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Clark, Jeremy; Ferrer, Ana M.

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The effect of house prices on fertility: Evidence from Canada

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The effect of house prices on fertility: evidence from Canada

Jeremy Clark and Ana Ferrer

Abstract
Persistent house price increases are a likely candidate for consideration in fertility decisions. Theoretically, higher housing prices will cause renters to desire fewer additional children, but home owners to desire more children if they already have sufficient housing and low substitution between children and other "goods", and fewer children otherwise. In this paper, the authors combine longitudinal data from the Canadian Survey of Labour Income and Dynamics (SLID) and averaged housing price data from the Canadian Real Estate Association to estimate the effect of housing price on fertility in a housing market that has historically been less volatile and more conservative than its American counterpart. The authors ask whether changes in lagged housing price affect the marginal fertility of homeowner and renter women aged 18–45. They present results both excluding and including those who move outside their initial real estate board area, using initial area housing prices as an instrument in the latter case. For homeowners, they find evidence that lagged housing prices have a positive effect on marginal fertility and possibly on completed fertility, while for renters they find no significant effects.

JEL D13 J13 J18 R21
Keywords Economic determinants of fertility; housing prices; wealth effects; home ownership

Authors
Jeremy Clark, University of Canterbury, Christchurch, New Zealand, jeremy.clark@canterbury.ac.nz
Ana Ferrer, University of Waterloo, ON, Canada

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I. Introduction

Most Western societies are concerned their fertility rates are far below replacement levels, while others are concerned their rates are far above. A key question in the face of such concerns is the extent to which fertility rates respond to various price signals. Researchers in economics and demography have tried to estimate the extent to which families' fertility rates respond to the effects of changing wages or income, or to changes in tax and welfare policies that affect wages or income. Within this context, housing prices are a key variable of interest since housing is the major store of wealth for most families, as well as one of the main determinants of child-raising costs. Hence, the large increases in housing prices experienced in most OECD countries over the 2000's have sparked concern about housing affordability, family formation and the adequacy of neighbourhood amenities (Adsera and Ferrer 2018). In Canada, average house prices more than doubled between 2000 and 2010, with some large urban areas such as Toronto, Vancouver or Calgary experiencing annual housing price growth rates of over 30% at some points in this period. Such price increases have drawn academic, public and policy attention to the effects of housing prices on demographic trends.[1]

The dual role of housing as a major store of wealth and key component of the "price" of raising children creates ambiguity regarding the influence of housing price on fertility. An exogenous increase in the price of housing may reduce family fertility by making the space needed for raising children more expensive, or by requiring both parents to work full time to service a mortgage. Yet for families who already own housing, an increase in the price of housing creates wealth effects, accessible by moving or by home equity extraction via mortgage refinancing or opening lines of credit. Such wealth effects may increase homeowners' fertility, particularly if their willingness to substitute between children and other "goods" is reasonably limited, and they already have sufficient housing. Thus, increases in the price of housing could be expected to have potentially very different effects on the fertility of home owners and renters, and among home owners, between those who own much or little housing, and those who are flexible or inflexible about desired family size. The net effect of housing prices on fertility is thus an empirical question.

[1] See Hulchanski (2005), Government of Canada (2011), or the journal article "Bad policy has played a role in Canada's housing crisis", The Globe and Mail, May 17, 2017 (https://www.theglobeandmail.com/report-on-business/rob-commentary/bad-policy-has-played-a-role-in-canadas-housing-crisis/article35019958/).

The empirical literature looks at this question conceding that, while housing and fertility are long term decisions, they are sufficiently fluid that large house-price increases may change the fertility decisions of people at the margin. A small number of primarily US-based studies have looked into the effect of housing price on fertility.[2] Walker (1995) attempts to explain variations in Swedish fertility as a function of its "shadow price", which includes the additional expenditures on housing that children pose for families. In descriptive analysis, Walker finds a strong negative correlation between fertility and its comprehensive "price", though the effect of housing expenditures alone is not identified. Curtis and Waldfogel (2009) use a similar conceptual framework as Walker, but use panel regression based on the U.S. Fragile Families and Child Wellbeing study to test whether unmarried mothers in cities with higher housing price indices are less likely to have additional children, and find this to be the case. Simon and Tamura (2009) use individual public use micro data (IPUM) from successive waves of the United States census linked with the median CMSA rental rate per room. They too find a significant negative relationship between the price of living space and the number of children living in households. Simon and Tamura also distinguish whether rental price affects spacing (delay) vs. total fertility by examining the number of children ever born to women aged 40 or greater. They find that a higher rental price per room both delays mother's age at first birth, and reduces completed fertility for older women. In contrast, Feyrer, Sacerdote and Dora-Stern (2008), who use the Office of Federal Housing Oversight's repeat sales index at state or MSA level, along with IPUM data from the 1980 and 2000 census, find a positive or no relationship between total fertility and housing price. None of these four studies, however, distinguishes between home owners and renters, for whom changes in housing price could be predicted to have different effects. They also cannot follow individuals over time to control for household-specific unobserved factors such as differing intrinsic desire for children, or willingness to substitute between children and other "goods".

There are, however, three recent papers by Lovenheim and Mumford (2013), Dettling and Kearney (2014), and Li, Whelan and Atalay (2017) that recognize the distinction between home owners and renters, and are able to use some form of fixed effects. Lovenheim and Mumford (2013) follow panels of individual women using restricted geo-coded data between 1985 and 2007 from the American Panel Study on Income Dynamics (PSID). They estimate the

[2] A related literature examines the effect of housing price on household formation (Borsch-Supan (1986), Giannelli and Monfardini (2003), Hughes (2003), Clark (2012)) and dissolution (Farnham et al., 2009).

effect of changes in house price on the subsequent likelihood of having a child, controlling for the number of other children already in the household. For home owners house prices are derived from self-reported household values, whereas for home renters, changes in MSA level average housing price growth are used. Under most specifications, results indicate a positive relationship between house price and fertility for homeowners (meaning wealth effects dominate substitution effects), but surprisingly no significant negative relationship for renters (where only substitution effects should be in operation). Though not conclusive, Lovenheim and Mumford argue that house prices are likely raising homeowners' total (completed) fertility, rather than just reducing their spacing of births, since positive effects are found even for women aged 35-39 and 40-44. In a paper concerning the Australian case, Li, Whelan and Atalay (2017) carry out a similar approach similar, but using individual level panel data from the Household Income and Labour Dynamics in Australia. Focussing on non-movers, and using pooled cross section estimates with fixed effects for local economic conditions, they also find a positive relationship between house price and fertility for homeowners, but not a significant negative relationship for renters.

Dettling and Kearney (2014) similarly recognize that housing prices may have different effects for home owners and renters. These authors use US vital statistics to follow aggregated MSA's over time rather than individuals. They estimate the effect of lagged MSA level house price levels (using the HPI on repeat sales transactions on homes with conforming, conventional mortgages securitised through Fannie Mae or Freddie Mac) and of MSA level home-ownership rates on MSA group level fertility. They include year and MSA level fixed effects as well as measures of time-varying MSA conditions such as unemployment. Across numerous specifications, Dettling and Kearney find that the main effect of an increase in lagged house price on the MSA fertility rate is negative, reflecting the negative effect of high housing costs on the fertility of renters. In contrast, an interaction term of house price and home ownership rate is positive, and of a greater magnitude than the main effect of house price. Thus, an increase in the aggregate home ownership rate raises the effect of house price on fertility, so that for MSA's with even moderate levels of home ownership, higher house prices have a net positive effect on fertility.

Our contributions to this literature is to extend the study of pricing on fertility to Canada, a setting similar to the United States, but with greater stability in the housing and mortgage markets over the time period considered here. We believe that studying the

Canadian case offers an interesting insight into the effect of housing prices on fertility. The differences between the home financing markets between Canada and the United States during the period of study suggest that to the extent that children are a normal good, house prices should have a larger effect on Canadian markets. This is because Canadian home buyers tend to make higher down payments and receive no tax benefits from mortgage interest, so are likely to have more equity in their homes, which would increase the income effect of house price changes.

