is also included. Lyons-Amos *et al.* (2011) find a particularly high concentration of natural method use among Bulgarians. Ethnic group is considered a fixed attribute.

Residence is included as a potential explanatory effect, particularly on switching/ abandonment, due to the systematic differences in family planning service provision in Moldova (Lyons-Amos *et al.* 2011, MacLehose 2002). The capital region – Chisinau – is relatively well supplied with contraception, and the family planning system is relatively well organised. However, outlying regions have an underdeveloped family planning network (MacLehose 2002). This could potentially affect the propensity to discontinue contraception through abandonment if the contraceptive supply became disrupted, switching to more readily available methods, or contraceptive failure due to improper use (e.g. rationing contraceptive pills, reusing condoms). Residence is assumed to be fixed for the duration of the contraceptive calendar.

5.5 Methodology

This section will briefly discuss the multilevel competing risk model and modelling strategy.

5.5.1 Regression model

The multilevel competing hazard model incorporates the effects of covariates on the hazard of discontinuation in each month of contraceptive use (Steele *et al.* 1996, Steele *et al.* 1999, Zhang *et al.* 1999, Steele 2003). Three discontinuations are possible; abandonment, switching and failure. Abandonment is defined as a month of contraceptive use followed by a month of contraceptive non-use. Switching is defined as a month of contraceptive use followed by a month of use of a different method, and contraceptive failure is defined as a month of contraceptive use followed by pregnancy. These definitions are consistent with Steele *et al.* (2003), Steele *et al.* (1999) Zhang *et al.* (1999) and Steele (2003).

The dependent variable in the model, $y_{ijk}(t)$, is discontinuation in spell *i* for woman *j* in community (PSU) *k,* where $y_{ijk}(t)$ is observed for every month (t) within a spell of contraceptive use. $y_{ijk}(t)$ is defined as:

$$y_{ijk}(t) = s = \begin{cases} 0 & Continuation \\ 1 & Abandonment \\ 2 & Switching \\ 3 & Failure \end{cases}$$

The hazard of discontinuation *s, s=0,1,2,3,* in month *t is* defined in Equation 5.1 (where t=1) and 5.2 (where t>1);

$$h_{ijk}^{s}\ (t=1) = \Pr(y(t=1)_{ijk} = s)$$

Equation 5.1

$$h_{ijk}^{s}\ (t) = \Pr(y(t)_{ijk} = s \mid y_{ijk}(t-1) = 0)$$

Equation 5.2

The log-odds of outcome s ($s = 1, 2, 3$) relative to outcome 0 (continuation) can be written in the form of Equation 5.3. This is the multilevel competing risk model employed in this analysis.

$$\ln\left(\frac{h_{ijk}^{s}(t)}{h_{ijk}^{s=0}(t)}\right) = \alpha_{ijk}^{s}(t) + \boldsymbol{\beta}^{s,T}\mathbf{x}_{ijk} + \nu_{jk}^{s} + \tau_{k}^{s}$$

Equation 5.3

In Equation 5.3, $h_{ijk}^{s}(t)$ denotes the hazard at time *t* of event *s,* $\alpha_{ijk}^{s}(t)$ is a dummy variable denoting the duration of spell *i*, of woman *j* in community *k,* $\boldsymbol{\beta}^{s,T}$ is a transposed vector of coefficients for discontinuation *s*, $\mathbf{x}_{ijk}^{s}$ a vector of explanatory variables.

Women can contribute more than one spell of contraceptive use and women within the same community may have similar contraceptive behaviours due to network effects (Kohler *et al.* 2001, Montgomery and Casterline 1996). A 3-level hierarchical clustering of spells within women and community is therefore present. ν_{jk}^{s} is a women-level random effect and τ_{k}^{s} is a community-level random effect for discontinuation *s*, representing unobserved women and community characteristics respectively. Random effects allow for the possibility that some outcomes may have shared or correlated unmeasured influence not captured by other explanatory variables in the model. For example, similarity between the 'abandonment' and

'switching' outcomes would be expected to lead to a positive correlation/covariance between $v_{jk}^{(2)}$ and $v_{jk}^{(3)}$ and between $\tau_j^{(2)}$ and $\tau_j^{(3)}$. The random effects are assumed to follow multivariate normal distributions, such that $\mathbf{v}_{jk} = (v_1, v_2, v_3) \sim N(0,0,\mathbf{\Omega})$ and $\boldsymbol{\tau}_k = (\tau_1, \tau_2, \tau_3) \sim N(0,0,\mathbf{\Psi})$ where **Ω** and **Ψ** are 3 by 3 variance-covariance matrices. The model in Equation 5.4 makes the assumption that the effect of $\boldsymbol{\beta}^s$ is invariant across *t*, i.e. the effect of $\boldsymbol{\beta}^s$ on the logit of h_{ijk}^s is proportional. By introducing an interaction term between $\alpha_{ijk}^s(t)$ and $\boldsymbol{\beta}^s$ it is possible to introduce time-varying effects into the model. Once estimated, the model can be used to generate estimated hazards of discontinuation. Where this is done, the estimated hazards are median hazards (the random effects take the value zero).

5.5.2 Modelling strategy

The model is built from a null model, with only random intercepts for each logit. This ensures convergence of the estimates of the random part of the model, v_{jk}^s and τ_k^s. Then, the duration variable ($\alpha_{ijk}^s(t)$) is added to the model. The model is re-estimated to obtain new values of the random effects. Next, the term describing the type of contraceptive use during the spell is added to the model. The inclusion of further control variables are tested for significance and included following a stepwise model building procedure; if they are significant following a joint-Wald test on the criterion of α=5% then they are retained in the model. First, the control variables for the proximate determinants of fertility (age, parity, union status) are tested. The remaining socio-economic controls are then added. If there is any improvement to the model even after the inclusion of the proximate determinants then this term is retained in the model. Once all of the socio-economic variables have been selected, the model produced is a proportional (odds) hazard model. To test for time varying effects, interactions between duration and other relevant variables within the model are tested for significance (α=5%) using the joint-Wald test. Random slopes for important explanatory variables are then explored. Random slopes allow β coefficients to vary at *j* and *k* levels, indicating heterogeneous effects

of explanatory variables for different women and communities respectively. Significance of these effects is based on the criterion of α=5% on the joint-Wald test.

Model estimation is conducted in MLwiN 2.02 (Rasbash *et al.* 2005), initially using 2nd order Penalised Quasi Likelihood (PQL) Restricted Iterative Generalised Least Squares (RIGLS) estimation. Second order PQL is used to provide initial parameter estimates, and is more suitable for estimation than Marginal Quasi Likelihood (MQL) due to small number of spells for some women (Steele *et al.* 1996). Markov Chain Monte Carlo (MCMC) is then used to re-estimate the model for interpretation. MCMC tends to produce more reliable estimates of standard errors and variances than PQL, which can provide downward biased estimated parameters for discrete response models (Browne 2009, Breslow and Clayton 1993). Starting values for MCMC chains are taken from the parameter estimates produced by 2PQL. MCMC parameter estimates are based on 80,000 samples, with a burn in of 5,000 samples. All parameters are verified for significance following MCMC estimation (95% credible intervals for parameter estimates should not include zero). Any non-significant effects are removed from the model.

5.6. Results

This section presents the descriptive analysis including the overall sample characteristics, Kaplan Meier plots of contraceptive methods and the results from the regression modelling.

5.6.1 Descriptive analysis

Table 5.6.1 reports the median time until abandonment, switching and failure. The results show that modern reversible method users have the shortest median duration until abandonment (15 months), which is substantially shorter than for natural method users or modern clinical methods users (both 22 months). Modern clinical method users have the shortest median time until contraceptive switching, although this is comparable to modern reversible method users. Natural method users have a substantially longer median duration until contraceptive switching. In contrast, natural method users are most likely to experience failure (16 months), which has a substantially shorter median than both modern reversible method users (23 months) and modern clinical method users (21 months).

Table 5.6.1: Descriptive analysis for potential predictor variables

Variable	Contraceptive abandonment		Contraceptive switching		Contraceptive failure		Total number of months
	Median event time	Number of events	Median event time	Number of events	Median event time	Number of events	
Contraceptive type							
Modern reversible	15	303	17	243	23	124	15740
Natural	22	170	21	199	16	273	15855
Modern clinical	22	33	16	48	21	23	13564
Age category							
Under 19	12	98	10	95	20	44	5070
20-24	16	189	20	139	18	148	12343
25-29	22	103	20	120	17	122	10488
30-34	23	46	20	57	16	69	7340
35 or over	22	70	16	79	24	37	9918
Parity							
Nulliparous	12	268	19	158	21	103	10408
1	21	142	20	165	18	179	14795
2 or more	23	96	17	167	17	138	19956
In union							
Yes	20	371	19	374	17	390	38140
No	12	135	14	116	-[a]	30	7019
Educational attainment							
Secondary or lower	18	330	20	292	18	309	30778
Higher	18	179	17	198	21	111	14381
Wealth index							
Low	19	178	20	168	17	196	16668
Medium	19	197	17	183	19	136	16329
High	18	131	17	139	19	88	12162
Previous child died							
No	18	503	18	448	19	418	44923
Yes	10	3	16	2	21	2	236
Type of employment							
Not working	19	218	19	219	17	204	16768
Professional/technical	18	107	16	123	20	81	11614
Clerical	16	72	16	62	18	49	6151
Agricultural	17	25	-[a]	10	20	25	2797
Domestic/services	19	21	14	36	21	22	3139
Manual	19	63	22	40	22	39	4690
Seasonality of employment							
All year	18	245	17	241	20	169	23577
Seasonal	18	32	21	36	20	31	3851
Occasional	15	18	19	10	16	17	1231
Does not work	19	211	19	203	17	203	16500

Variable	Contraceptive abandonment		Contraceptive switching		Contraceptive failure		Total number of months
	Median event time	Number of events	Median event time	Number of events	Median event time	Number of events	
Abortion history							
0	18	364	18	320	20	225	24820
1	20	69	19	82	17	93	9341
2	19	39	22	44	16	53	5724
3 or more	22	34	20	44	14	49	5274
Religion							
Orthodox	18	480	18	467	19	394	42842
Other Christian	16	15	21	12	17	17	1189
Other religion	15	3	17	5	13	6	600
No religion	6	8	14	6	12	3	528
Ethnicity							
Moldovan	18	377	19	347	18	311	33195
Romanian	-[a]	15	12	21	21	9	1132
Ukranian	18	48	14	43	17	35	3861
Russian	17	37	17	40	20	25	3770
Gaguz	16	19	15	17	19	14	1490
Other	24	10	17	22	16	26	1711
Region of residence							
North	17	129	17	116	17	112	11895
Center	19	84	22	77	18	88	9085
South	19	90	21	82	19	79	8197
Chisinau	18	203	17	215	20	141	15982
Urbanicity							
Urban	18	339	17	353	19	258	28728
Rural	18	167	21	137	17	162	16431
Total sample	**18**	**506**	**18**	**490**	**19**	**420**	**45159**

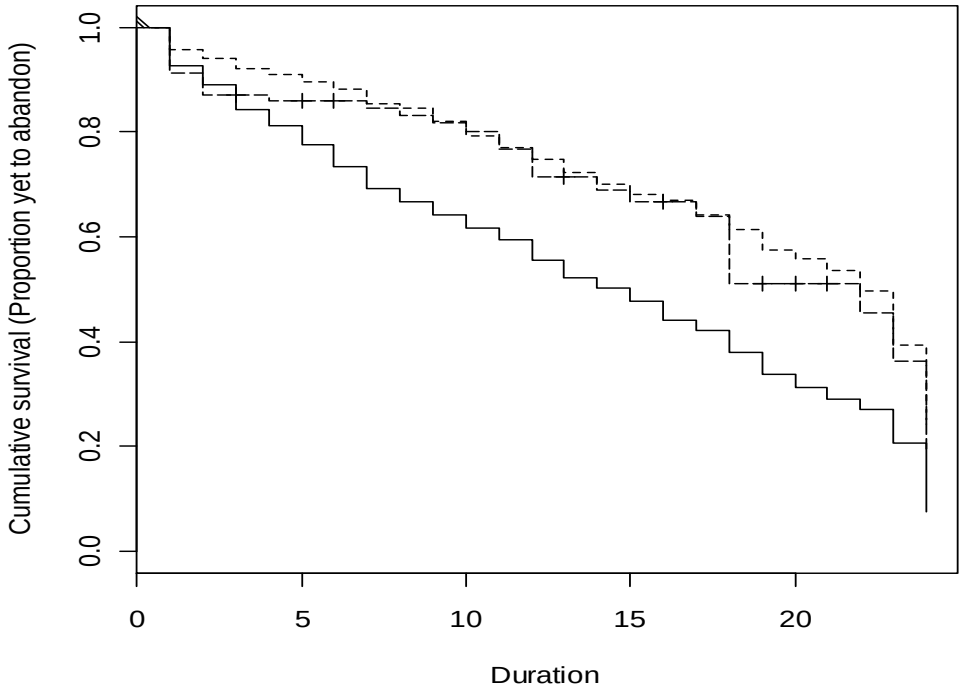
Note: [a] denotes problems in estimation due to small event frequencies or very long survival times.

