THE ROLE OF HOUSING COSTS IN FAMILY FORMATION: AN INSTRUMENTAL VARIABLE APPROACH

By

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***Abstract***

*This senior undergraduate thesis explores the relationship between the United States’ rising housing costs and declining fertility rates. To establish a causal relationship between housing costs and fertility, this analysis utilizes an instrumental variable (IV) regression design, using the variation in land-use regulations at the local level as an instrument for home value and rent. This thesis relies on metropolitan statistical area (MSA)-level data from the United States Census and the Wharton Residential Land Use Index (Gyourko, Hartley, & Krimmel, 2019). This analysis finds that the increase in housing costs, through increases in home values and increases in monthly contract rent, results in a statistically significant reduction in the number of children in the household. A $500 increase in rent is associated with a 0.1165 decrease in the number of children in the household. A $1,000 increase in home value is associated with a -.000317 decrease in the number of children in the household.*

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**Chapter 1: Introduction and Background**

**Introduction**

Research on housing as a potential policy tool for shifting national fertility rates is still in its infancy. This context provides an exciting opportunity for researchers to further explore the role of housing and land-use policy in family fertility decision-making, while producing data that can be used to craft evidence-based pro-natalist policy in the future.

This honors thesis examines the relationship between land-use regulations, increasing housing costs, and the declining fertility rate in the United States using an instrumental variable (IV) regression design. It builds off a large literature providing observational data and correlations between the relationship between housing costs and fertility rates. However, this will use quantitative methods to estimate causal relationships and focuses specifically on land-use policies as a driving force of increased housing costs. This not only establishes causality and disaggregates housing costs from other potential causes for decreasing fertility; but it also provides a policy framework for future reforms.

**Key Question**

This thesis seeks to answer the following question: do increased housing costs in metropolitan regions, because of restrictive land-use regulations, decrease fertility rates in those metropolitan regions? This paper analyzes land-use data and American Community Survey (ACS) data from the 50 largest (by population size) metropolitan areas in the United States to estimate the relationship between housing costs and fertility decline.

**Background**

Increase in Housing Costs

The median sale price of a home in the United State has risen from $219,000 in 2009 to $274,900 as of 2021 (prices adjusted for inflation). This reflects that housing prices have dramatically increased since 2001 when the median sale price of a home was $171,000 (US Census Bureau). In 2020, housing expenditures increased 3.5% (Bureau of Labor Statistics, 2021). In high housing cost states like California, 53.9% of renters are considered “rent-burdened”, meaning they spend over 30% of their monthly income on housing costs. Even in lower-cost states, such as Texas, 45.2% of rents are cost-burdened (Joint Center for Housing Studies, 2021). Notably, this increase in housing costs has been widespread throughout the United States, and it has only sped up since the beginning of the COVID-19 pandemic (Hermann, 2021). This increase in housing expenditures has also been true of both homeowners and renters, potentially offsetting the financial benefits of homeownership *and* raising the barriers for entry into homeownership for young families.

The issue of increasing housing costs has been covered extensively in the popular press. The New York Times published an article in June 2021 claiming that an affordable housing crisis is underway. Dougherty and Thrush (2021) point to a lack of housing supply as a primary driver of increased housing costs. This follows the classical economic logic that as supply decreases (or remains stable) while demand continues to increase, prices will inevitably rise. This increase in housing costs cuts across all income levels; however, lower-income Americans are most negatively affected. When supply remains stable but demand continues to rise, low-income Americans must compete with higher income individuals for the same housing stock.

The Role of Land Use in Housing Costs

One potential cause for American cities’ low supply of housing is land-use policy, or zoning laws. Zoning encompasses a broad range of land-use regulations that determine the use, size, shape, and appearance of buildings. The most common residential zoning in much of the United States is “R1” zoning. R1 zoning only permits low-density, single family detached homes. Outside of formal zoning, other regulations exist, including parking minimums, maximum height limits, setback requirements, and minimum lot sizes. R1 zoning, as well as the previously mentioned regulations, typically increase the amount of land buildings must use. This reduces the supply of both land and housing, which potentially increases the cost of housing.

There is compelling evidence that exclusionary zoning increases the costs of housing. The empirical data on this relationship is broad and varied. Rothwell (2008) finds that upwards of 20% of variation in metropolitan housing growth is attributable to anti-density regulation, and that these same regulations inflate housing prices during demand shocks. Quigley and Raphael (2003) find that every additional land-use regulation in California increases the prices of owner-occupied housing by 4.5% and increases the price of rental housing by 2.3%. Glaeser and Gyourko (2005) exploits gaps between housing and construction costs to determine the role that land-use regulations play in increased housing costs in several metropolitan areas in the US. They argue that these regulations play a significant role in the inflation of housing costs, especially in New York City. Ihlanfeldt (2003) conducts a broad review of the literature on the association between land-use regulations and housing costs and finds mixed, but compelling, evidence that exclusionary zoning increases the cost of housing.