The main challenge of studying the Canadian case resides in the level of aggregation of available housing price data. Most Canadian surveys do not collect self-reported information on housing prices (although it is included in the 2010 Canadian Household Survey). An HPI on repeat sales transactions is only available for recent years, and for a limited number of Canadian cities.[3] Other than this promising recent index, the Canadian Real Estate Association (CREA) is the only source of historic house pricing data, averaged by real estate board and without control for type or quality of residential housing unit. Our paper is the first to collect this price data directly from CREA to study the effect of house price on fertility using rural and urban areas across Canada. We build empirically on the approach of Lovenheim and Mumford (2013), using confidential geo-coded longitudinal Canadian data for women aged 18-45 from successive waves of the Survey of Labour and Income Dynamics (SLID), matched to time-series data on average housing price at the real estate board level from the Canadian Real Estate Association's Multiple Listing Service data set (CREA MLS). We distinguish between home owners and renters when examining the effects of changes in house price on fertility, and examine price effects across both urban and rural areas. We take various steps to address the challenges posed to identification of location self-selection. Our first strategy, similar to Li et al. (2017), is to focus on women whose families have not moved outside their initial real estate board boundary during the six years they are included in the SLID. These "non-movers" may experience house price changes in their areas as exogenous shocks. Our second strategy is to include women whose families move across real estate boards and address potential

[3] The Teranet–National Bank House Price Index measures the rate of change of Canadian single-family home prices, based on the property records of public land registries using repeated sales estimation methodology. The monthly index covers eleven Canadian metropolitan areas and has only very recently been released dating back to 1999. Although of higher quality than the CREA data we use, this price data has only limited geographical coverage and would reduce the sample size considerably, given that the SLID oversamples rural areas.

endogeneity of house prices for those who move in order to raise families, by instrumenting housing prices using initial location housing price.

The rest of the paper proceeds as follows. In Section II, we briefly summarize theoretical predictions regarding housing price and fertility, and the differences in housing and its related credit markets that exist between Canada and the United States. In Section III we describe our data and empirical estimation strategy. In Section IV we present our results, and provide a final discussion and conclusions in Section V.

II. Housing Prices and Fertility in Theory, and Housing Markets in Practice

Liu and Clark (2016) provide a recent theoretical treatment of the relationship between house prices and fertility. The paper assumes that unitary households have constant elasticity of substitution preferences over number of children, leisure, and a composite good. Fertility is modelled using a Cobb Douglas household production requiring time and housing. Households choose whether to rent or buy housing based on the price of each, and maximise utility subject to time and budget constraints. Liu and Clark (2016) confirm that renters will respond to an increase in the cost of housing by desiring smaller families. For homeowners, those who both have a low willingness to substitute between family size and leisure or consumption of other goods, and who already own substantial housing, are predicted to respond to an increase in house prices by desiring more children. However if such homeowners' initial quantity (size) of housing is sufficiently small, they may desire fewer children. In contrast, those homeowners who are more willing to substitute between family size and other things are predicted to respond to higher housing prices by desiring fewer children, regardless of how much housing they own. This model emphasizes the importance of a family's renter/owner status, as well as its (generally unobserved) elasticity of substitution between children and other 'goods', and for owners, the physical size of housing already owned.

Our contribution to the literature lies in the examination of the Canadian housing market. This offers a useful complement to the US studies, given the two countries' overall institutional similarities, paired with idiosyncratic differences in their housing markets. In Canada (as in the US), housing prices remained stable over the late 1990's and increased steadily over the 2000's, while fertility diminished over the period (see Figure 1 using Canadian data from Cansim). However, the institutional arrangements, incentives and outcomes of housing markets have been more stable and conservative in Canada than in the United States.

House prices rose more precipitously in the United States than Canada prior to their peak in 2006, and fell more precipitously during the subprime mortgage lending crisis of 2007 to 2009 even as Canadian house prices quickly recovered (Carney 2011).[4] North American housing policy promotes home ownership as a social and economic end, but using different means. In the United States mortgage interest is tax deductible, and government sponsored housing agencies Fannie Mae and Freddie Mac have the explicit objective of enabling lower income/higher risk families to achieve home ownership. In Canada homeowners may instead make interest free tax withdrawals from retirement savings accounts, and neither capital gains nor imputed rents are taxed. These differences create incentives for Canadian home buyers to make relatively larger down payments.[5] Another difference is that securitisation of mortgage debt is widespread in the United States, via the debt bundling and on-selling activities of Fannie Mae (for banks) and Freddie Mac (for savings and loans). Capital markets rather than bank depositories thus make up the dominant source of funds for US mortgages (Green and Wachter 2005), with the reverse holding in Canada. As a result, the 10, 15 or 20 year fixed term mortgages funded by securitisation in the United States are not available in Canada. Canadian mortgages also tend to be "full recourse," meaning banks can pursue defaulting borrowers beyond the mortgaged property itself, and they tend to include penalties for early repayment, unlike in the United States (Green and Walker, 2005). Canadian mortgage lenders have also been more conservative, and operated in a more conservative regulatory framework, than their US counterparts (Concetta-Chiuri and Japelli 2010). Typical loan-to-value (LTV) ratios and regulated LTV maximums have been lower in Canada, as have the proportion of mortgages made to sub-prime borrowers or those without mortgage insurance (Tsatsaronis and Zhu 2004, Green and Walker 2005).

A final difference with potential relevance for fertility is a lag in the prevalence of uptake in home equity extraction (i.e. borrowing against home equity) by homeowners in the two countries. Greenspan and Kennedy (2005) report increased prevalence of such extraction by

[4] By 2016, United States housing prices were still 20% below 2006 peak levels in real terms (www.economist.com/blogs/graphicdetail/2016/08/daily-chart-20).

[5] According to a study by the Bank of Montreal, the average Canadian first time home buyer in 2013 paid 16% of the house value as down payment (Genworth Canada), compared to 11% in the United States in 2016 ("The big downpaymtent Myth", Realtor Mag, February 15, 2017. *National Association of Realtors*, http://realtormag.realtor.org/daily-news/2017/02/15/big-down-payment-myth). Overall, Canadian home equity was estimated to be between 66% and 72% during our sample period (Cooper, 2017), compared to the US where it was estimated to be between 38% and 63% (Board of Governors of the Federal Reserve, 2018).

American homeowners in the late 1990's and early 2000's, whereas as of 2004 Tsatsaronis and Zhu report that mortgage equity withdrawal was available but "unused" in Canada. However, Bailliu, Kartashova and Meh (2011-2012) find this reticence among Canadian home owners to have abated subsequently, driven partly by continuously rising housing prices and household debt in major urban areas such as Toronto and Vancouver.[6]

What effect might these institutional differences in housing markets have on the relationship between housing price and fertility? We expect that larger down payments and higher equity in Canada could magnify the income effects associated with rises in house price. It is also possible that the relatively larger volatility of US house prices could make US families less likely to immediately adjust their desired fertility (a long term 'investment/consumption good') to changes in housing price if they view these changes to be more transitory. Either effect could magnify the effect of rising house prices on fertility in Canada, relative to the United States.

We turn now to examine the data and estimation strategy we use to look for such effects.

III. Data and Empirical Methodology

Our two main sources of data for this paper are the Canadian Survey of Income and Labour Dynamics (SLID) and house price data at real estate board level constructed from the Canadian Real Estate Association (CREA). We use the confidential files of the SLID to obtain panel information about Canadian households from 1994 to 2010. The SLID is a household survey that covers all individuals in Canada, excluding residents of Indian Reserves, northern territories, or of institutions. The survey is designed as a series of two overlapping panels, each panel consisting of roughly 17,000 households surveyed for six consecutive years. A new panel is introduced every three years, so two panels always overlap. Besides ample information on household composition or income, the SLID also provides information on a broad selection of human capital variables, labour force experience and demographic characteristics such as education and family relationships. Its richness of information and relatively large sample size

[6] Given differences in equity held, it would have been interesting to explore the effects of both house price and equity on fertility. This would be possible in theory with the SLID survey, as it includes a question on monthly mortgage payments. Preliminary tests founds a mortgage indicator variable was not significant in fertility regressions, however question non-response meant we had less than half the observations than in our current sample.

make the SLID a valuable dataset for our purposes, and its six year panel nature allows us to control for stable but unobserved household characteristics that may influence family size.

However, because the SLID does not ask home owners to estimate the value of their homes, a key challenge in this analysis was to obtain a consistent measure of housing price that was as detailed geographically as possible. There is no official source of resale house prices in Canada. The Teranet National Bank House Price Index (HPI) has recently released information dating back to 1999, but covers only 11 Census Metropolitan Areas (CMAs). The best information available for an extended period of time, for all regions of the country, comes from the Canadian Real Estate Association's Multiple Listing Service data set (CREA MLS), which we collected for the period 1991-2010. This data set provides mean house prices, (i.e. total sales value over total number of residential units sold) for 92 urban and rural 'boundaries' in Canada, generally the geographic boundaries of 92 real estate boards (REBs).[7] While 92 real estate board prices offer greater coverage than 11 MSA's, for a country the size of Canada some real estate board boundaries are quite large, and will likely contain sizeable variation in house prices within them. For panel regressions, the relatively small number of REBs should not present a problem if there are sufficient co-movements in house prices in adjacent low and high price neighbourhoods within REB's over time. While we know of limited evidence regarding this question, research by Clapp and Ross (2004) finds this to be true between the towns of labour market areas (similar to metropolitan statistical areas) in the American state of Connecticut.