These results are supported by Figure 5.6.1, which presents Kaplan-Meier survival plots by contraceptive type are for each outcome: a) contraceptive abandonment, b) contraceptive switching and c) contraceptive failure. For each plot the recurrent nature of spells is ignored and spells ending in other discontinuations are treated as censored. Abandonment (Figure 5.6.1, plot a.) is most frequent for modern reversible method users – indicated by the lower cumulative survival profile. In comparison, the propensity to abandon a method is lower for natural and clinical methods, which have a higher cumulative survival profile. Natural method users are

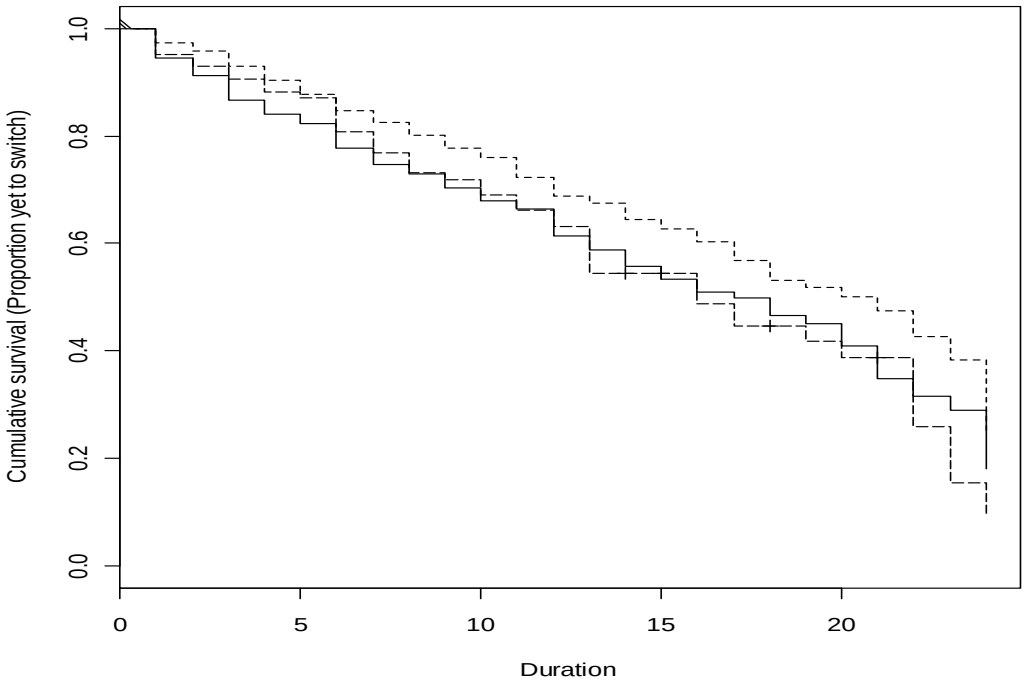
least likely to switch method, while both modern method types show high rates of switching (plot b.). The propensity to fail is highest among natural method users as shown by the low profile of the cumulative survival (Fig. 5.6.1 plot c.). Modern reversible method users show a higher cumulative survival profile, while the survival profile for modern clinical method users is higher still.

Figure 5.6.1: Kaplan-Meier survival plots for by contraceptive type a) contraceptive abandonment, b) contraceptive switching and c) contraceptive failure.

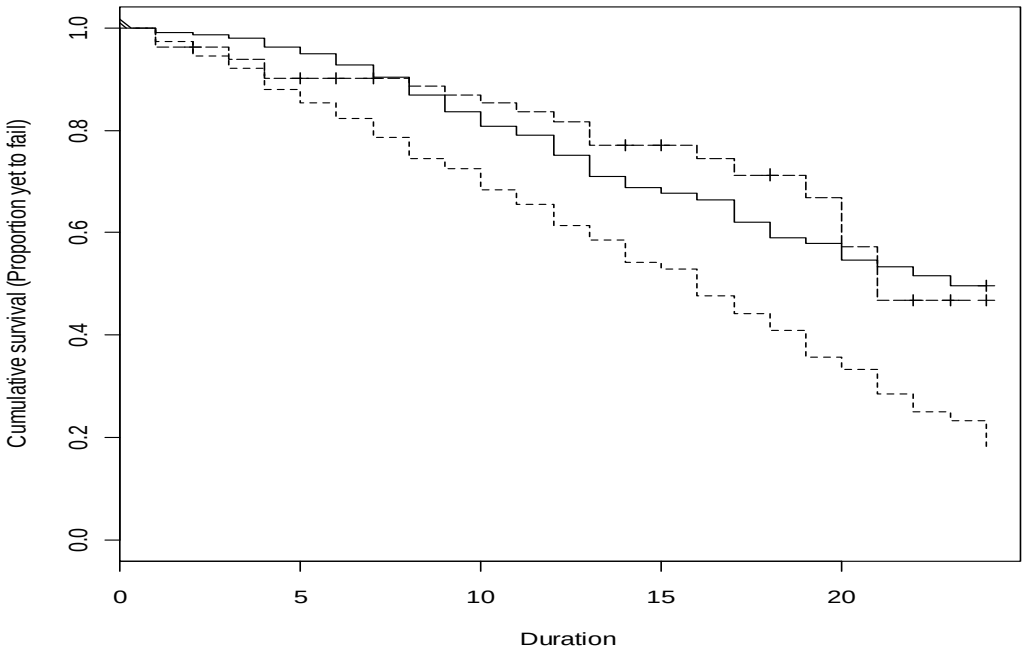
a) Contraceptive abandonment



b) Contraceptive switching



c) Contraceptive failure



Note:

Modern reversible method
Natural method
Modern clinical method

5.6.2 Regression model

This section presents the results of the final multilevel competing hazard model. First, the random effects structure is discussed, and then the fixed effects. Fixed effects are considered for the contraceptive type – which is used to test the research hypothesis – as well as for the proximate determinants and socio-economic controls. Hazards estimated from the model are also presented.

Random effects

The community level (level *k*) random effect was significant in the null model but became non-significant once fixed-effect explanatory variables were included. Consistent with the modelling strategy, this effect was dropped from the model. The final model therefore includes random effects at the woman level only (level *j*). Random slopes could not be estimated in the final model, as a small number of spells for some women led to non-convergence.

The estimated random effects at the woman level for the final model are presented in Table 5.6.2. All three logits demonstrate a significant variance term, indicating that there is unexplained variation between women in the hazard of discontinuation after controlling for fixed effects. The largest of the estimated variances is for the hazard of abandonment (although it also has the widest credible interval), while the smallest is for failure (which also has the narrowest credible interval).

There is a significant positive covariance between the hazard of abandonment and the hazard of contraceptive switching (the credible interval does not include zero). This indicates that a woman who is more likely abandon a method also has a higher propensity to switch contraceptive method. The covariances between the hazard of contraceptive failure and the hazards of abandonment and switching are both non-significant.

Table 5.6.2: Estimated variance-covariance matrix for final model

Parameter	Parameter estimate	95 % credible intervals for estimated (co)variance
Variance (abandonment)~ ν_j^1	1.882	1.221 - 2.587
Variance (switching)~ ν_j^2	0.928	0.610 - 1.286
Variance (failure)~ ν_j^3	0.434	0.156 - 0.800
Covariance (Abandonment, Switching)~ $\text{cov}(\nu_j^1, \nu_j^2)$	0.598	0.263 - 0.953
Covariance (Abandonment, Failure)~ $\text{cov}(\nu_j^1, \nu_j^3)$	-0.343	-0.728 - 0.045
Covariance (Switching, Failure)~ $\text{cov}(\nu_j^2, \nu_j^3)$	-0.016	-0.254 - 0.232

Model estimated using 80000 MCMC samples with 5000 burn-in. Starting values for MCMC from 2nd order PQL (RIGLS).

Fixed effects

Table 5.6.3 presents the fixed effects from the final estimated model. Data sparsity for some months meant that interactions between the duration variable and other covariates could not be estimated due to structural problems. Collapsing time intervals to create a piecewise hazard model did not overcome this problem. Hence this analysis assumes proportional effects of covariates on the hazards of discontinuation.

As well as the contraceptive method and the proximate determinants of fertility (age, parity, union status), the socio-economic variables of educational status, seasonality of employment and wealth index were found to be significant. All other variables (type of employment, child death, abortion history, religion, ethnicity, region of residence and urbanicity) were not significant in the model.

Table 5.6.3: Competing risk discrete time hazard model for contraceptive discontinuation, for a) abandonment, b) switching and c) failure.

a) Logit for contraceptive abandonment

					Contraceptive Abandonment		
Variable	β1		SE(β1)	Approximate hazard ratio 1 ($e^{\beta(1)}$)	95% credible interval for hazard ratio 1		
Intercept	-2.903	* *	0.226				
Duration (ref=1)							
2	-0.721	* *	0.213	0.486	0.320	-	0.738
3	-0.504	*	0.208	0.604	0.402	-	0.908
4	-0.854	* *	0.244	0.426	0.264	-	0.687
5	-0.720	* *	0.245	0.487	0.301	-	0.787
6	-0.558	*	0.238	0.572	0.359	-	0.913
7	-0.280		0.230	0.756	0.482	-	1.186
8	-0.930	* *	0.296	0.395	0.221	-	0.705
9	-0.611	*	0.272	0.543	0.319	-	0.925
10	-0.462		0.272	0.630	0.370	-	1.074
11	-0.595	*	0.295	0.552	0.309	-	0.983
12	-0.157		0.268	0.855	0.505	-	1.445
13	-0.454		0.302	0.635	0.351	-	1.148
14	-0.666		0.342	0.514	0.263	-	1.004
15	-0.691		0.355	0.501	0.250	-	1.005
16	-0.695		0.370	0.499	0.242	-	1.031
17	-0.644		0.369	0.525	0.255	-	1.082
18	-0.074		0.310	0.929	0.506	-	1.705
19	-0.289		0.343	0.749	0.382	-	1.467
20	-0.951	*	0.462	0.386	0.156	-	0.956
21	-1.080	*	0.507	0.340	0.126	-	0.917
22	-0.792		0.463	0.453	0.183	-	1.122
23	0.125		0.341	1.133	0.581	-	2.211
24	0.600		0.312	1.822	0.989	-	3.359
Contraceptive Type (ref=Modern reversible)							
Natural	-0.604	* *	0.127	0.547	0.426	-	0.701
Modern clinical	-1.89	* *	0.226	0.151	0.097	-	0.235
Age group							
15-19	-0.412	*	0.168	0.662	0.477	-	0.921
20-24 (ref)	-		-	1.000			
25-29	0.249		0.17	1.283	0.919	-	1.790
30-34	0.059		0.232	1.061	0.673	-	1.671
35 or over	0.571	*	0.232	1.770	1.123	-	2.789
Parity (ref=Nulliparous)							
1	-1.474	* *	0.192	0.229	0.157	-	0.334
2 or more	-2.284	* *	0.261	0.102	0.061	-	0.170

