



Bayesian treatment effects models with variable selection for panel outcomes with an application to earnings effects of maternity leave



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ABSTRACT

We propose two alternative Bayesian treatment effect modeling and inferential frameworks for panel outcomes to estimate dynamic earnings effects of a long maternity leave on mothers' subsequent earnings. Modeling of the endogeneity of the treatment and the panel structure of the earnings are based on the modeling tradition of the Roy switching regression model and the shared factor approach, respectively. We implement stochastic variable selection to test, for example, for the presence of different dynamics under the treatment. Exploiting a change in maternity leave policy and Austrian registry data we identify substantial negative but steadily decreasing earnings effects over a 5 years period.

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1. Introduction

In this paper we introduce two modeling and inferential frameworks within the Bayesian paradigm to estimate the causal effect of an endogenous binary treatment on panel outcomes and implement Bayesian variable selection. We apply the methods to analyze the dynamic causal earnings effects of a long leave after childbirth for mothers returning to the labor market.

The estimation of treatment effects has become a focus of many econometric papers, in particular the identification and estimation of the effect of an endogenous treatment variable on some outcome of interest. Several approaches have been popular to identify

causal treatment effects in such settings, in particular instrumental variable approaches, the LATE estimator and joint modeling approaches (Lee, 2005; Heckman et al., 1998; Heckman and Navarro-Lozano, 2004). Bayesian inferential methods to treatment effect estimation are commonly based on some flexible joint modeling approach, often in the spirit of Roy's switching regression model (Roy, 1951; Lee, 1978) and have addressed a range of issues such as panel outcomes and heterogeneity in treatment across subjects (Koop and Poirier, 1997; Chib and Hamilton, 2000; Munkin and Trivedi, 2003; Chib, 2007; Chib and Jacobi, 2007; Li and Tobias, 2011).

Building on this literature, we consider two modeling frameworks within the Bayesian paradigm to estimate the causal effect of an endogenous binary treatment on panel outcomes. Both models are formulated within the potential outcome framework following the standard approach in the treatment literature. The first framework is formulated in the tradition of Bayesian treatment effects models in terms of a joint modeling framework for the

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treatment and the potential outcomes based on the Roy switching regression model (Roy, 1951; Lee, 1978) to capture the endogeneity of the treatment, and does not require the specification of the unidentified joint distribution of the two potential outcome sequences. Within this framework, we discuss two alternatives to model the dependence across the panel outcomes. The second framework employs the more recent factor approach to model the endogeneity of the treatment as well as the panel structure of the earnings following Aakvik et al. (2005), Carneiro et al. (2003), Heckman et al. (2014). Both frameworks contain flexible parametric mean formulations of the potential outcomes to capture possible interactions between observed covariates with the treatment level, allowing for different effects of the treatment across subjects and, importantly, different time dynamics in the two treatment groups.

As an additional innovative and useful feature of these frameworks we introduce Bayesian variable selection in the context of treatment effects models, which has been implemented in many Bayesian papers in the context of “non-treatment” models (for example George and McCulloch, 1993, 1997; Geweke, 1996; Ley and Steel, 2009; Frühwirth-Schnatter and Wagner, 2010). This feature together with a suitable specification of the model will enable us to determine which covariates should be included in the model and to test for the existence of common and level-specific effects of the treatment as well as covariates.

Our empirical analysis provides the first investigation of the dynamics of a range of treatment effects of a mother's yearly earnings after her return to the labor market as a result of her decision regarding the length of leave after childbirth. A number of empirical studies have investigated the effects of maternity leave policies, a key determinant in the length of leave taken, on labor market outcomes and found mixed results as reported in Lalive et al. (2014). However, the amount of time mothers spend at home before returning to the labor market varies considerably, even among mothers covered by the same maternity leave policy. A mother's decision when to return to the labor market depends also on a range of additional factors and is likely driven by observed and, more importantly, unobserved factors that also affect labor market outcomes directly.