Unfortunately, the CREA MLS boundaries do not match official boundaries, such as census tracts or dissemination areas used by government agencies. In order to match prices to house owners or renters, we use the census subdivision of a SLID respondent - which translates roughly into the first 3 digits of their 6 digit postal code - to assign respondents into the 92 urban and rural boundaries of CREA MLS. For the matching procedure, we collected images of the real estate boundaries from the various provincial real estate board websites across Canada (Alberta Real Estate Association, 2013; British Columbia Real Estate Assocation, 2013; Nova Scotia Association of Realtors, 2013; Ontario Real Estate Association, 2013;

[7] We also collected a secondary data set - called CREA MLS II – which provides median house prices for roughly 123 boundaries. Unfortunately, this secondary data set was only available for the years 2005-2010, and was limited to 14 urban centres in Canada. A full list of regions contained in CREA MLS and CREA MLS II is provided in the appendix.

Winnipeg Realtors, 2013). When this data was not publically available, we consulted with real estate board representatives in order to define the provincial real estate boundaries on hard copy maps (Saskatchewan, New Brunswick, and the Toronto Area within Ontario). We obtained digital boundary data for the Real Estate Boards by rectifying the images to their geographic location and digitizing polygon files using Esri ArcGIS 10.0 software (Esri, 2013). We used Statistics Canada's census subdivision (CSD) as the aggregate geographic level of the census data. The CSD level of Canadian census data corresponds to "a municipality or an area that is deemed to be equivalent to a municipality for statistical reporting purposes" (StatsCan, 2001). Because this area corresponds generally to the size of the real estate areas, this level of aggregation seemed appropriate. The sales data for a particular Real Estate Board Area was linked to a unique CSD when the geographic centre of the CSD area fell within that particular Real Estate Boundary.

Alberta, British Columbia, Saskatchewan, Manitoba, Ontario, Nova Scotia and New Brunswick were all spatially linked as described above.[8] In some cases, the available real estate board maps did not provide complete coverage of a province, and in those cases we created an 'other' category to represent the rest of the province (in Saskatchewan, Manitoba, and New Brunswick). According to experts these were mostly scarcely populated rural areas that have not seen great variation in prices. Within the Province of Quebec, the Quebec Federation of Real Estate Boards provided sales data by Census Metropolitan Area (CMA), which unlike in the rest of Canada could be linked directly to the CSDs within the six CMAs. Unfortunately, this was not available for the final three years of the sample. Those parts of Quebec outside these CMA's were classified into a single 'other' category. The real estate data for the two provinces of Prince Edward Island and Newfoundland/Labrador were each a single value, and thus all unique CSD identifiers within each province were linked to a single province-wide price. Real estate data for northern territories was collected, but not used because the SLID does not cover these areas.

We measure marginal fertility with an indicator variable that equals one if the woman gave birth last year. Our empirical analysis focuses primarily on the effect of (lagged) housing

[8] A complication arose regarding Canada's largest city Toronto in Ontario – whose real estate board sets intra-city boundaries that diverge from those for the Toronto area set by the Ontario association of real estate boards. We opted to use the price/boundaries provided by the provincial association, which necessitated imputing a house price for the combined area of Toronto and Brampton using provincially-sourced data.

price levels, rather than changes in housing price.[9] In addition, because the proportion of women who give birth each year is small, we emphasize logit rather than linear probability model results. For homeowners and renters separately, we estimate the likelihood that family *i* (containing a female head or spouse aged 18-45) will have an additional child in year *t* (F_{ict}) as a function of the mean REB housing price (HP_{ct-1}) as reported by the real estate board for *i*'s city or rural region *c* with a one year lag (t-1). More precisely, fertility is measured over the period between surveys - for example our dependent variable is equal to 1 if the woman had a baby between May 1995 and May 1996 - while our one year lagged house price variable corresponds to the average for the year previous to the survey, i.e. calendar 1995. This lag should provide appropriate information about housing price trends surrounding conception for most births in 1996, particularly if families forecast prices later in a calendar year from its earlier months. However, depending on ease of conception or the rate of house price increase in-year, a one year lag might not be sufficient – perhaps the likelihood of women giving birth between May 1995 and May 1996 is affected by calendar 1994 average house price. We therefore try lags of two years in robustness checks (see Section 4.3). The model estimated is the logistic transformation of

$$F_{ict} = \beta_0 HP_{ct-1} + \beta_1 X_{ict-1} + \beta_2\, UR_{c\,t-1} + \; i + t \qquad (6)$$

We include a set of either 'sparse' or 'full' controls in fertility regressions (X_{ict-1}); sparse controls are the woman's age, while full controls include well known determinants of fertility such as the woman's family income - to reflect current economic conditions - marital status, and labour force status - to account for time constraints - education and previous number of children born - which are related to fertility preferences. We also include the overall provincial unemployment rate (*UR)* to capture local economic conditions in the area, and year dummies to capture time trends. We use first simple pooled cross section models that pool all observations from all SLID panels to estimate the coefficients, and later turn to panel data models that take individual effects (i) into consideration. Individual fixed effects control for within panel time invariant characteristics, such as fertility preferences or degree of

[9] Lovenheim and Mumford (2013) argue that using price levels may represent different changes in wealth for households who own more or less of the equity in their homes, whereas using changes in price should represent the same degree of wealth increase for all types of owners. We believe that using lagged price levels is more intuitive for panel estimation, and that the more conservative nature of mortgage markets in Canada (with lower LTV ratios and higher equity) lessen the force of this argument. We thus adopt Dettling and Schettini-Kearney's (2014) focus on price levels.

financial awareness, and so on. Observations are clustered to the REB level at which house prices are available, to yield cluster-robust standard errors.

Our marginal fertility measure cannot itself identify whether changes in housing price are affecting total fertility, or merely its timing. We cannot provide conclusive evidence either way, but we will extend our analysis to add age – house price interaction terms, to see how price effects may differ over women's childbearing years. If, for example, the same effects are found for older women as are found for the sample overall, we will take this as suggestive evidence that house prices are affecting total fertility (Lovenheim and Mumford's approach, 2013).

We select a sample of women aged 18 to 45, who are married or live common law in the first year of the panel. This selection aims to capture relevant fertile years of women who have already selected a spouse/partner. Given our selection criteria, note that our control for married/common law status vs. separated/single status can vary only in the second or higher year of each panel. We distinguish between women who live in homes owned by one or more members of the household ("owners") and women living in non-owner occupied households ("renters"). In order to observe any differential effects of house price changes on the fertility of the two groups, we focus only on women who do not change their 'owner'/ 'renter' status during their six year panel. Hence, we exclude a number of changes in ownership status that are likely to be associated with major life transitions, such as a couple's purchase of a first house or a couple's separation, which may have an independent effect on fertility. We acknowledge this limitation, but consider that a proper analysis of these transitions requires a different treatment and possibly data with specific questions on fertility intentions and preferences. This restriction reduces our initial number of observations by 25% overall.

We initially restrict our sample to those women who remain at the same residence over the six years of their panel, or who move only within their initial real estate board area, and thus were assigned the same REB house price. By focusing on individuals who remain in their REB, house price increases will more resemble "exogenous" changes in household wealth. Ideally, however, we would like to account for the decision to move. To do this, we must also consider individuals who move outside their initial REB area. These women could potentially be trying to realize a(n observable) change in wealth which might be related to their child-bearing decisions. For example, if women who do not want children stay in expensive areas,

but those who want more children leave expensive REB's to afford bigger houses, we will observe a spurious correlation between house price increases and *reduced* fertility. We consider this possibility, including movers across REB's in the sample and using an instrumental variable methodology (IV) to address the decision to move. Seeking causal effects while including movers has the potential confounding effect of assuming that women who move from expensive to less expensive areas with a desire to increase fertility are unaffected by house price increases, when in fact they are. When we include movers, we use as an instrument for (say) t-1 house price the t-1 house price of the initial REB area in which the woman began the panel. Intuitively, this instrument effectively assigns women who move to realize an increase in wealth originating from rising house price to the treatment – rather than the control – group. The validity of this instrument requires the assumption that the past house price at origin affects the fertility of movers only through the changes in wealth it might bring about (i.e. through changes in prices) and not via other channels. Such changes in wealth are removed from the instrumented price, so that the IV estimates using these predicted house prices are unbiased by such wealth changes.[10]

3.1 Descriptive Statistics

We begin in Figure 2 by illustrating the behaviour over time of real (CPI deflated 2002 = 100) average housing prices for real estate boards in Canada, divided into regions, for the 18 years of combined panel data (1993 – 2010). We plot all REB prices by region, in order to show the variation in house prices that exists within and across regions, even if it makes for a cluttered figure. Note that the vertical scale differs between regions, reflecting strong variation in housing prices between regions in Canada. Prices are higher in British Columbia and Alberta in Western Canada, and in Ontario in central Canada. There is also strong variation within regions, usually between large urban, suburban, and rural areas. Prices are higher for urban centres: Vancouver, Victoria, Calgary, Saskatoon, the regions of Toronto, Montreal, and Halifax. Also of note within regions is the strong - but not universal - co-movement in prices between REB's, with price growth generally strongest in major urban centres.