Continues

Variable	β1		SE(β1)	Approximate hazard ratio 1 ($e^{\beta(1)}$)	95% credible interval for hazard ratio 1		
In union (ref=Yes)							
No	-0.309		0.158	0.734	0.539	-	1.001
Educational attainment (ref=secondary or lower)							
Higher	-0.576	* *	0.143	0.562	0.425	-	0.744
Seasonality of employment (ref=All year)							
Seasonal	-0.056		0.262	0.946	0.566	-	1.580
Occasional	0.337		0.341	1.401	0.718	-	2.733
Not in work	0.16		0.137	1.174	0.897	-	1.535
Asset wealth index (ref=Low)							
Medium	0.075		0.145	1.078	0.811	-	1.432
Higher	0.085		0.163	1.089	0.791	-	1.499

b) Logit for contraceptive switching

					Contraceptive Switching		
	β2		SE(β2)	Approximate hazard ratio 2 ($e^{\beta(2)}$)	95% credible interval for hazard ratio 2		
Intercept	-4.629	* *	0.256				
Duration (ref=1)							
2	-0.574	*	0.228	0.563	0.360	-	0.881
3	-0.112		0.207	0.894	0.596	-	1.341
4	-0.465	*	0.234	0.628	0.397	-	0.994
5	-0.635	*	0.249	0.530	0.325	-	0.863
6	-0.037		0.213	0.964	0.635	-	1.463
7	-0.382		0.243	0.682	0.424	-	1.099
8	-0.61	*	0.270	0.543	0.320	-	0.922
9	-0.532	*	0.270	0.587	0.346	-	0.997
10	-0.604	*	0.291	0.547	0.309	-	0.967
11	-0.415		0.279	0.660	0.382	-	1.141
12	0.083		0.246	1.087	0.671	-	1.760
13	-0.419		0.298	0.658	0.367	-	1.179
14	-0.408		0.303	0.665	0.367	-	1.204
15	-0.879	*	0.376	0.415	0.199	-	0.868
16	-0.412		0.326	0.662	0.350	-	1.255
17	-0.543		0.343	0.581	0.297	-	1.138
18	-0.455		0.344	0.634	0.323	-	1.245
19	-1.242	*	0.496	0.289	0.109	-	0.764
20	-0.665		0.396	0.514	0.237	-	1.118
21	-0.46		0.382	0.631	0.299	-	1.335
22	-0.262		0.364	0.770	0.377	-	1.571
23	-0.547		0.424	0.579	0.252	-	1.328

24	0.296		0.319	1.344	0.719	-	2.512

Variable	β2		SE(β2)	Approximate hazard ratio 2 ($e^{\beta(2)}$)	95% credible interval for hazard ratio 2		
Contraceptive Type (ref=Modern reversible)							
Natural	-0.233	*	0.112	0.792	0.636	-	0.987
Modern clinical	-1.579	* *	0.181	0.206	0.145	-	0.294
Age group							
15-19	0.432	*	0.171	1.540	1.102	-	2.154
20-24 (ref)							
25-29	0.022		0.153	1.022	0.757	-	1.380
30-34	-0.344		0.200	0.709	0.479	-	1.049
35 or over	-0.276		0.196	0.759	0.517	-	1.114
Parity (ref=Nulliparous)							
1	0.353		0.186	1.423	0.989	-	2.049
2 or more	0.378		0.225	1.459	0.939	-	2.268
In union (ref=Yes)							
No	0.288		0.160	1.334	0.975	-	1.825
Educational attainment (ref=secondary or lower)							
Higher	0.173		0.121	1.189	0.938	-	1.507
Seasonality of employment (ref=All year)							
Seasonal	-0.141		0.225	0.868	0.559	-	1.350
Occasional	-0.389		0.375	0.678	0.325	-	1.413
Not in work	0.056		0.112	1.058	0.849	-	1.317
Asset wealth index (ref=Low)							
Medium	0.088		0.130	1.092	0.846	-	1.409
Higher	0.191		0.140	1.210	0.920	-	1.593

c) Logit for contraceptive failure

					Contraceptive Failure		
	β3		SE(β3)	Approximate hazard ratio 3 ($e^{\beta(3)}$)	95% credible interval for hazard ratio 3		
Intercept	-4.425	* *	0.265				
Duration (ref=1)							
2	-0.464		0.306	0.629	0.345	-	1.145
3	-0.373		0.297	0.689	0.385	-	1.233
4	0.226		0.255	1.254	0.760	-	2.066
5	-0.324		0.296	0.723	0.405	-	1.292
6	-0.172		0.281	0.842	0.485	-	1.460
7	0.019		0.274	1.019	0.596	-	1.744
8	0.238		0.262	1.269	0.759	-	2.120
9	-0.146		0.296	0.864	0.484	-	1.544
10	0.170		0.278	1.185	0.687	-	2.044
11	-0.157		0.314	0.855	0.462	-	1.582
12	0.327		0.281	1.387	0.800	-	2.406
13	0.171		0.300	1.186	0.659	-	2.136
14	0.064		0.318	1.066	0.572	-	1.988
15	-0.978	*	0.474	0.376	0.149	-	0.952
16	0.139		0.321	1.149	0.613	-	2.156
17	0.191		0.325	1.210	0.640	-	2.289
18	-0.113		0.371	0.893	0.432	-	1.848
19	0.051		0.359	1.052	0.521	-	2.127
20	-0.175		0.404	0.839	0.380	-	1.853
21	0.101		0.372	1.106	0.534	-	2.294
22	-0.474		0.476	0.623	0.245	-	1.582
23	-1.194		0.659	0.303	0.083	-	1.103
24	-0.750		0.578	0.472	0.152	-	1.467
Contraceptive Type (ref=Modern reversible)							
Natural	0.768	* *	0.120	2.155	1.704	-	2.727
Modern clinical	-1.552	* *	0.238	0.212	0.133	-	0.338
Age group							
15-19	-0.304		0.197	0.738	0.502	-	1.086
20-24 (ref)							
25-29	0.081		0.145	1.084	0.816	-	1.441
30-34	0.017		0.180	1.017	0.715	-	1.447
35 or over	-0.798	* *	0.225	0.450	0.290	-	0.700
Parity (ref=Nulliparous)							
1	-0.092		0.171	0.912	0.652	-	1.275
2 or more	-0.512	*	0.208	0.599	0.399	-	0.901
In union (ref=Yes)							
No	-1.145	* *	0.221	0.318	0.206	-	0.491

Continues.

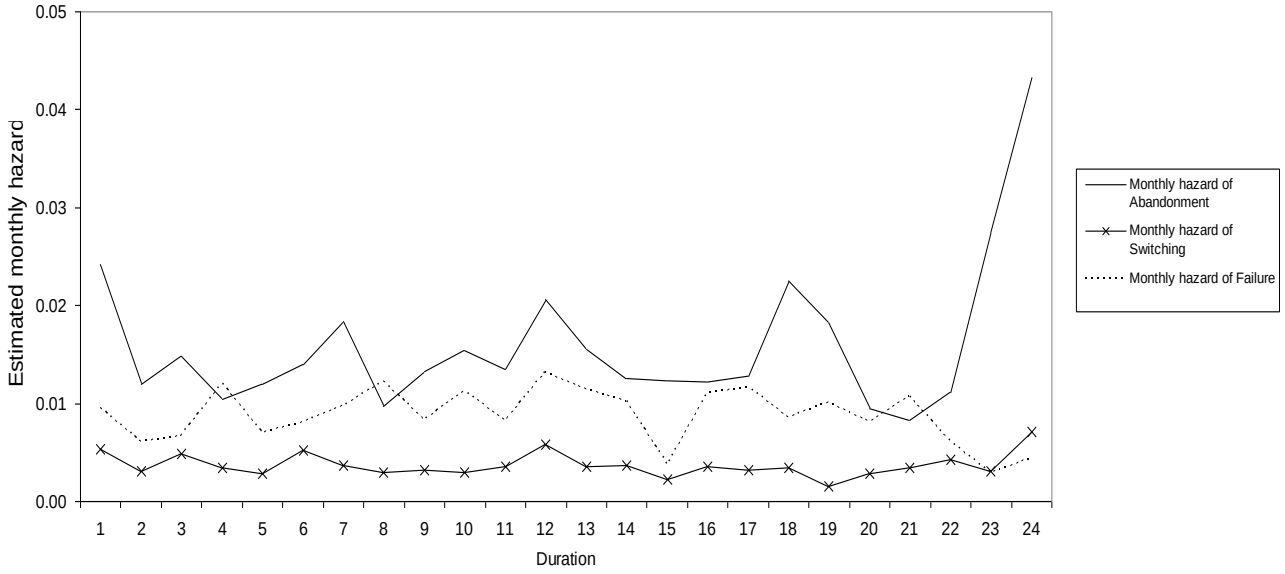
Variable	β3			SE(β3)	Approximate hazard ratio 3 ($e^{\beta(3)}$)	95% credible interval for hazard ratio 3		
Educational attainment (ref=secondary or lower)								
Higher	-0.285	*		0.113	0.752	0.603	-	0.938
Seasonality of employment (ref=All year)								
Seasonal	-0.132			0.225	0.876	0.564	-	1.362
Occasional	0.413			0.291	1.511	0.854	-	2.673
Not in work	0.314	*	*	0.121	1.369	1.080	-	1.735
Asset wealth index (ref=Low)								
Medium	-0.207			0.125	0.813	0.636	-	1.039
Higher	-0.305	*		0.144	0.737	0.556	-	0.977

** denotes significance at 1% level (p<0.01)
* denotes significance at 5% level (p<0.05)
Model estimated using 80000 MCMC samples with 5000 burn-in. Starting values for MCMC from 2nd order PQL (RIGLS).
Exponential hazard ratios are interpreted as approximate hazard ratios.

Table 5.6.3 is used to generate the underlying hazard distribution, which is presented in Figure 5.6.2. Abandonment has the highest hazard in all time periods, and the hazard of failure is higher than the hazard of switching (except in months 22 – 24). The hazard of abandonment increases sharply during months 23 and 24 though it is difficult to establish whether this is a robust trend, or simply that the hazards are imprecisely estimated.

There are spikes in all hazards at multiples of 6 months - perhaps indicating some rounding in the duration of spells during reporting. Heaping in contraceptive calendar data was also noted by Curtis and Blanc (1997).

Figure 5.6.2: Estimated monthly hazards of discontinuation by discontinuation type