We consider a set of model specifications formulated within the two inferential frameworks for treatment effect models with variable selection for panel data introduced in the paper to obtain estimates of short and medium run earnings effects of short versus long leave based on the average and marginal treatment effects, as well as the treatment effect on the treated and untreated. We exploit a recent exogenous change in the parental leave policy in Austria to help identify causal dynamic earnings effects of the endogenously determined length of leave. Our empirical analysis is based on a large sample of mothers from a unique administrative data set with global coverage from the Austrian Social Security Register.

The remainder of the paper is organized as follows. In Section 2 we provide some background about the maternity policy change in Austria and provide a context for the model discussions. Section 3 describes our modeling frameworks and in Section 4 we discuss Bayesian inference including variable selection. Section 5 discusses the definition and estimation of various treatment effects within our modeling framework. Section 6 contains the empirical analysis and Section 7 concludes the paper.

2. Background: parental leave policy in Austria

In Austria, the earliest time mothers can return to work is two months after the birth of the child which is the end of the standard mother protection period. The parental leave policy starts after the end of this period. In Austria, the parental leave policy has two

components: job protection and the payment of parental leave benefits. Since July 1990, the job protection and leave benefits periods were extended from previously 12 months since the birth of the child to 24 months. The length of the benefits payment period has undergone several changes more recently. A reduction to 18 months in July 1996 has been followed by an extension of the leave period to up to 30 months, 6 months beyond the job protection period, in July 2000. For our analysis we consider the 2000 policy change. The extension of the benefits period by one year and beyond the job protection period in July 2000 induced a substantial proportion of mothers to delay return to work, leading to a considerable exogenous variation in time mothers spent at home (Lalive et al., 2014). Panel (a) in Fig. 1 shows the empirical cdfs of the duration of leave after child birth by policy regime based on a sample of mothers who gave birth in a two year window before and after the 2000 policy change.

The graph is based on a sample of mothers taken from the Austrian Social Security Register (ASSD) which contains the complete individual employment histories for the universe of Austrian employees since 1972, including information on number of births and maternity and parental leave spells. The mothers could not predict the policy change as it was made public on August 7th, 2001 with an effective date of January 1st 2002. Further, to ensure equal treatment of mothers who were on leave August 7th, 2001 and gave birth after July 1st, 2000, they could extend the job protected leave to 2 years and parental leave payments to 30 months. As we can see from panel (a), mothers start to return to work after the end of the mother protection period, within each group the majority of mothers return in the months leading up to the end of the benefit period under the relevant policy scheme. Under the old policy regime a large proportion of mothers return just before month 18, while under the new policy regime most mothers return just before month 30. This strong response of mothers to the length of the benefit period has been observed and studied in Lalive and Zweimüller (2009), Lalive et al. (2014) who also find negative short-term consequences for wages from the new policy. Their model on job search offers an explanation for the higher relative importance via strong effects on the reservation wage of mothers. Interestingly, change of the parental leave duration has no effect on the number of children, but some effect on the timing of subsequent births (Lalive and Zweimüller, 2009). However, since the policy change was only announced in August 2001 but applied to all mothers who gave birth from July 2000, we can define our sample to minimize any effects of mothers who delay the birth of the 2nd or 3rd child under the new more generous policy and consider the fertility decision of a mother as exogenous in our empirical analysis.

For our analysis we therefore consider two groups of mothers based on their leave, those with a maternity leave up to 18 months (short leave) and those with a maternity leave beyond 18 month (long leave).

This paper focuses on the identification of the effect of a long versus a short maternity leave, the binary treatment, on the subsequent earnings of mothers following their return to the labor market. As discussed, there are several potential reasons to believe that mothers with a longer maternity leave receive lower earnings at their return to the labor market such as a higher loss of human capital and loss of good job matches. Panel (b) in Fig. 1 shows the average log yearly earnings for mothers in both leave groups for six consecutive panel periods (years) following their return to the labor market. The graph suggests that mothers with longer leave start out with substantially lower earnings in their first full year in the labor market than mothers with a short leave, and continue to earn less in the 5 years after their return before the gap closes.

However, we have to be careful with the interpretation of the differences in terms of earnings effects as we do not account

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