As previously mentioned, there has been a general decline in marginal fertility over the SLID sample years (see Appendix Table 1 along with Figure 1). The mean proportion of women

[10] The IV strategy is similar to that used by Currie and Rossin-Slater (2013) to address the effect of hurricane-related maternal stress on infant health for mothers who subsequently move from the affected area.

reporting a birth dipped then recovered between 1995 and 2005 before falling again by 2010, broadly consistent with models predicting that fertility moves with the business cycle (Adsera, 2011). Table 1 shows marginal fertility separated by tenure and mover status, but pooled over years. Overall, 6.1% of homeowner women in our subsample gave birth in the year, whether with or without movers, while 7.4 to 7.7% of renting women did so. Finally, in Figure 3 we illustrate how the total number of children born per woman varies according to lagged real housing prices for homeowner women who reported a birth over the previous year. We focus here on women who remained within their REB over their six year panels There is a positive correlation between house price and total children born, but only up to three children, with a negative correlation thereafter. Of course, this correlation does not take into account individual characteristics, such as the influence of the life cycle on saving and investment, or characteristics of the house such as location or neighbourhood amenities. Fortunately, the SLID collects a broad range of information that we can use to control for the main economic determinants of income, savings and fertility. Table 1 shows the sample statistics for the main variables used in our analysis, broken down by owners vs. renters, and excluding or including movers to other REB's who kept their owner/renter status. In general, renters are younger, have lower household income, are less likely to be working (part time or full time), to have a post-secondary degree or to be married/common law, and have had fewer children in total. Yet renters are slightly more likely to have had a child in the last year (7 to 8% vs. 6%)

IV. Regression Results

We look first in Table 2 at homeowners who remain within their real estate board boundaries. Pooled cross section analysis in sparse model (1) shows that a $10,000 increase in lagged house price is significantly associated with a 2.2% increase in the odds of having a birth. To put this in perspective, this would raise the sample mean odds of having a birth from (.061/.939 =) .0650 to .0664, or raise the likelihood of birth from 6.10% to 6.23%. This association weakens slightly as additional covariates are added in model (2), to a 1.6% increase in the odds of having a birth. Covariates (significantly) positively associated with marginal fertility for non-moving homeowners are "continuing to be married/common law", and "post-secondary education". Covariates (significantly) negatively associated with marginal fertility (and thus with estimated odds ratios less than one) are "age", "previous number of children born", and with less precision, our proxy for macroeconomic conditions - "provincial

unemployment rate," and the woman's full time work status. Surprisingly, household income is not significant.

In some specifications for homeowners we also proxy for the physical quantity of housing owned using information on number of bedrooms along with its interaction with house price. Liu and Clark (2016) identify the potential importance of physical quantity of housing owned for the effect of housing price on homeowner fertility. Note however that the number of observations drops because the number of bedrooms variable is not available for all years of the SLID sample, and even when it is included not all individuals report it. Nevertheless, to test this prediction, we add number of bedrooms and its interaction with lagged house price in columns (3). We do not find the interaction to be significant. However, we also suspect that house quantity proxies, such as number of bedrooms, suffer from endogeneity problems as individuals may select the size of a house based on fertility preferences.[11] Hence, we consider model (2) our preferred specification.

The next three columns perform a similar analysis while exploiting the panel nature of our data. This allows us to remove any bias due to the existence of unobserved individual traits that do not change over time, most importantly fertility preferences.[12] The analogue of our preferred specification for the panel estimates, shown in column (5), finds that a $10,000 increase in lagged house price is associated with a 6.7% increase in the odds of having a birth (raising the sample mean odds from .0650 to .0693, or the likelihood of birth from 6.10% to 6.48%). Thus the estimated size of effect is greater under fixed effects than pooled cross section, but the coefficient is significant only at the 10% level.

Having found positive pro-natal effects of house prices for owners who stay within their REB, we move in Table 3 to analogous models for renters. Unlike for homeowners, theory unambiguously predicts that if higher housing prices translate into higher rental costs, they will be negatively associated with the fertility of renters. The first item of note is that we have a much smaller number of observations for renters than for homeowners. This is in part because we are restricting our sample to renters who do not change REBs, nor their renter/owner status

[11] In particular, when we regress number of bedrooms on lagged house price, we find that lagged house price has large significant effects in explaining variation in number of bedrooms. This holds across sparse or full specifications, and is consistent with housing in more sought-after areas containing fewer bedrooms.

[12] The fertility literature generally considers that fertility preferences are part of the social norm and are formed at a relatively young age. See for instance, Adsera and Ferrer (2014) and Adsera et al. (2012)

over a six-year period. Also, given that quantity of housing owned is not relevant for renters we exclude it from all renter specifications.

In contrast to theory, we find either a very weak positive, or no significant effect of rising house prices on the fertility of renters. The point estimates of the odds ratios for house price in models (1) to (4) of Table 3 are significant only in the pooled cross section sparse specification. Overall, we have less insight on how to interpret these slightly surprising results, as we have no data on how closely movements in rental costs track changes in housing prices. However we note that this lack of significant negative correlation between housing price and fertility for renters is similar to what was found by Lovenheim and Mumford (2013) for the United States and Li et al. (2017) for Australia.

4.1 Including Movers

We move next to results when we retain in our sample women who moved to other REB's in Canada, but retained their renter/owner status. In principle, retaining movers has the virtue of including in the analysis those who care sufficiently about desired family size to change location, perhaps to access more space in less expensive areas. Conversely, however, it raises endogeneity concerns, since by choosing location, individuals may be playing a greater role in influencing the change in wealth associated with the housing price they experience. We thus consider an instrumental variable (IV) approach through a two-step least squares (2SLS) regression framework to address this issue. We instrument the current REB house price with the current housing price for the REB in which the woman is first observed in the SLID panel. Such prices will be identical to experienced prices for those who remain in their REB, but differ for those who move. Initial REB's prices are strongly correlated with current REB's prices (its coefficient in the first step regressions is always large and significant at 1%) and it is hard to imagine how initial REB's ongoing housing price should affect a woman's marginal fertility other than its effect through her current REB's housing price. This strategy alleviates concerns about endogenous moving as a result of house price changes that are related to fertility because women who move are correctly assigned to the prices of areas they were originally in. Therefore, these predicted prices reflect the exogenous change in wealth for movers, rather than the endogenous response through the move. Our IV strategy is linear as there are difficulties implementing IV procedures for nonlinear models. To bridge the results between

the non-instrumented logit regressions and our linear IV estimates, we also provide the results for the linear probability model.

Table 4 provides our results, focussing on the odds ratio/coefficient on lagged house price. Rows (1) through (3) show the pooled cross section specifications and rows (4) to (6) the fixed effects specifications. The first two columns refer to the sample of homeowners while the last two columns refer to the sample of renters. Starting with logit models in rows (1) and (4), we find very similar results to when movers were excluded, which suggests that endogeneity may not be a big concern. A $10,000 increase in lagged house price again raises the odds of having a child by 1.6% in pooled cross section model (1), and by 5.0% in the FE panel regression model (4), though the latter is no longer significant with a p value of .153. Before moving to IV results, we note that our bridging linear probability model also finds that housing prices are pro-natal for homeowners in pooled cross section and panel models. From model (2), a $10,000 increase in lagged house price raises the probability of having a child by .1 percentage points (from 6.1% to 6.2% at sample mean, similar to the logit case). The bridging fixed effects panel in model (5) finds a slightly larger result (from 6.1% to 6.3% at sample mean). Moving to our IV estimates, row (3) presents results for the pooled cross section model. With our instrument, we find that a $10,000 increase in predicted lagged house price again raises the probability of birth by .1 percentage points just as without an instrument, significant at the 5% level (p value .039).[13] The IV results in panel model (6) similarly track those for the non-IV linear fixed effects (5), but they are no longer statistically significant.