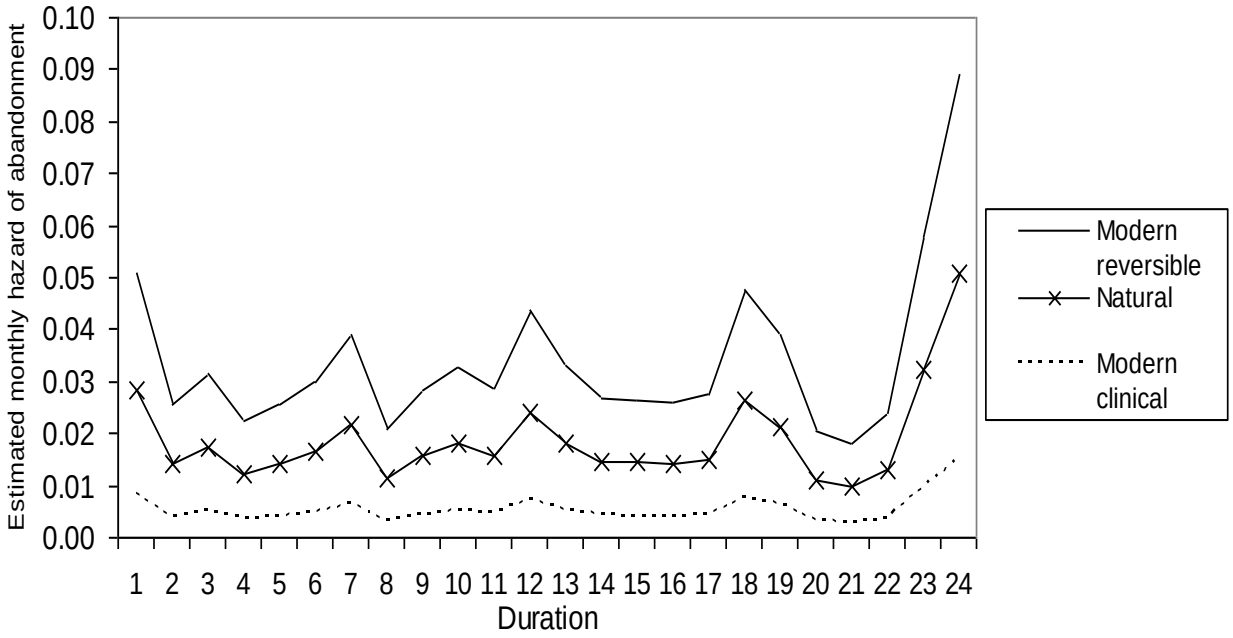


Contraceptive type

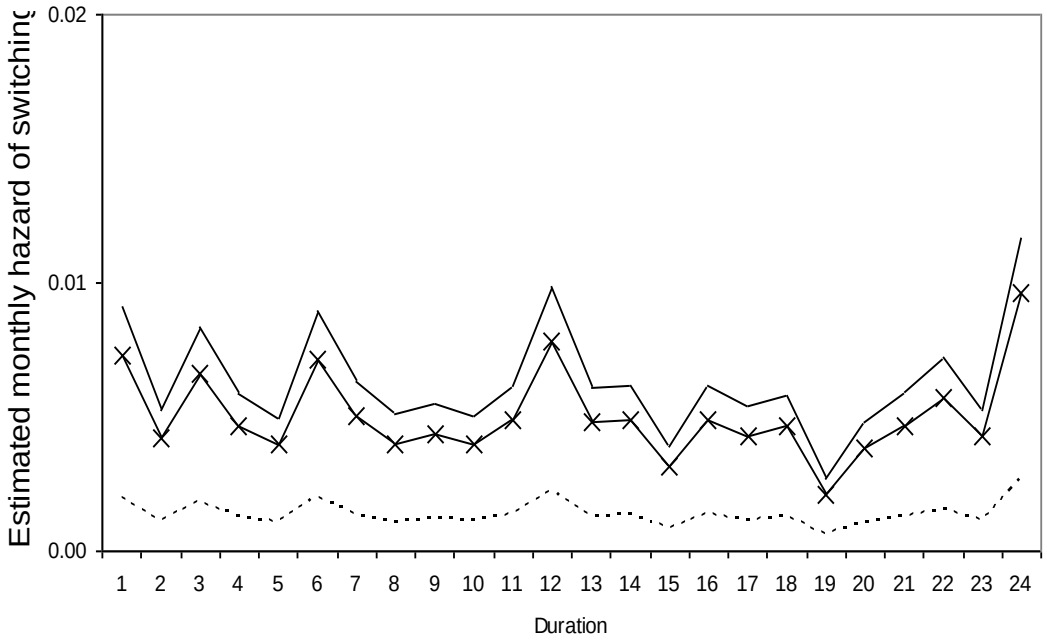
According to the research hypothesis, the hazard of failure for natural and modern reversible methods should be approximately equivalent in the Moldovan context. Estimated hazards of discontinuation for a) abandonment, b) switching and c) failure by contraceptive type (modern reversible, natural, and modern clinical) are presented in Figure 5.6.3. Compared to the baseline category of modern reversible methods, spells of natural method use are significantly less likely to end in abandonment or switching – indicated by the low hazard profiles in plots 5.6.3 a) and b). This reflects the fact that many natural method users are reluctant to try other contraceptives (Kost 1993). However, natural method users are approximately twice as likely as modern reversible method users to experience contraceptive failure (plot c.). This refutes the research hypothesis. Further examination of the contraceptive calendar data was conducted to determine the outcome of contraceptive failures (whether the pregnancy resulted in birth or termination). Following a contraceptive failure, 47.3% of pregnancies were aborted.

Figure 5.6.3: Estimated hazards of discontinuation for by contraceptive type a) abandonment, b) switching and c) failure

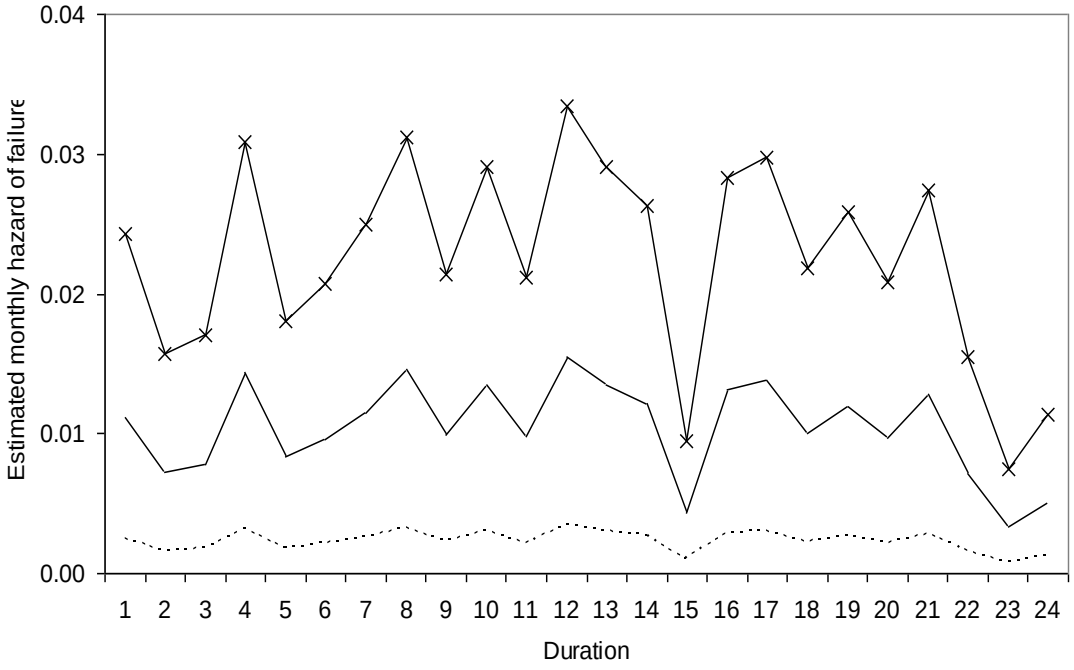
a) Contraceptive abandonment



b) Contraceptive switching



c) Contraceptive failure



Modern clinical method users are significantly less likely to experience contraceptive abandonment or contraceptive switching than modern reversible method users (see Figure 5.6.3-a.) - unsurprising since these methods require clinical intervention to discontinue. This result is consistent with the hypothesised association that modern clinical method users will have a low propensity to switch or abandon their method. Modern clinical method users are also 79% less likely to experience contraceptive failure than modern reversible method users (Table 5.6.3 and plot c), highlighting the efficacy of clinically administered contraception. Both modern reversible and natural methods offer less contraceptive protection than clinical methods, reflected in their higher failure rates.

Controls for Proximate determinants

Women in the age group '35 or older' are significantly less likely to experience contraceptive failure than women 20-24 - possibly due to lower fecundability making

conception increasingly difficult. Women in this age group are also significantly more likely to abandon contraceptive use, possibly due to the difficulty in conceiving at older ages making contraceptive use redundant. There is a significantly lower hazard of contraceptive abandonment in the age group 15-19 than for women age 20-24 (baseline). This is consistent with social pressure to avoid premarital or teenage pregnancy in Moldova. However, the hazard of switching is 54% higher. This perhaps reflects women who are yet to find their most suitable contraceptive and hence have a high propensity to switch methods.

Compared to nulliparous women, women with 2 or more children have a 41% lower hazard of contraceptive failure. This is consistent with declining fecundability at higher parity (Van Bavel 2004). The hazard of abandonment is 77% and 90% lower for women with 1 and '2 or more' children respectively when compared to nulliparous women. This reflects the desire to restrict fertility at a relatively small family size in Moldova (Sobotka 2003). There are no significant effects of parity on switching behaviour.

The only significant effect of sexual exposure is on contraceptive failure. Women who are not married or in union have a hazard of failure only 31.8% that of women who are sexually active. This is unsurprising given that sexual activity is a prerequisite for pregnancy. No significant effects were found for either abandonment or switching. It might be expected that a woman may be unlikely to continue with contraceptive use if she were not in union and regularly sexually active. However, women may not abandon a method by only one month of inactivity. For example the difficulty and cost of IUD removal may mean women have to experience substantial periods of sexual inactivity before they consider contraceptive abandonment.

Socio-economic controls

Following the model selection procedure, three socio-economic terms were found to be significant: education, seasonality of employment and wealth index. Education was found to have a significant effect on abandonment, where the hazard for

women with a higher education was lower by 44% than women with 'secondary or lower' education. Similarly, women with a higher education were 25% less likely to experience contraceptive failure.

Compared to the baseline category of women employed all year, women who do not work are 37% more likely to experience a contraceptive failure. No significant effects of employment were found for abandonment and switching. Compared to women in the lowest income group, women in the highest wealth bracket were 27% less likely to experience contraceptive failure. It should be noted this effect was only marginally significant ($p<0.05$). The wealth index had no significant effect for switching and abandonment.

5.7: Conclusions

The aim of this analysis was to investigate the efficacy and failure rates of natural, modern reversible and modern clinical methods of contraception in Moldova. It was hypothesised that modern reversible and natural methods could potentially have comparable effectiveness. When compared to modern reversible methods, it was found that the likelihood of experiencing contraceptive failure is substantially higher for women using a natural contraceptive method. This effect is magnified when comparing natural methods to modern clinical methods. The conclusion of this analysis is therefore to reject the research hypothesis. The widespread use of natural contraception is likely to contribute to high rates of unwanted pregnancy in the Moldovan setting (NCPM and ORC Macro 2006). Previous research had shown that unwanted pregnancies often result in abortion - which remains a major reproductive health challenge in Moldova (NCPM and ORC Macro 2006).

The analysis also included controls for the proximate determinants of fertility, which showed results consistent with expectation. Older women, women of higher parity and women not in union are substantially less likely to experience contraceptive failure. Results from the regression modelling also indicated that three socio-economic variables were significant. This indicates that although the relevant control variables were included, the model did not correctly specify the effect of the proximate determinant of fertility on discontinuation behaviour (Baschieri and Hinde 1997). Women with higher education were less likely to experience contraceptive abandonment or contraceptive failure. Two explanations are possible for this result. Firstly, women with a higher education may have a greater motivation to avoid pregnancy. Accidental pregnancy could potentially disrupt workforce participation which is likely to be higher among more highly educated women. This would motivate highly educated women to continue using contraception, and to use it diligently. Alternatively, women with a higher education may possess a greater ability to effectively use contraceptive methods.

Women who were not engaged at all in the employment market were less likely to experience contraceptive failure. This suggests possible motivation to avoid unwanted pregnancy; women who do not work have a lower opportunity cost of accidental pregnancy than their counterparts. Finally women who were in the highest wealth bracket were significantly less likely to experience a contraceptive failure. This perhaps reflects a higher opportunity cost to having an unwanted pregnancy in higher income groups. Alternatively, this may reflect the ability of higher income women to obtain high quality contraceptive methods – for example, seamed condom were available in Eastern Europe until recently (Popov *et al.* 1993).

Discussion

The motivation behind the research hypothesis was that low fertility in the Moldovan setting was associated with particularly effective use of natural contraception. Since this research hypothesis has been refuted, some other influence on must be responsible for low fertility rates. A plausible candidate is the seasonal economic migration of males. Moldova is heavily reliant on remittance payments from economic migration (World Bank 2005). The result of this is that approximately 25% of the Moldovan population works abroad. Controls in this analysis did not account for coital exposure directly, but only whether a woman was married or in union. If the migration of the male spouse means that – although married – women are not exposed to regular coital activity, fertility could be low. Further work into the effect of seasonal migration on fertility in Moldova is warranted.

Although the research hypothesis in this analysis was refuted, the results suggest directions for policy development. Natural method use in Moldova is associated with a significantly higher probability of method failure than modern reversible and modern clinical method use. The failure of natural contraceptive methods is associated with potentially negative maternal health outcomes, such as abortion and unwanted births (NCPM and ORC Macro 2006, Westoff 2005). Clearly, encouraging natural method users to switch to more effective contraceptive methods is a family

planning programme priority in Moldova (Westoff 2005, NCPM and ORC Macro 2006). This could have a major impact on the reproductive health situation in Moldova. Of the accidental pregnancies in the contraceptive calendar approximately half were terminated, indicating widespread recourse to induced abortion. Westoff (2005) estimates that abortion rates could be reduced by 33% if all natural method users switched to a modern method. This reflects the close association between natural contraceptive failure and abortion in Moldova (Sobotka 2003, Westoff 2000, 2005).

However, encouraging switching away from natural method use is challenging due to the low switching rates among natural method users compared to modern reversible method users - a finding by Kost (1993) and Goldburg and Toros (1994) also verified by this analysis. Greater integration of family planning and abortion services and improved post-abortion counselling represent one potential route to outline alternatives to unwanted pregnancy (Comendant 2005).

High rates of method abandonment among modern reversible method users are also a key issue. Abandoning use of a contraceptive method leaves a woman at risk of unwanted pregnancy if she does not want children - potentially resulting in abortion or the birth of an unwanted child. Improving the quality of contraceptive services is a key factor, since quality of care has been shown to be closely associated with contraceptive continuation (Steele *et al.* 1999, Comendant 2005). Service provision in Moldova is generally patchy, except Chisinau. However, many rural areas suffer from an underdeveloped family planning network (MacLehose 2002, Lyons-Amos et al 2011). Extending the availability of contraceptive counselling would also ensure appropriate method choice (Comendant 2005).

Chapter 6: Conclusions

This thesis had two major objectives. Firstly, the thesis aimed to extend and refocus the analysis of natural contraceptive use in order to provide a quantitative understanding of the dynamics of natural methods. This was achieved through three interrelated research questions, which explored the correlates, fertility patterns and contraceptive discontinuation patterns associated with natural method use. The second aim of this thesis was to examine fertility behaviour in Moldova. The specific focus on the idiosyncrasies of fertility change in Moldova – the use of induced abortion and the dramatic decline in fertility patterns post-1991 – produced policy relevant evidence through systematic analyses of the Moldovan Demographic Health Surveys.

The remainder of this concluding chapter is structured as follows. Section 1 considers how the research chapters address the research questions posed. Section 2 explores how further research could build on this thesis, while the overall policy recommendations arising from the research findings are considered in section 3.

6.1 Summary and research questions

This thesis posed three research questions. These are considered in detail below, and related to the relevant research findings.

What are the correlates of natural method use in Moldova?

This research question focussed on the role of economic disadvantage on natural method use. Two research hypotheses were specified: (a) lower economic status is associated with use of natural methods and (b) spatial remoteness is associated with natural method use. The impact of Family Planning (FP) campaigns in Moldova was assessed through two additional hypotheses: c) greater exposure to FP media is

associated with reduced natural method use and d) higher levels of AIDS awareness is associated with lower natural method use.

The key findings were that the effect of wealth on the type of method used was small – indicating that the financial cost of contraception was not a major influence on the choice of contraceptive method. Natural contraceptive use was more prevalent in rural areas, and regions outside of Chisinau. Exposure to FP media increased the use of modern contraception, while decreasing the use of natural methods. However, this effect was smaller among older women – who showed a greater propensity to use natural contraception. The analysis also found that contraceptive switching was highly dependent on the region of residence, with a lower degree of switching from natural to modern methods in regions outside of Chisinau. Although AIDS awareness was associated with lower natural and greater modern method use, the use of barrier contraception was very limited.

How does method choice influence women's reproductive strategies, and how does this relate to other influences?

The research question was addressed by evaluating the contraceptive confidence hypothesis in two research chapters.

Firstly, the effect of contraceptive confidence on the marriage to first birth interval was analysed, since existing literature had ignored the duration between marriage and first-birth (Ní Bhrolchaín 1988). The changes in Moldovan fertility behaviour in the post-independence period (1991) were also analysed. This analysis found that there is an effect of contraceptive confidence on the first-birth interval. Low contraceptive confidence was associated with a long interval between marriage and first-birth and in contrast high contraceptive confidence was associated with shorter first-birth intervals. The analysis also revealed longer first-birth intervals in younger marriage cohorts. There was a differential effect of education across marriage cohorts. For marriage cohorts in the pre-independence period, highly educated women tended to have short first-birth intervals. However, highly educated women

had the longest first-birth interval in the post-independence cohorts. This is taken to indicate Westernisation of Moldovan fertility.

The second research chapter that dealt with the contraceptive confidence hypothesis focussed on the role of abortion in increasing contraceptive confidence for natural method users. The results of this analysis demonstrated evidence of a contraceptive confidence effect in Moldova – although measurement limitations mean that this conclusion is not robust. In general, the contraceptive confidence of natural method users and modern reversible method users were equivalent in a context dominated by high use of induced abortion. The effect of greater abortion use was to lengthen inter-birth intervals, which further showed that induced abortion is not associated with stopping behaviour in the same manner as effective contraception.

How effective is natural method use in Moldova, and what are the determinants of contraceptive discontinuation?

This analysis sought to examine whether low Moldovan fertility may be a result of effective natural method use - similar to historic populations (Szreter *et al.* 2003, Fisher 2000, Fisher and Szreter *et al.* 2003). Additionally, the analysis expanded the understanding of other contraceptive discontinuation (switching and abandonment) in the Moldovan context.

The analysis found that natural methods were more likely to fail compared to modern reversible and modern clinical methods. Clinically administered modern methods (IUD, injectable) were most effective in preventing unintended pregnancy and had the lowest probability of discontinuation overall. Modern reversible methods were effective – due to a low probability of contraceptive failure. However, modern reversible methods were also associated with a high probability of contraceptive abandonment.

6.2 Further research

The development of a robust measure for contraceptive confidence could overcome the major limitations addressed in Chapters 3 and 4. The use of a proxy variable suffers from a number of limitations including potential misclassification due to contraceptive switching, endogeneity and reverse causality. The definition is particularly problematic for those with high level of contraceptive confidence who are particularly likely to switch to permanent methods following a method failure (Zavier and Padmadas 2000). A robust measure is therefore important to understand the contraceptive confidence phenomenon and related influences.

Deriving a more precise measure presents a considerable challenge, since there are number of factors which influence contraceptive confidence beyond efficacy. While there is undoubtedly a widespread perception that natural contraceptives are less effective than modern methods (Skjeldstad 1995, Trussell 1995, Westoff 2005), this may not correspond with contraceptive confidence - since users of natural methods may accept failure as a 'side effect' (Goldburg and Toros 1994, Kost 1993, Fisher and Szreter 2003). Motivation to avoid pregnancy is also important (Jones *et al.* 1980). A diligent natural method user may have a lower probability of accidental pregnancy than an ambivalent modern method user (Potter *et al.* 1996).

A more complete examination of the factors associated with switching and discontinuation is clearly another route for future research. These factors are likely to be socioeconomic, extending the range of controls employed in Chapter 5, which focussed primarily on the proximate determinants of fertility. The effect of access to contraception on continuation rate is important, as access is a barrier to modern method use in Moldova (MacLehose 2002, Lyons-Amos *et al.* 2011). Additional research also relates to extending the definition of contraceptive failure to extended user failure (pregnancy within 6 months of method abandonment). This is crucial, since abandonment was the most common discontinuation in Moldova and modern reversible method users had a particularly high propensity to abandon contraceptive use (Chapter 5). In particular, examining the effect of FP service quality on

abandonment rates could offer better policy insights. A large proportion of contraceptive discontinuation is accounted for by poor service quality (Blanc *et al.* 2002, Steele *et* al. 1999, Bruce 1990, Jain 1989) which is also common in Moldovan FP facilities (Comendant 2005).

6.3 Policy implications

Each Chapter identifies relevant policy implications resulting from the individual analysis; however some overarching issues emerge from the thesis.
Firstly, reducing reliance on natural methods through programmes such as NPRH should be stressed. Natural method use is associated with frequent contraceptive failure, apparent from existing literature (Westoff 2005) and reconfirmed in the results of this thesis (Chapter 5). The Moldovan government has made the reduction of reliance on natural methods a key objective of the NPRH (NCPM and ORC Macro 2006). Further, this objective has been supported with economic investment, including the restructuring of the healthcare system to increase community level distribution (MacLehose 2002) and media campaigns such as the NPRH (NCPM and ORC Macro 2006).

However, current programmes are not successfully reaching all women. Natural method users are less likely to switch to more effective contraceptives than other women (Chapter 5, Goldburg and Toros 1994, Kost 1993). Natural method users also tend to be older, and existing FP messages are ineffective in targeting this group (Lyons-Amos *et al.* 2011). Women in rural areas are particularly less likely to switch to modern contraception (MacLehose 2002, Chapter 2). The direct and appropriate targeting of older, rural women through both media and FP services would have the effect of reducing natural method use among the most prevalent users. This may also reduce demand for abortion since older women are more likely to use termination (Agadjanian 2002, Westoff 2000, 2005). The integration of family planning in services utilised by women following contraceptive failure provides a potential route to encouraging method switching. In particular, the provision of FP

counselling at abortion facilities and maternity and sexual and reproductive health services should be encouraged (Comendant 2005, Bruce 1990).

One of the major FP priorities in Moldova is to encourage a wider method mix and reduce on reliance on IUD. A method mix skewed towards clinically administered contraceptives is problematic since it limits the options available to women when making contraceptive choices. Additionally, the fact that IUD insertion needs to take place in FP facilities means that women in rural areas can experience difficulty in accessing modern methods (Lyons-Amos *et al.* 2011). In particular, the long standing neglect of hormonal contraceptives also needs to be addressed (Popov 1991, Popov *et al.* 1993). Modern reversible contraception such as the pill can increase the use of modern methods within the rural setting where clinically administered contraceptives are not widely available. If the fear surrounding the use of hormonal contraception can be overcome, then the spread of modern methods may be achieved more rapidly using existing locally based facilities, rather than dramatically increasing surgical and clinical capacity required for mass IUD uptake. That said, the support for users of modern reversible methods needs to be improved. Even if women can be persuaded to switch from natural to modern reversible methods, this does not imply that the prevalence of modern contraception will increase – because of high rates of modern reversible method abandonment (Chapter 5). In order to achieve FP goals of diversifying modern contraceptive use, the Moldovan government should prioritise support for modern reversible method users, and concentrate on increasing informed contraceptive choices (Jain 1989).

The reduction of abortion is a major public health priority in Moldova. Abortion was the second largest cause of maternal death in 2005 (NCPM and ORC Macro 2006, Comendant 2005) and multiple abortions are common. Despite the efforts of the Moldovan government through programmes such as NPRH, the abortion rate is intractably high. The lack of integration between contraceptive provision and abortion services - as well as a lack of post-abortion counselling – has hindered contraceptive uptake following abortion (Comendant 2005, Lyons-Amos *et al.* 2011). FP or medical centres used by women seeking abortions offers an effective medium

for promoting behavioural change (Comendant 2005, Bruce 1990). Therefore, this thesis concludes that there is an urgent need for integrating abortion and FP services as a key policy priority in Moldova.

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Appendix A: Correlation matrix and scoring factors for PCA of asset ownership

Correlation matrix;

	Has electricity	Has radio	Has television	Has refrigerator	Has bicycle	Has car/truck	Has motorcycle/ scooter
Has electricity	1.00	-	-	-	-	-	-
Has radio	0.29	1.00	-	-	-	-	-
Has television	0.40	0.18	1.00	-	-	-	-
Has refrigerator	0.39	0.20	0.50	1.00	-	-	-
Has bicycle	0.14	0.11	0.16	0.17	1.00	-	-
Has car/truck	0.12	0.09	0.24	0.25	0.16	1.00	-
Has motorcycle/ scooter	0.05	0.06	0.04	0.03	0.12	0.06	1.00

Scoring factors:

Variable	Scoring factor
Has electricity	0.312
Has radio	0.212
Has television	0.336
Has refrigerator	0.338
Has bicycle	0.178
Has car/truck	0.209
Has motorcycle/scooter	0.071

NOTE; Variables take the value 1 if respondent reports ownership. This provides a simple interpretation; for example a woman owning a radio has an asset score 0.212 higher than a woman who does not *ceteris paribus*

- Eigenvalue of first component; 2.226

- Proportion of variance explained by first component; 31.797%

Appendix B: Correlation matrix and scoring factors for PCA of FP media exposure

Correlation matrix;

	Heard FP on radio during last month	Heard FP on TV during last month	Read FP in newspaper during last month
Heard FP on radio during last month	1.000	-	-
Heard FP on TV during last month	0.580	1.000	-
Read FP in newspaper during last month	0.520	0.534	1.000

Scoring factors;

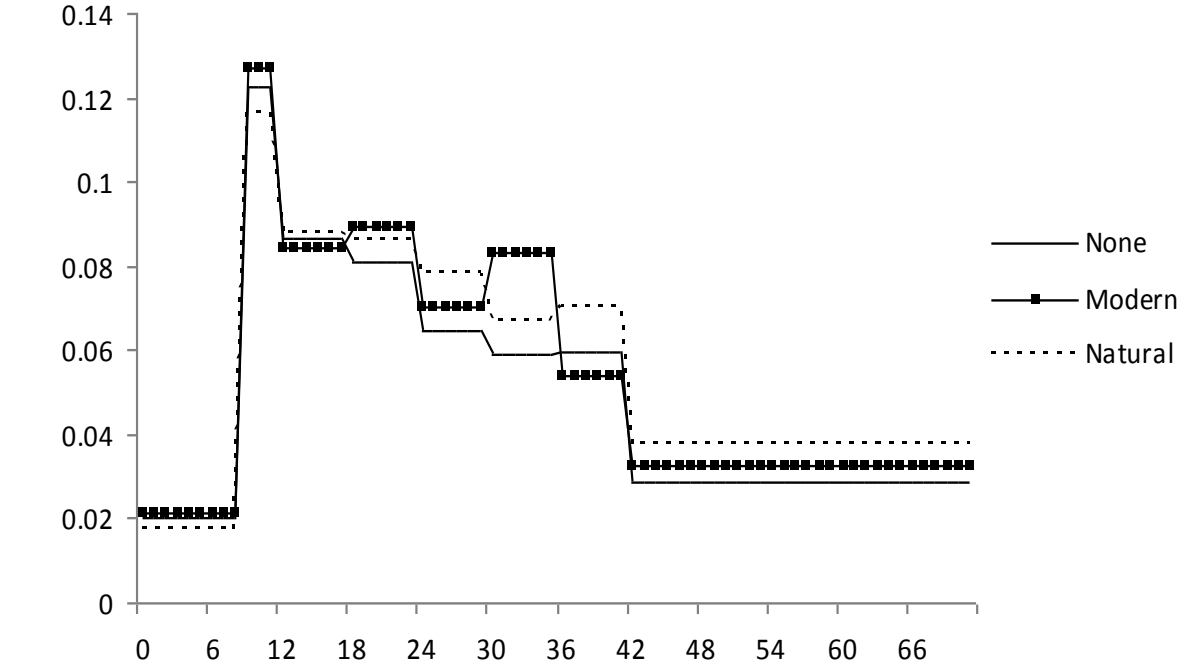
Variable	Scoring factor
Heard FP on radio during last month	0.402
Heard FP on TV during last month	0.405
Read FP in newspaper during last month	0.391