In summary, when we include home owners who move to other REB's but retain their owner status, pooled cross section models with and without an instrument for house price continue to find a positive effect of lagged house price on marginal fertility of similar magnitude. However, results are less robust for panel models. Linear models continue to find significant pro-natal effects as before, but when prices are instrumented, effects are no longer statistically significant.

Results are more stable when we move to retain movers among renters in the last two columns of Table 4. Here, whether as pooled cross-section or panel, logit odds ratios or linear probability models, and with or without instruments, the point estimates for the effect of

[13] The coefficient of the instrument on actual housing prices is 0.722 in the first stage regression, significant at 1%, making it a strong instrument.

lagged house price are small, positive, and never significant. We thus again find no significant association between lagged REB housing price, and the marginal fertility of renters.

4.2 House Prices and Completed Fertility

So far we have evidence that an increase in lagged average REB house price has significant positive effect on the odds of home-owning women giving birth, particularly if we restrict the sample to those who remain within an REB for the six years they are followed up. Such positive effects could, however, simply reflect a timing issue. A price increase might cause home-owning families to wish to have more children in total, or merely to have the same number sooner. Our marginal fertility measure does not enable us to address this ambiguity conclusively, but we try to get suggestive evidence by focussing on the effects of house prices on women nearing the end of their potential child-bearing years. Because effects seem most evident for home owners who remain in their initial REB over 6 years, we focus on this sample.

We replace our continuous age variable with a dummy for whether the woman is 35 or older, together with an interaction of this dummy with lagged house price. This enables us to ask whether women aged 35 plus with the lowest house price have different odds of giving birth than younger women (the main effect), and then whether living in higher price REB's augments or offsets this effect (the interaction). We also consider a more flexible specification for the effect of age, replacing the continuous age variable with multiple age bracket dummies, each also interacted with lagged REB house price. Under this approach, our omitted age bracket is women aged 23-27, the peak fertility bracket. Our results are provided in Table 5, both for pooled cross section in columns (1) and (2), and panel models, in columns (3) and (4).

From pooled cross section model (1), we see that with the house price kept at its lowest bound, women 35 or older have lower odds of having given birth in the last year than younger women (with a reduction in the odds ratio of 84 percent (1-.16=.84)). From the interaction term, a $10,000 increase in lagged house prices raises the odds of older women giving birth by 1.2% relative to younger women. For a more helpful comparison, Panel B reports the cumulative effect of price increases on women by age, relative to women of the same age who do not experience a price increase. Here, a $10,000 increase in lagged house price raises the

odds of older women giving birth by 1.7% (column (1) Panel B).[14] In the equivalent fixed effects model (3), it raises the odds of older women giving birth by 6.3% (=1.125*.945). Hence, rising house prices have a pro-natal effect even for older home-owning women.

We glean more nuanced results when we move to multiple age bracket dummies and interactions. Beginning with pooled cross section in model (2), we see that, relative to women aged 23-27, a $10,000 increase in lagged REB house price does not significantly increases the odds of women aged 33-37 giving birth. But relative to other women their own age (33-37) in Panel B, a $10,000 increase in price increases the odds of women in this age cohort giving birth by 2.2% (=1.011+1.011), which is significant in a joint test at the 1% level. The effects are larger under fixed effects. In model (4), relative to other women aged 33-37, a $10,000 increase in price increases the odds of giving birth by 11.9% (=1.241*.902), significant at the 1% level. Do these pro-natal effects persist even for women aged 38 and above? In cross section model (2), relative to other women aged 38 and older, a $10,000 increase in price does not significantly increase the odds of giving birth – the point estimate is a .8% increase, but the joint test p value is 0.146. In the fixed effects model (4), the equivalent price increase raises the odds of women 38 and over giving birth by 5.9%, which is marginally significant at 10% level.

Putting these results together, higher house prices raise the marginal fertility of women 33-37, and to a lesser extent, the marginal fertility of women aged 38 and up. According to fixed effects however, house prices have a yet higher effect on younger women aged 28-32. Thus overall, our age interaction results provide suggestive evidence that, to the extent that later (in life) fertility may account for an increase in the total number of children born, part of the positive effect we find might be raising the total fertility of homeowners, rather than just bringing forward the timing of their births. However, the fact that the magnitude and significance of price effects is weaker for older cohorts suggests that a part of the effect of house price increases might simply be on birth timing.

4.3. Using a Longer Lag

One possible objection to our general approach is that a one-year lag between measures of average annual REB house price and a woman giving birth may not allow sufficient

[14] The total effect of a price increase relative to similarly aged women is given by the cumulative effect of house prices plus the interaction of price and age, which here for older women sums to .5% + 1.2% = 1.7% in column (1). We conduct joint tests of the statistical significance of these total effects, reported in Panel B of Table 5.

time for families' fertility to respond to housing price changes. Increasing the house price time lag beyond one year allows more time for fertility responses, but at the cost of losing additional year(s) of observation from each six year SLID panel.[15] For panel regressions in particular, this compression further reduces potential within-family variation in house prices and fertility. We have thus repeated the analysis of our preferred specifications (2) and (5) in Table 2, but using REB house prices lagged by two years. The results are reported in model (5) and (6) of Table 5. For pooled cross section, increasing the lag of price results in it having a slightly higher effect on marginal fertility (a 1.9% increase in odds of giving birth rather than 1.6%). For fixed effects, however, increasing the lag results in a reduced positive point estimate (a 2.7% increase rather than 6.7%) that is no longer statistically significant.

4.4 Family Composition and Sample Selection

The near-impossibility of convincingly modelling all major life transition decisions such as marriage, separation, adoption, etc. drives much of the choice of outcomes and sampling selection in the literature. In particular, considering other family outcomes requires separate analysis (see for example Farnham et al. 2011).

We have not considered here the fertility of single mothers, for example, as very few births occur among single mothers in our SLID sample. Other authors who have focused on the effects of house prices on single mothers (Curtis and Waldfogel, 2009) have used specialised surveys that contain enough non-marital births for meaningful analysis. Another significant restriction in our sample involves tenure stability. Considering individuals who change tenure status requires more complex modelling than what was considered here. In particular, the decision to purchase a first home (and how house prices affect this decision) would require different analysis, such as a hazard rate model that better captures the timing of the decision.

V. Discussion and Conclusions

In this paper, we have joined a limited number of recent investigations into the effects of housing price on the marginal fertility of homeowners separate from renters. We investigate

[15] While we have the REB average housing price in the years preceding the start of each new SLID panel, we cannot know if a woman and her family lived in that REB in those pre-survey years.

house price effects on fertility specifically in Canada, where the housing market has historically been less volatile, mortgages backed more by bank deposits than securitisation, and lending/borrowing practice and regulation more conservative. We have used individual level data from the Canadian Survey of Labour Income and Dynamics (SLID) merged with average housing price data at real estate board (REB) level from the Canadian Real Estate Association (CREA). Theoretically, higher housing prices that translate into higher rental costs should depress fertility among renters. Higher prices could raise fertility among homeowners if their elasticity of substitution between children and other goods is low and they already own sufficient housing, but depress their fertility otherwise.

Empirically, we find that the effect of housing price on marginal fertility does vary by homeowner status. For homeowners, we find that higher lagged REB average house price raises the odds of a woman giving birth, though the effect is significant in some credible specifications, and not in others. In particular, for women who have not moved outside their REB during the 6 years of their panel, we find - using fixed effects panel logit regressions with bootstrap standard errors clustered to the REB level - that a $10,000 real increase in lagged REB average housing price raises the odds of a woman giving birth by 6.7%. This is equivalent to raising the annual likelihood of giving birth from a sample mean of 6.10% to 6.48%, a 6.2% increase. While non-trivial in magnitude (since a $10,000 increase is not large), this effect is significant only at the 10% level. We find this overall effect strengthened for some age-cohorts and weakened for others – the price increase significantly increases the odds of giving birth for women aged 23-27 at the 5% level, (the house price main effect in Table 5), for women aged 28-32 at the 1% level, and for those aged 33-37 at the 1% level. It has no significant effect on women 18-22, and only a suggestive effect on those aged 38 and higher (at the 10% level). However, if we retain those who move to another REB, higher house prices are not significantly associated with the likelihood of home-owning women giving birth, either in logit fixed effects without an instrument for house price, or in linear 2SLS with an instrument, though they are significant in linear FE without an instrument. Similarly, when we increase the lag in prices for non-movers, we lose significance in the FE model, likely due to the reduction in the number of observations and within-variation, whereas effects grow larger in pooled cross section specifications.