-Eigenvalue of first component; 2.089

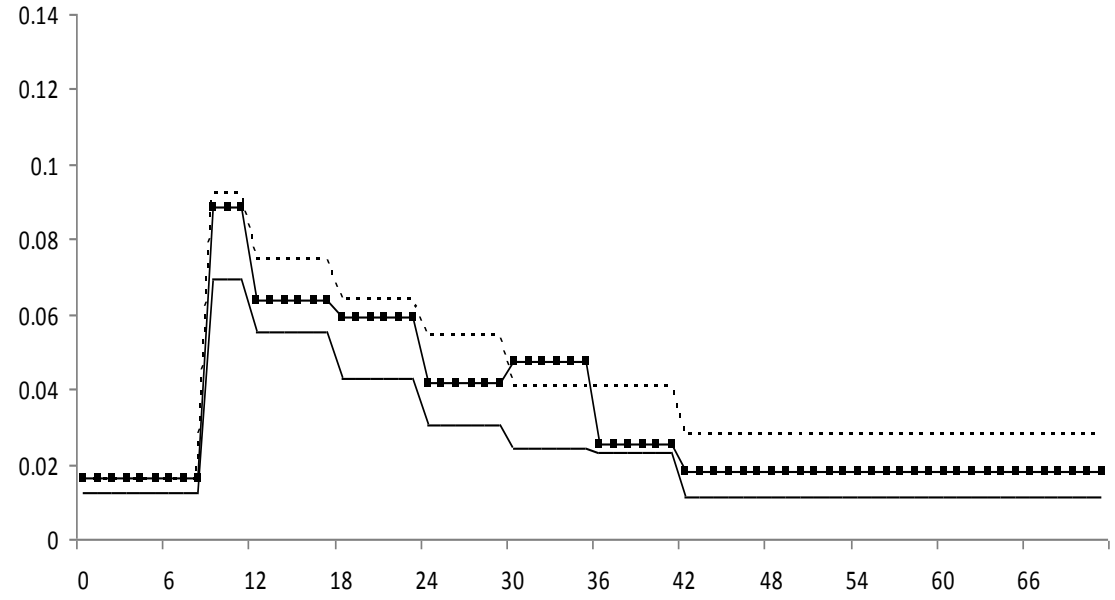
-Proportion of variance explained by first component; 69.648%

Appendix C: Estimated hazard plots by previous method discontinued given a) modern reversible method use (moderate contraceptive confidence, b) non-use (unobserved), c) natural method use (low) and d) permanent method use (high).

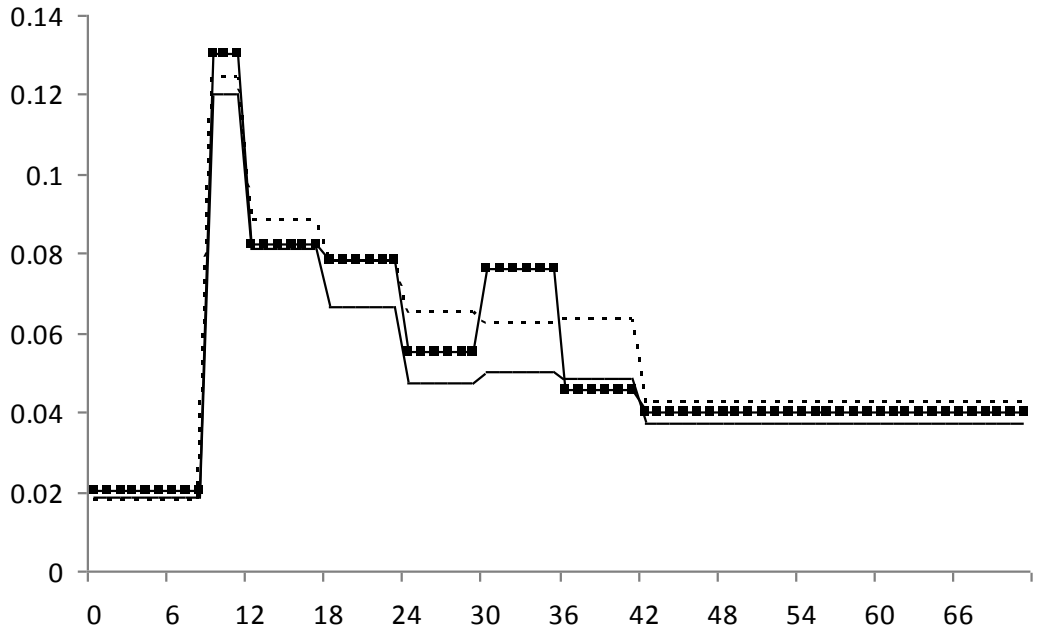
a)



b)



c)


0.14
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0.1
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0.06
0.04
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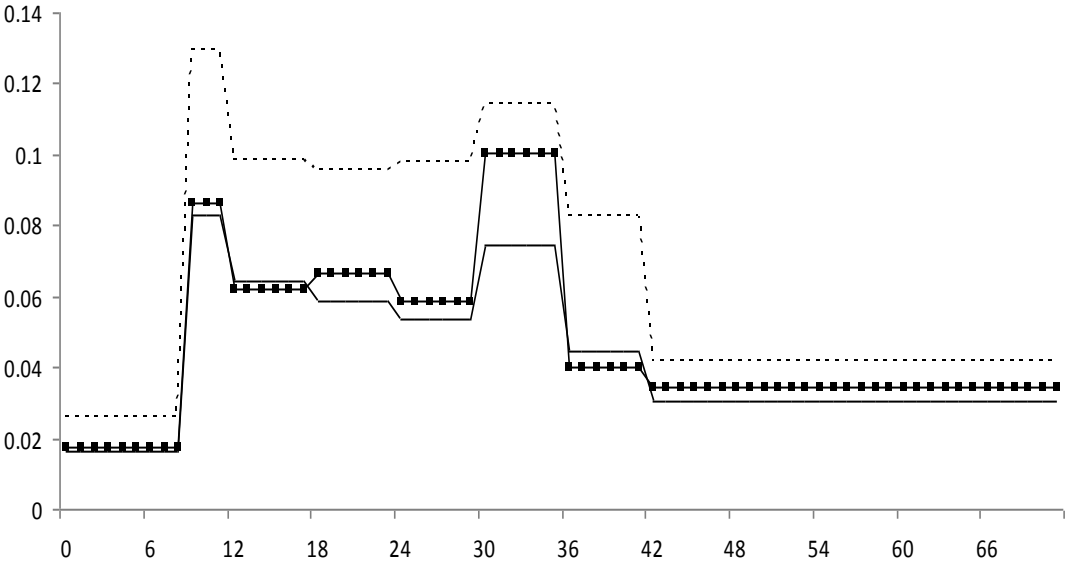
0
0 6 12 18 24 30 36 42 48 54 60 66

d)


0.14
0.12
0.1
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0.04
0.02
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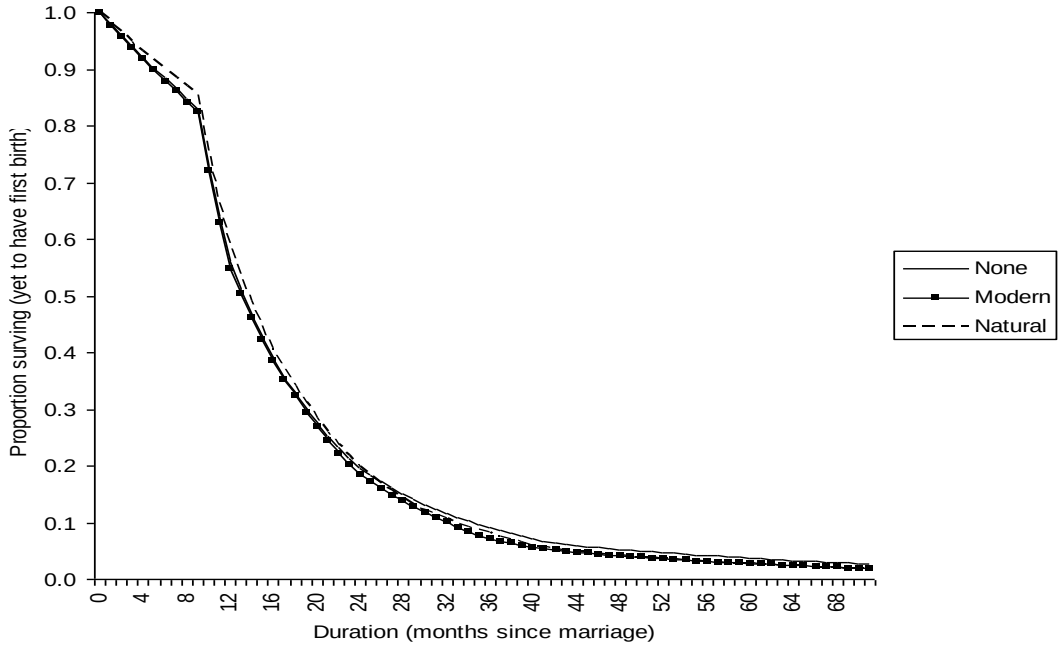
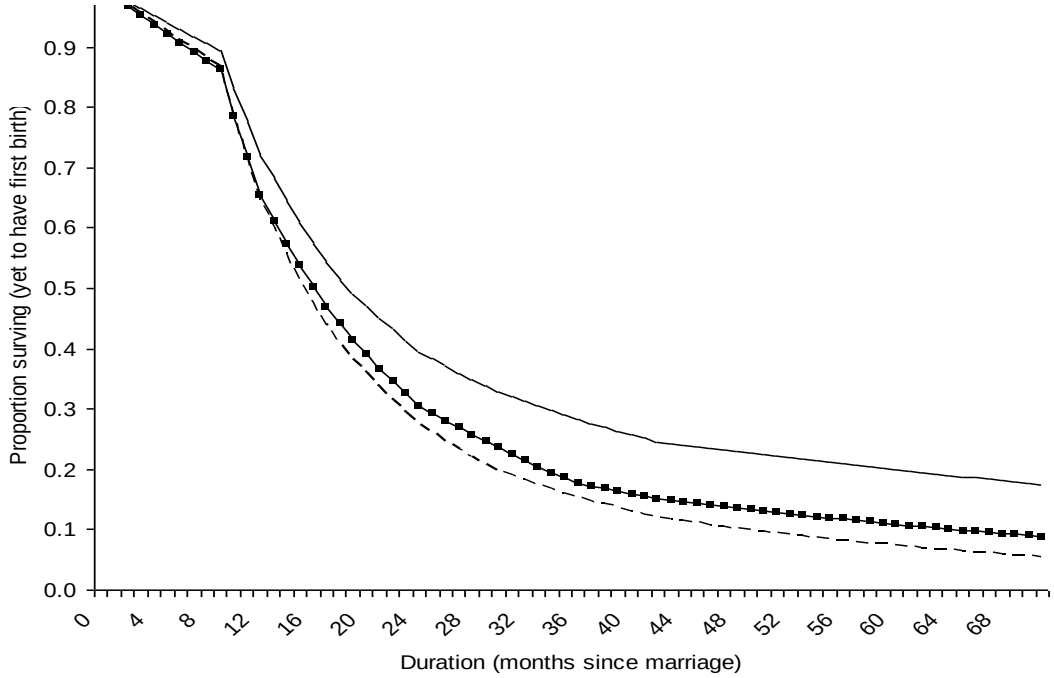
0 6 12 18 24 30 36 42 48 54 60 66

Appendix D: Estimated survival curves by previous method discontinued given a) modern reversible method use (moderate contraceptive confidence, b) non-use (unobserved), c) natural method use (low) and d) permanent method use (high).

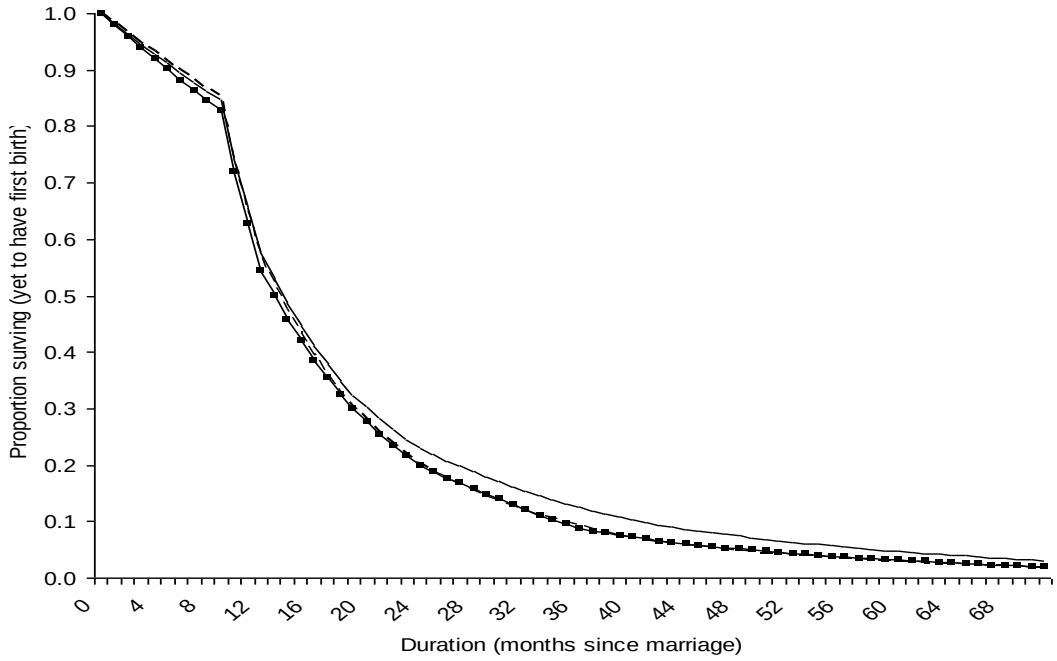
a)



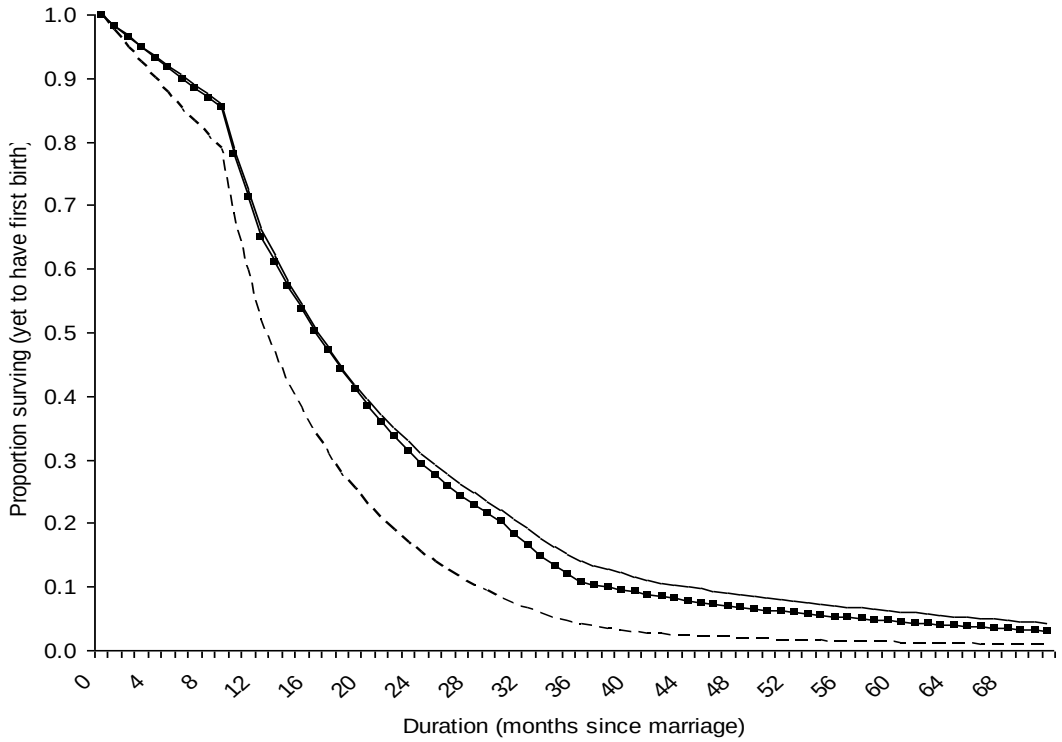
b)



c)

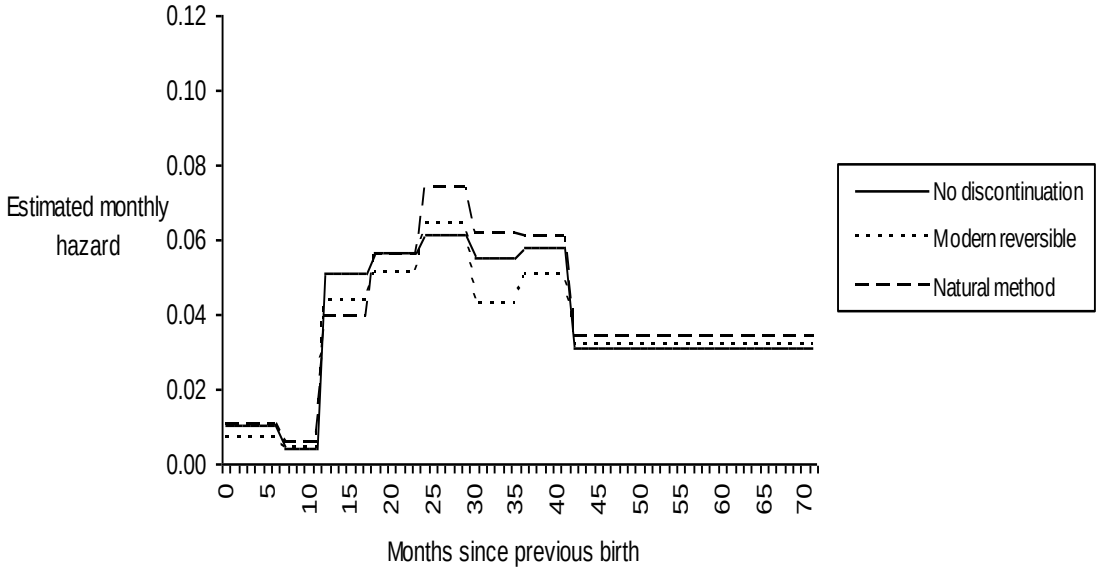

Proportion surving (yet to have first birth)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68
Duration (months since marriage)

d)

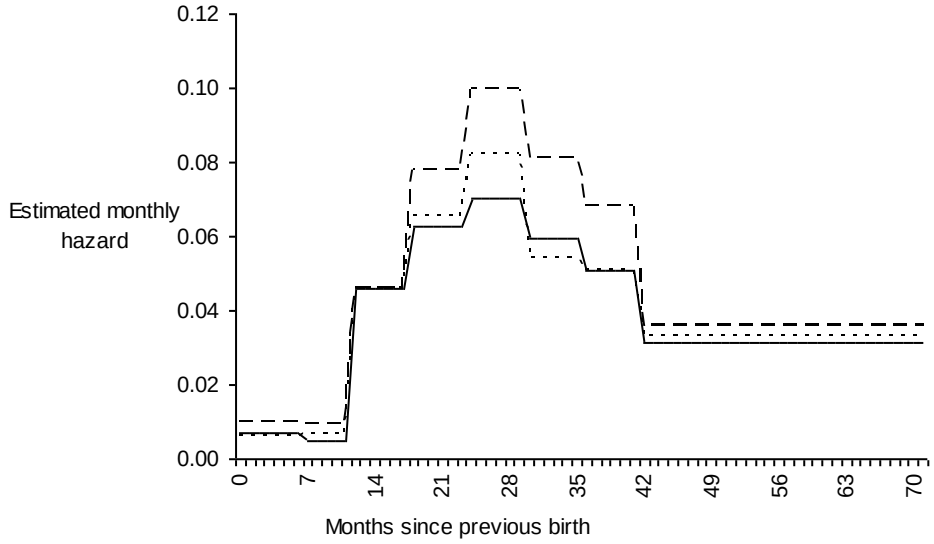

Proportion surving (yet to have first birth)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 4 8 12 16 20 24 28 32 36 40 44 48 52 56 60 64 68
Duration (months since marriage)

Appendix E: Estimated hazard plots of next birth by previous method discontinued on the timing of next birth by previous method discontinued for b) modern reversible user, b) natural method user, c) permanent method user and d) non-user

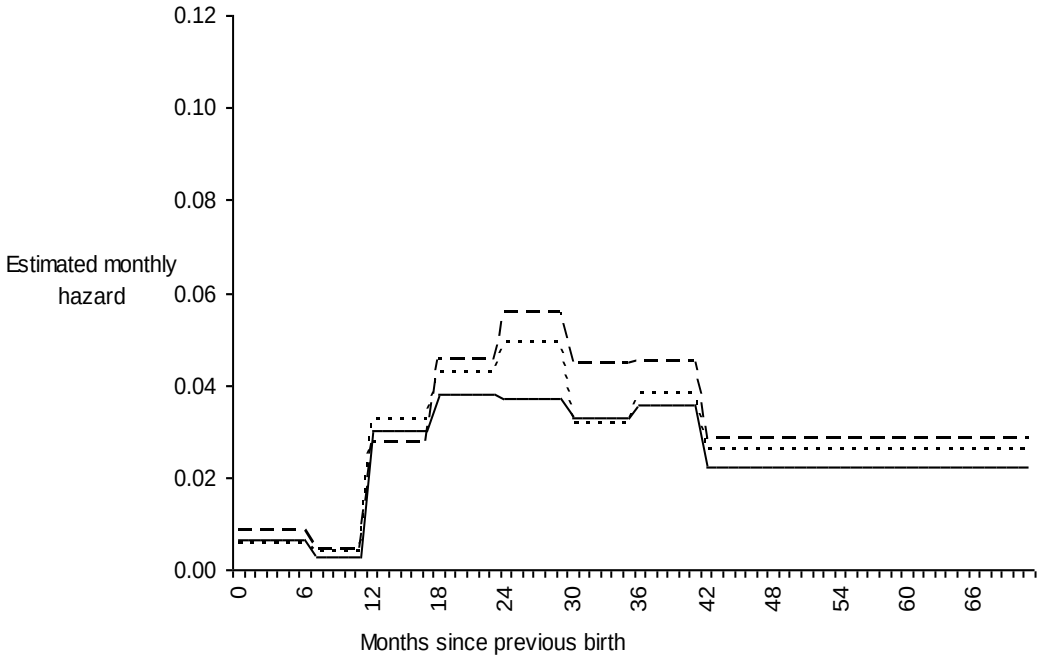
a)



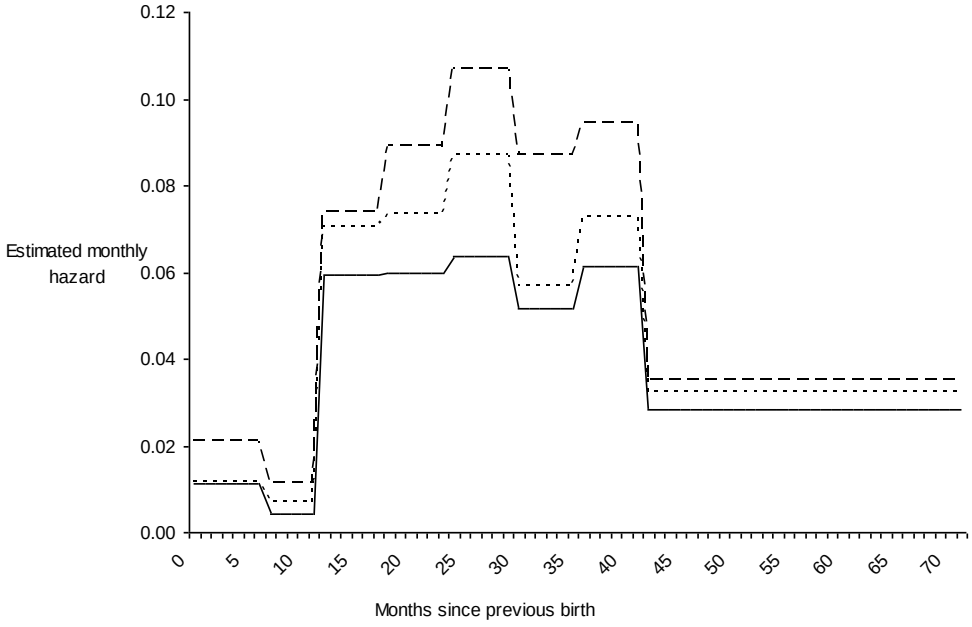
b)