We find greater stability of results for renters. Under no fixed effects specifications (with or without movers to other REB's, and with or without instruments) do we find any significant effect of lagged REB house price on the marginal fertility of renters.

By way of comparison, Lovenheim and Mumford (2013) find for American homeowners that a US $10,000 increase in homeowners' own house price raises the .05 baseline probability of giving birth by .00085 percentage points, a 1.7% increase. Li et al. (2017) find that a AUS $10,000 increase raises the .081 baseline probability by .00061 percentage points, a .75% increase. Thus, at 6.2%, we find larger effects of changes in house price on the marginal fertility of Canadian homeowners.

Our findings provide some conclusions for those regions of Canada that experienced strong increases in housing price over recent decades, such as Vancouver and Toronto. They do not suggest that areas experiencing rapid price growth will see significantly depressed fertility among those families who rent there, even if rapidly rising prices force more young families into renting rather than home ownership. Among families fortunate enough to already own homes and remain with their REB boundaries, our findings suggest they may even have slightly more children than they otherwise would have. Combining these two findings, if the number of school-aged children is falling in high price growth locations such as Vancouver or Toronto, it is not because extant homeowners and renters there are choosing to have fewer children. Such declines might instead be caused by other factors, such as migration into high growth urban centres of people with preferences for smaller family size.

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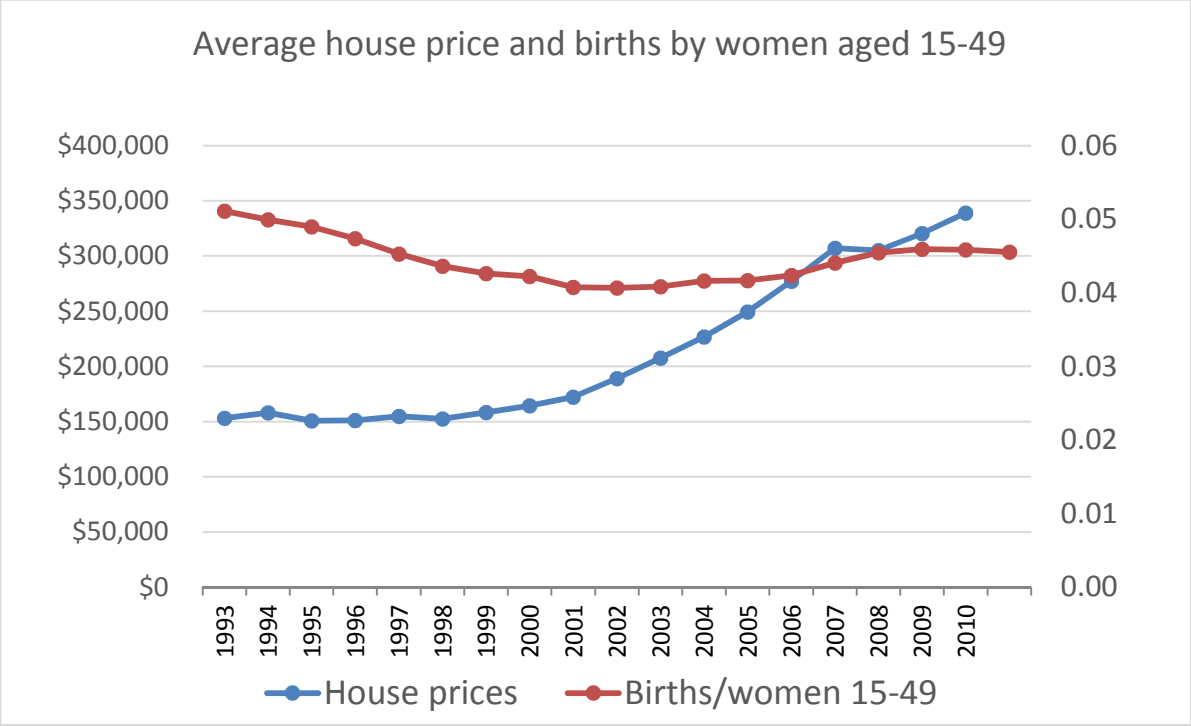
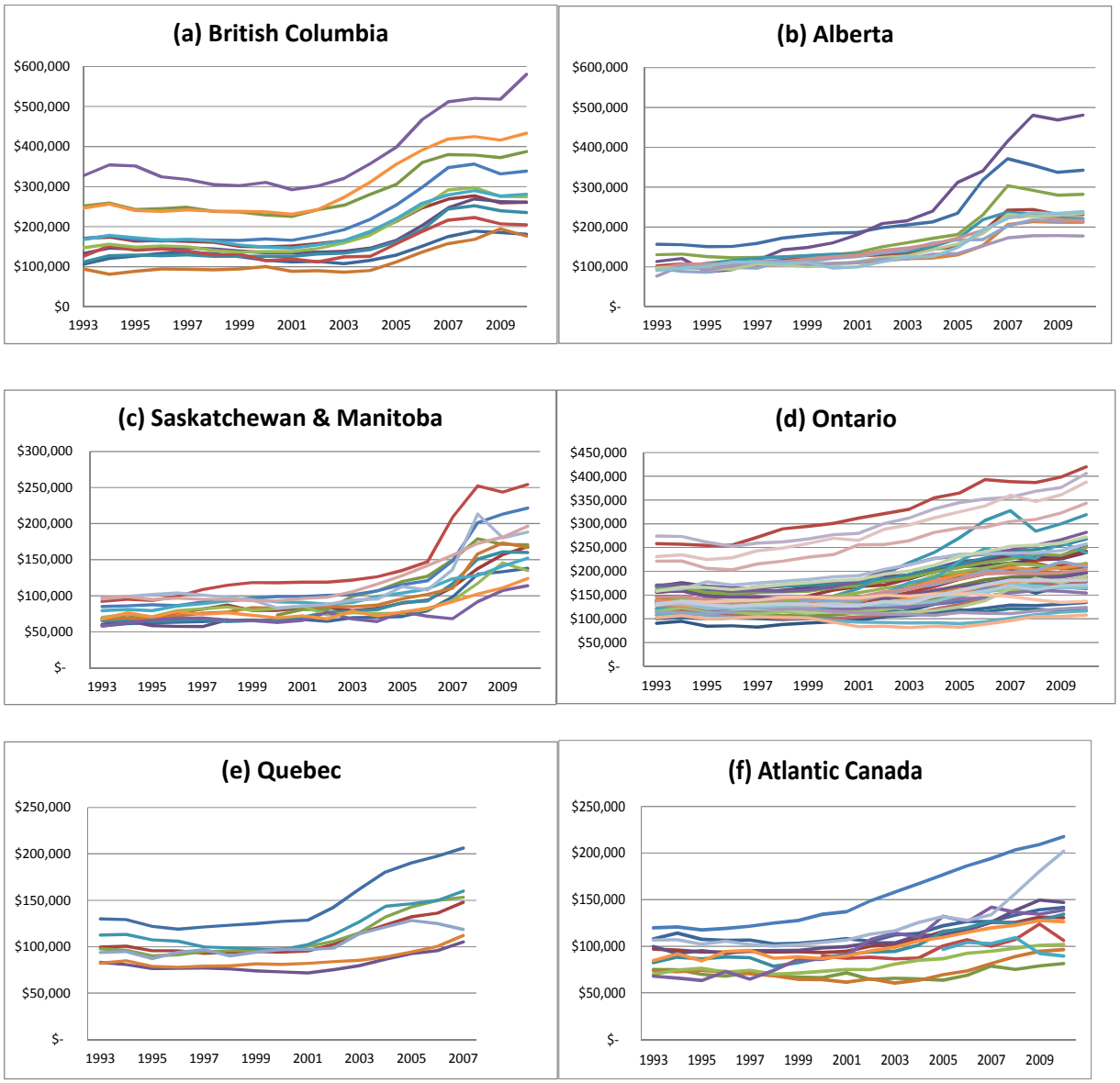
Figure 1. Canadian Average House Price and Births by Women aged 15-49, 1993-2010



Source: Authors' calculations using CREA-MLS data and CANSIM Table Table 051-0001 and Table 051-0004 Statistics Canada

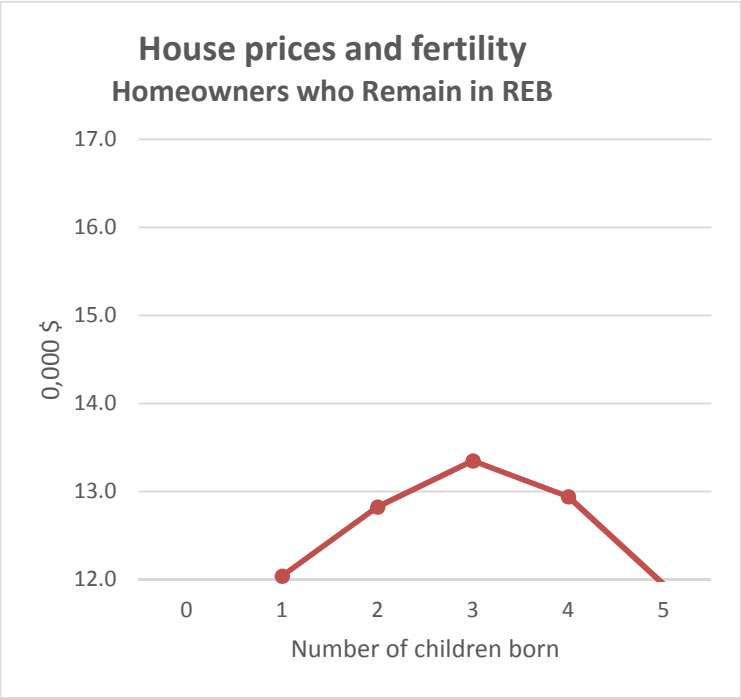
Figure 2. Real average housing price by Real Estate Board*, 1993-2010, by Region



* Each line represents an individual REB average residential house price within the region.