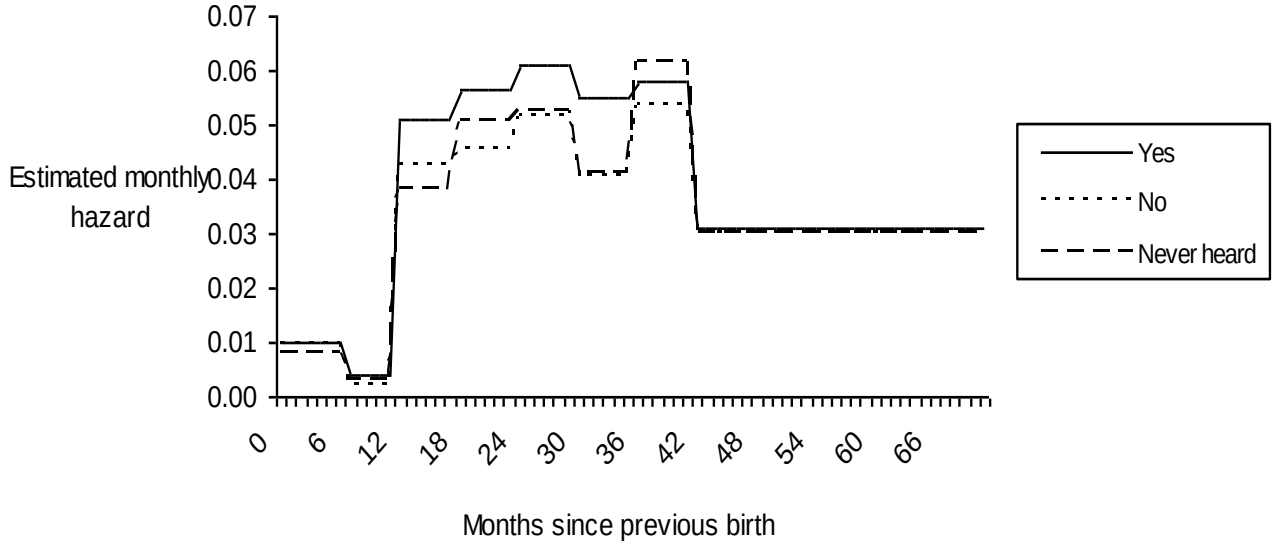
c)


0.12
0.10
0.08
Estimated monthly hazard
0.06
0.04
0.02
0.00
0
6
12
18
24
30
36
42
48
54
60
66
Months since previous birth

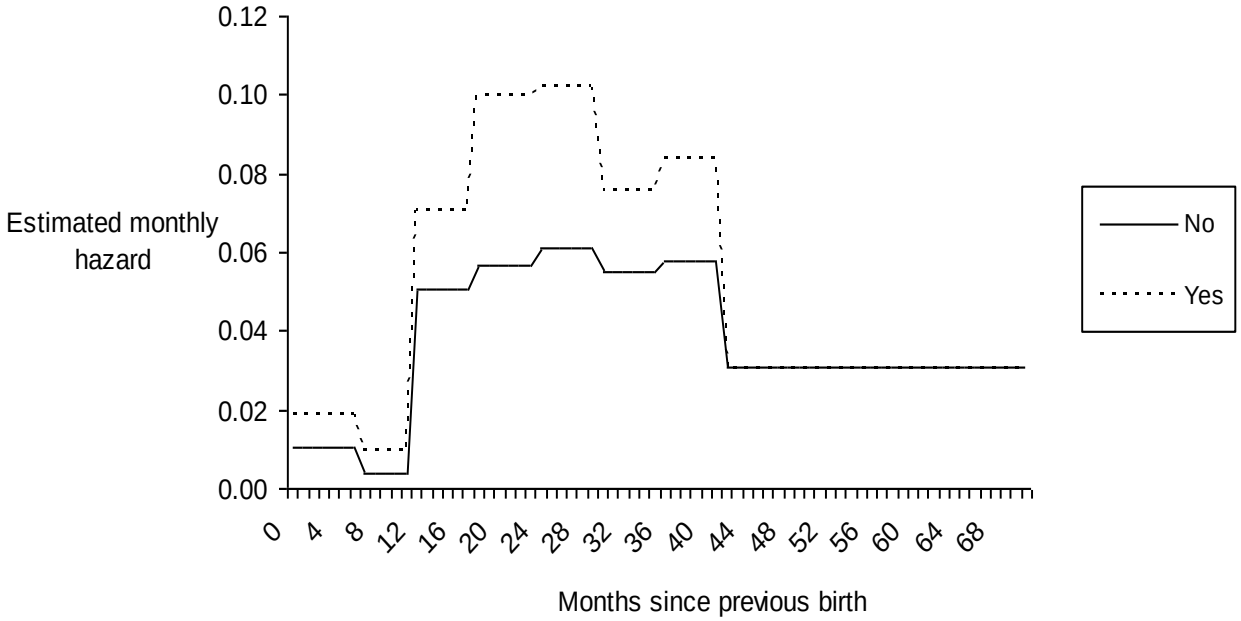
d)


0.12
0.10
0.08
Estimated monthly hazard
0.06
0.04
0.02
0.00
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
Months since previous birth

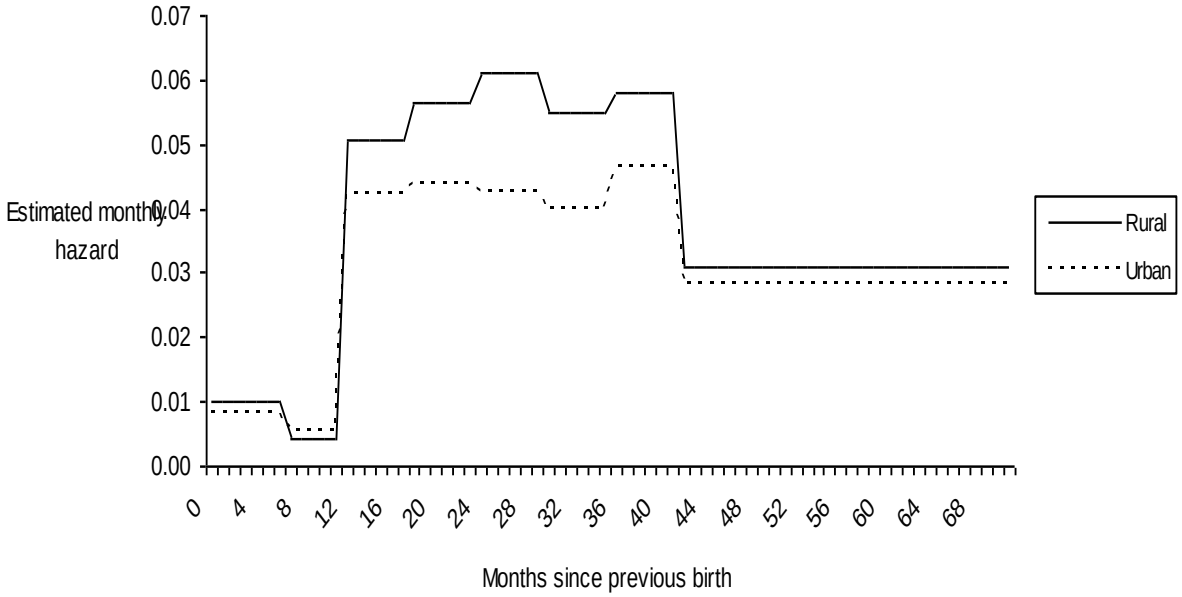
Appendix F: Estimated hazard of next birth by ever use of breastfeeding as a contraceptive



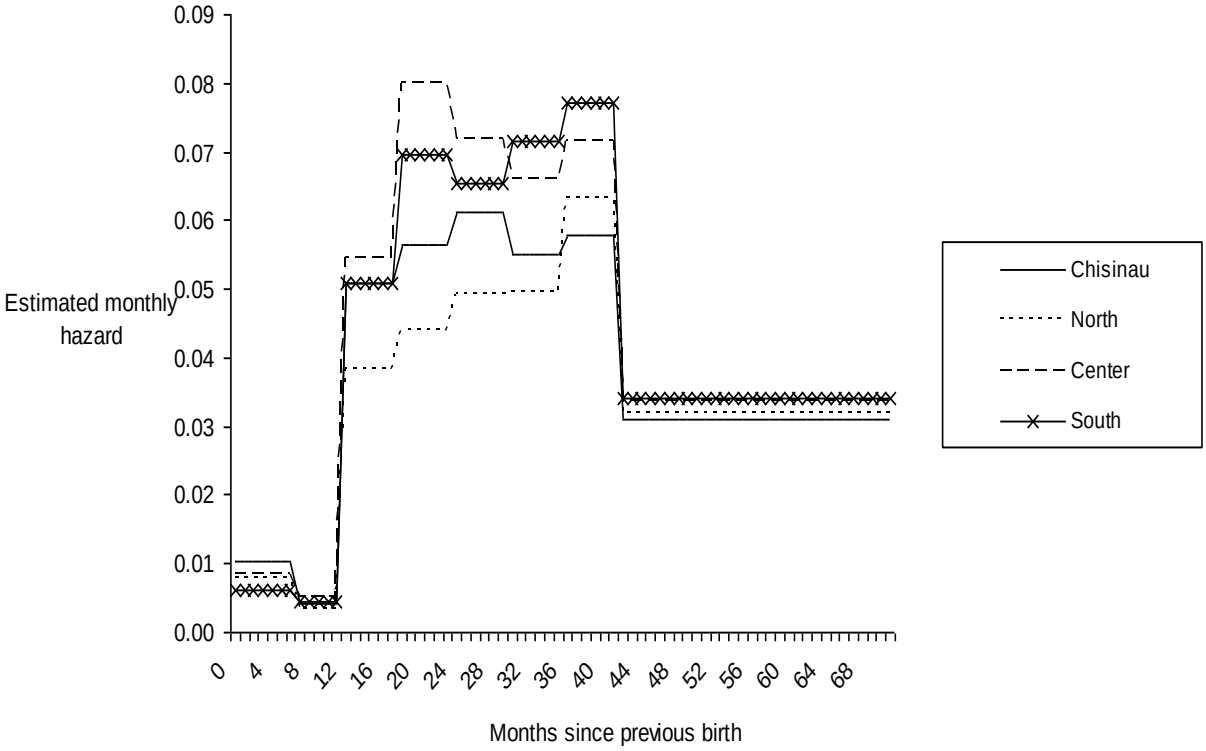
Appendix G: Estimated monthly hazard of birth by whether the older sibling died



Appendix H: Estimated hazard of birth by urban/rural residence



Appendix I: Estimated hazard of birth by region of residence



Appendix J: Poisson model for fertility in Eastern Europe

Data for this comparison are drawn from WHO Europe (World Health Organisation, 2011). A total of 19 countries in the post-Socialist region are compared, with the relevant indicators being the TFR (per hundred women), the contraceptive prevalence and the number of abortions per 1000. Contraceptive prevalence is limited to overall prevalence, since WHO do not disaggregate by method. The most recent value of these indicators is used, and data are restricted to post-2000 surveys. The TFR (λ) is assumed to follow a Poisson distribution, and is the response in the model displayed in Equation J.1. It is assumed that the synthetic estimator of the TFR is fixed for each country of observation at the fertility of the average woman across her reproductive lifetime.

$$\ln(\lambda) = \mathbf{x_i^T \beta}$$

Equation J.1

In Equation J.1 $\mathbf{x_i}$ represents a vector of explanatory variables (contraceptive prevalence and abortion rate) and $\boldsymbol{\beta}$ a vector of coefficients. In this case, the explanatory variables are the contraceptive prevalence and the number of abortions.

In the model building process, it was found that the conditional variance of the data was too large, violating the fundamental assumption of the Poisson model $\mu = E(\lambda) = \text{var}(\lambda)$. Therefore, the variance of the observed TFR is modelled in the form of Equation 5.2

$$Var(\lambda) = \phi\mu$$

Equation J.2

In Equation J.2 ϕ is a scale parameter, which allows for correct conditional variance to be estimated. The variance of the data was much greater than μ - $\hat{\phi}$ was estimated at 12.7. The final model is an over-dispersed Poisson model, since $\hat{\phi} > 1$. The inclusion of the ϕ parameter is important to this analysis, since the focus is on deviation from expected values.

The model was estimated using R 2.9.0, and used to generate expected values of TFR. The observed values of TFR were then compared to the predicted values from the model, to generate a raw residual. Raw residuals are standardised by subtracting the mean and dividing by the standard deviation of the residuals.