Source: Authors calculations using CREA-MLS house price data.

Figure 3. Average housing price and total number of children born for women who gave birth in the previous year



Source: see Appendix Table 2

Table 1. Summary statistics (by home ownership and moving status)

A. Home Owners and Renters Remaining within Real Estate Board Area (keeping owner/renter status)						
	Owners			**Renters**		
	N	Mean	SD	N	Mean	SD
Child born last year	36,046	0.061	0.240	3,385	0.074	0.262
House price (Real $0,000)	36,046	18.63	11.43	3,385	18.68	11.67
Age	36,046	36.80	4.73	3,385	33.96	5.71
Full Time job	36,046	0.553	0.497	3,385	0.420	0.494
Part Time job	36,046	0.231	0.421	3,385	0.165	0.371
Family income (Real $000)	36,046	71.72	49.51	3,385	39.61	21.42
# Children born	36,046	1.926	1.036	3,385	1.696	1.267
# Bedrooms in home	24,436	3.391	0.819	2,259	2.543	0.914
Provincial UR	36,046	7.70	2.48	3,385	8.05	2.39
Married /CL	36,046	90.3	0.300	3,385	0.750	0.432
Post-Secondary education	36,046	0.220	0.414	3,385	0.119	0.324
B. Home Owners and Renters including movers outside REB (while keeping owner/renter status)						
Child born last year	36,562	0.061	0.239	3,534	0.077	0.267
House price (Real $0,000)	36,562	18.65	11.42	3,534	18.63	11.60
Age	36,562	36.71	4.74	3,534	33.88	5.79
Full Time job	36,562	0.555	0.497	3,534	0.434	0.496
Part Time job	36,562	0.230	0.421	3,534	0.175	0.380
Family income (Real $000)	36,562	70.09	47.86	3,534	40.14	21.42
# Children born	36,562	1.942	1.045	3,534	1.657	1.245
# Bedrooms in home	24,807	3.389	0.826	2,351	2.581	0.890
Provincial UR	36,562	7.70	2.46	3,534	8.04	2.377
Married /CL	36,562	0.884	0.320	3,534	0.741	0.438
Post-Secondary education	36,562	0.218	0.413	3,534	0.134	0.341

Sample: women aged 18 to 45, who are married or live common law in the first year of the panel. SLID (1993-2010)

Table 2. Effect of house prices on marginal fertility of owners
(excluding movers outside REB, p values in parentheses)

	Logit Pooled Cross Section Proportional effect on Odds Ratios			Logit Panel – Fixed Effects Proportional effect on Odds Ratios		
	(1)	(2)	(3)	(4)	(5)	(6)
1-yr lag house price	1.022***	1.016***	1.017	1.009	1.067*	1.047
($0000)	(0.000)	(0.000)	(0.173)	(0.619)	(0.092)	(0.682)
# of bedrooms			1.188**	--	--	1.162
			(0.035)			(0.758)
# bedrms x lag			0.998	--	--	1.005
house price			(0.678)			(0.830)
1-yr lag FT job		0.856*	0.798*		0.642**	0.429**
		(0.076)	(0.054)		(0.150)	(0.020)
1-yr lag PT job		1.012	1.040		0.844	0.560
		(0.892)	(0.740)		(0.509)	(0.128)
1-yr lag real family		1.001	0.999		0.994**	0.994*
income (x $000)		(0.514)	(0.463)		(0.042)	(0.083)
Married /CL		1.392**	1.467**		1.995	2.197
		(0.021)	(0.022)		(0.137)	(0.513)
Previous # of children		0.571***	0.556***		0.00005***	0.00001***
		(0.000)	(0.000)		(0.000)	(0.000)
Post-Sec. education		1.735***	1.664***		--	--
		(0.004)	(0.000)			
Age	0.806***	0.831***	0.832***		--	--
	(0.000)	(0.000)	(0.000)			
Provincial UR	0.964**	0.977	0.985	0.899	0.876	0.816
	(0.013)	(0.112)	(0.201)	(0.118)	(0.285)	(0.164)
Year effects	YES	YES	YES	YES	YES	YES
Observations	35,453	35,453	23,925			
Number of Individuals				7,545	7,424	4,631
Pseudo R^2 or Chi^2	0.136	0.177	0.175	342.5	437.6	345.41

Dependent variable is an indicator for "child born last year".
REB clustered robust SE in models (1)-(3) and replicated bootstrapped standard errors clustered to REB in models (4)-(6)
CL stands for common law
(*), (**) and (***) indicates that the coefficient is significant at 10%, 5% and 1% level, respectively.

Table 3. Effect of house prices on marginal fertility[1] of renters.
(Excluding movers outside REB, p values in parentheses)

	Logit Pooled Cross Section Proportional effect on Odds Ratios		Logit Panel – Fixed Effects Proportional effect on Odds Ratios	
	(1)	(2)	(3)	(4)
1-yr lag house price ($0000)	1.018**	1.004	1.014	0.985
	(0.033)	(0.549)	(0.798)	(0.959)
1-yr lag FT job		0.686		0.428
		(0.165)		(0.211)
1-yr lag PT job		1.096		0.791
		(0.689)		(0.713)
1-yr lag real family income		1.004		1.019
(x $000)		(0.284)		(0.428)
Married /common law		2.042***		1.579
		(0.005)		(0.817)
Previous # of children		0.808**		0.0004
		(0.023)		(0.562)
Post-Sec. education		0.960***		
		(0.359)		
Age	0.872***	0.878***		
	(0.000)	(0.000)		
Provincial Unemployment	0.956	0.960	1.077	0.922
	(0.248)	(0.359)	(0.721)	(0.854)
Year effects	YES	YES	YES	YES
Observations	3,297	3,297		
Number of Individuals			768	763
Pseudo R^2 or $Chi^2(19)$	0.086	0.105	21.35	26.42

Dependent variable is an indicator for "child born last year".
REB clustered robust SE in models (1)-(2) and replicated bootstrapped standard errors clustered to REB in models (3)-(4)
CL stands for common law
(*), (**) and (***) indicates that the coefficient is significant at 10%, 5% and 1% level, respectively.

Table 4. Effect of house prices on marginal fertility of owners and renters
(Including movers outside REB, p-values in parentheses)

	Homeowners		Renters	
	1-yr lag house price	**Year Effects**	**1-yr lag house price**	**Year Effects**
Pooled Cross Section([1])				
(1) Logit – Proportional effect on Odds Ratio	1.016***	YES	1.005	YES
	(0.000)		(0.484)	
(2) LPM Coefficient	0.001***	YES	0.00016	YES
	(0.000)		(0.750)	
(3) Linear 2SLS coefficient([2])	0.001**	YES	0.00034	YES
	(0.039)		(0.725)	
Panel ([3,4])				
(4) Logit FE - Proportional effect on Odds Ratio	1.050	YES	1.024	YES
	(0.153)		(0.713)	
(5) Linear FE Coefficient	0.002**	YES	0.002	YES
	(0.030)		(0.277)	
(6) Linear 2SLS FE Coefficient([2])	0.016	YES	0.421	YES
	(0.528)		(0.740)	

Dependent variable is an indicator for "child born last year".

REB clustered robust SE in models (1)-(3) and

([1]) Models (1) – (3) include control for Provincial Unemployment, 1year Lagged Real Family Income, Number of Previous Children and indicators for 1year-Lagged Full Time and 1year-Lagged Part Time job, Married/Common law, Age and Post-secondary Education, unless otherwise specified.

([2]) The first stage of 2SLS models (3) and (6) regress lagged house price on lagged house price at woman's initial REB and on the controls used in the second stage estimation,

([3]) Models (4) – (6) use replicated bootstrapped standard errors clustered to REB.

([4]) Models (4) – (6) include controls for Provincial Unemployment, 1year Lagged Real Family Income, Number of Previous Children and indicators for 1year-Lagged Full Time Work Status, 1year-Lagged Part Time Work Status, Married/Common Law indicator and individual fixed effects.

(*), (**) and (***) indicates that the coefficient is significant at 10%, 5% and 1% level, respectively.

Table 5. Suggestive Evidence on Completed Fertility, and Increasing Time Lag. Proportional effects on fertility odd ratios of owners[1]

(Excluding movers outside REB, p values in parentheses)

	Single/Multiple Age Interaction Terms Logit Pooled CS		Single/Multiple Age Interaction Terms Logit Panel FE		Logit Pooled CS Lagged t-2	Logit Panel FE Lagged t-2
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Relative to Age 23-27						
1-yr (2-yr) lag house price	1.005	1.011	1.125**	1.241**	1.019***	1.027
	(0.199)	(0.433)	(0.028)	(0.010)	(0.000)	(0.690)
Age 35 or Older	0.156***		1.098			
	(0.000)		(0.822)			
Age 35 x 1-yr lag hp	1.012**		0.945*			
	(0.037)		(0.068)			
Age 18-22		0.603		0.110		
		(0.422)		(0.641)		
Age 18-22 x 1-yr lag hp		1.078**		1.006		
		(0.029)		(0.988)		
Age 23-27 (reference)						
Age 28-32		0.848		1.875		
		(0.467)		(0.379)		
Age 28-32 x 1-yr lag hp		0.995		0.969		
		(0.767)		(0.575)		
Age 33-37		0.294***		3.388		
		(0.000)		(0.212)		
Age 33-37 x 1-yr lag hp		1.011		0.902		
		(0.476)		(0.129)		
Age 38 up		0.072***		2.741		
		(0.000)		(0.421)		
Age 38 up x 1-yr lag hp		0.997		0.853**		
		(0.849)		(0.030)		
Panel B. Cumulative predicted effect of house prices by age, relative to similarly aged women([1])						
Age 35 up	1.017***		1.063 *			
	(0.000)		(0.081)			
Age 18-22		1.090**		1.249		
		(0.014)		(0.617)		
Age 28-32		1.006		1.203***		
		(0.036)		(0.000)		
Age 33-37		1.022***		1.119***		
		(0.000)		(0.000)		
Age 38 up		1.008		1.059*		
		(0.146)		(0.100)		
Year effects	YES	YES	YES	YES	YES	YES
Regressors as in Table 2 or 5:	As (2)	As (2)	As (5)	As (5)	As (2)	As (5)
Observations	35,453	35,453			27,900	
Number of Individuals			7,424	7,424		4,420
Pseudo R^2 or Chi^2	0.161	0.182	445.7	544.5	137.5	162.1

Dependent variable is an indicator for "child born last year".

Standard errors clustered to REB in models (1)(3)(5) and replicated bootstrapped standard errors clustered to REB in models (2)(4)(6).

([1]) Effect of a $10,000 increase in the price of the house on the marginal fertility of women of a given age

(*), (**) and (***) indicates that the coefficient is significant at 10%, 5% and 1% level, respectively.

Appendix Table 1. Annual Trends in Marginal Fertility

	% children born last year	
	Mean	SD
1995	7.7	(0.072)
2000	6.5	(0.059)
2005	7.6	(0.071)
2010	3.4	(0.035)

Source: SLID 1993-2010, married or Common Law women aged 18-45 in the first year of the panel.

Appendix Table 2. Average house price and fertility for homeowners (Used for Figure 3)

	Average house price (0,000$)					
Total # children born	**By child**		**If no child born last year**		**If child born last year**	
	All	Non Movers	All	Non Movers	All	Non Movers
0	14.95	13.52	14.95	13.52		
1	14.24	12.92	14.28	12.98	13.88	12.04
2	14.43	13.37	14.42	13.40	14.63	12.83
3	14.14	13.25	14.09	13.25	14.84	13.35
4	14.11	12.66	14.04	12.64	15.01	12.94
5	13.63	12.19	13.39	12.21	15.86	11.94

Source: SLID 1993-2010, married or Common Law women aged 18-45 in the first year of the panel. Non Movers refers to homeowners who remained within their REB boundary for all six years of their panel.

Appendix: Full List of 92 CREA Boundaries for MLS and 123 CREA Boundaries for MLS II

MLS I: (1993-2010)

British Columbia: Northern, Chilliwack, Fraser Valley, Kamloops, Kootenay, Northern Lights, Okanagan- Mainline, Powell River, South Okanagan, Vancouver, Vancouver Island, Victoria

Alberta: Calgary, Central Alberta, Edmonton, Fort McMurray, Grande Prairie, Lethbridge, Lloydminster(AB), Medicine Hat, North Eastern Alberta, South Central Alberta, Alberta West

Saskatchewan: Battlefords, SE Saskatchewan, Lloydminster (SK), Moose Jaw, Prince Albert, Regina, Saskatoon, Swift Current, Yorkton

Manitoba: Brandon, Portage La Prairie, Thompson, Winnipeg

Ontario: Bancroft, Barrie, Brantford, Cambridge, Chatham Kent, Northumberland Hills, Cornwall, Georgian Triangle, Grey Bruce Owen Sound, Guelph, Hamilton-Burlington, Huron Perth, Kawartha Lakes, Kingston, Kitchener-Waterloo, London and St Thomas, Muskoka& Haliburton, Niagara Falls - Fort Erie, North Bay, Oakville-Milton, Orillia, Ottawa, Parry Sound, Peterborough & the Kawarthas, Quinte, Sarnia-Lambton, Sault Ste. Marie, Simcoe, Southern Georgian Bay, St. Catharines, Sudbury, Thunder Bay, Tillsonburg, Timmins, Toronto+Brampton, Durham Region, Mississauga, Orangeville, York Region, Welland, Windsor-Essex, Woodstock-Ingersoll

New Brunswick: Fredericton, Moncton, Northern New Brunswick, Saint John

Nova Scotia: Annapolis Valley, Cape Breton, Halifax-Dartmouth, Highland, Northern Nova Scotia, South Shore, Yarmouth

Prince Edward Island

Newfoundland & Labrador

Yellowknife

Yukon

MLS II: (2005-2010)

Victoria: Victoria, Oak Bay, Esquimalt, View Royal, Saanich East, Saanich West, Sooke, Longford, Metchosin, Colwood, Highlands, North Saanich, Sidney, Central Saanich, Gulf Islands

Vancouver: Burnaby, Coquitlam, Delta, Maple Ridge, North Van, New Westminster, Port Moody/Belcarra, Port Coquitlam, Richmond, Van East, Van West, West Van/Howe Sound

Fraser Valley: North Delta, North Surrey, Surrey, Cloverdale, White Rock+District, Langley, Abbotsford, Mission, Chilliwack

Calgary: North West, North East, South West, South East

Edmonton: Northwest, North central, Northeast, Central, West, Southwest, Southeast, St. Albert, Sherwood Park

Regina: Area 1, Area 2, Area 3, Area 4, Area 5, Area 6

Saskatoon: Area 1, Area 2, Area 3, Area 4, Area 5, Area 6, Area 7, Area 8, Area 9, Area 20

London/St.Thomas: London East, London North, London South, Middlesex County, Elgin County, St. Thomas, Strathroy

Hamilton: Hamilton West, Hamilton Centre, Hamilton East, Hamilton Mountain, Burlington, Dundas, Ancaster, Stoney Creek, Grimsby

Toronto: Central, East, North, West

Ottawa: Area A&B, Area C&D, Area E&F, Area G&H, Area I, Area J, Area K, Area L, Area M, Area N, Area O

Saint John: Grand Bay Westfield, West & Musquash, North Saint John, East Saint John, Rothesay & Quispamsis, Hampton and Sussex, Kingston Peninsula, Other Areas, City Centre and South, Charlotte County

Halifax: Areas 1/2/3/4, Areas 5/6, Areas 7/8/9/40, Areas 10/11, Areas 12/13, Areas 14/30, Areas 15/16/17, Areas 20/21, Area 25/26, Area 31/35

St. John's: Conception Bay North, Conception Bay South, East Extern, Mount Pearl, St. John's, Southern Shore, All Other Areas

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The Editor

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