Fertility Trends

Fertility rates across the United States, as well as across Western developed nations, have been steadily declining for decades. The US reached its lowest Total Fertility Rate (TFR) in 2020 at 1.64 children per 1,000 women, which was a 4% decline in fertility from the previous year (Hamilton, et. al., 2021, p, 2). Much of this decline can be attributed to positive changes in women’s educational attainment, increased access to contraception, and a decline in adolescent pregnancies. However, declining fertility has become a policy concern due to its implications for long-term economic growth and dynamism.

A range of factors influences fertility, including the recent COVID-19 pandemic that may have acted as a “shock” on fertility rates. However, the 2020 TFR reflects the broader trend of declining fertility rates. Even without the “shock” of the pandemic, fertility rates were likely to stay on the same trajectory.

Another demonstration of lowering fertility is what is referred to as the “fertility gap”, or the difference between the stated preferences of mothers and the number of children these women have. The most recent estimates indicate that the average number of children women say they want to have is 2.7, while complete fertility averages out 1.8 (Beaujouan & Berghammer, 2019) (Stone, 2019). This gap has been getting consistently larger, suggesting that external factors other than personal desires are influencing the declining birth rate (Stone, 2018).

**Significance for Public Policy**

The United States’ declining fertility rate could potentially have long-term impacts on its domestic economy, innovation, and the social welfare state. A declining fertility rate means a shift in the national age distribution. This means more older people who are less likely to work; have higher healthcare costs; and will likely receive Social Security benefits. The increased costs of caring for an aging population will burden a smaller and smaller portion of working-age younger people.

These concerns appear as the United States faces a fiscal crisis with Social Security benefits (Social Security Office, 2010). The nature of the US Social Security system is necessarily harmed by a decrease in the working-age population. Young people pay into Social Security in the hopes to receive that same money in the future to cover the costs of old age. However, as the working-age population declines, the Social Security office’s future becomes more tenuous. Fears about Social Security going bankrupt have loomed in political discourse, especially from members of the Republican party, but a declining fertility rate may accelerate these concerns. The implications of the declining fertility rate for Social Security are already being felt. The age of Social Security recipients has been steadily increasing and the number of working-age adults has been decreasing, largely as a function of the declining fertility rate (Congressional Research Service, 2019).

Even beyond Social Security, the majority of the US welfare state is directed towards the elderly (Sheiner, 2018). Declining fertility rates necessarily reduce the number of working age individuals, shifting the age distribution further up. This causes increasing strain on the American welfare state, with the program either running on a tighter budget (and likely reducing service provision) or increasing taxes on a smaller and smaller working age population. Furthermore, increasing healthcare costs and lowered productivity growth will further this strain on the federal budget (Sheiner, 2018).

Preference Satisfaction

The fertility gap could have potentially large impacts on broader social welfare. If parents believe that having the family they want is financially, socially, or functionally out of reach, that could have significant impacts on mental health and marital wellbeing. A recent New York Times survey found that the driving forces for this fertility gap are economic considerations, including broad unaffordability, as well as the costs of childcare, lack of paid family leave, and worries about the economy (Miller, 2018). While housing is not directly mentioned, alleviating the costs of housing could make it easier for parents to meet their fertility goals.

Why housing?

As birth rates have declined across developed countries, a range of pro-natalist policies have been implemented. According to the United Nations, in 1976, only 10% of countries had explicitly pro-natalist policies, while in 2015, that share jumped to 28%. Japan is notable for its exceptionally low fertility rate (1.26 TFR), and the government has responded with policies aimed at improving work-life balance, with some localities offering direct subsidies for childcare, housing, and health care (Timsit, 2019). Poland’s “500+” program provides tax benefits for each additional child families choose to have; however, its effectiveness has been hotly debated, and the additional benefits may have adverse effects on female labor force participation (European Commission, 2018). Other national programs have included the “baby box” in Finland, which expanded parental leave, free childcare services, and even free parking for mothers (Wamsley, 2020) (Poon, 2018).

The results of pro-natalist policies have been mixed. Research studying the impacts of Singapore’s pro-natalist policies found them to be effective (Park, 2005), while research on Central and Eastern European policies found them to only be modestly effective at raising birth rates (Brainerd, 2014). As Lyman Stone, an adjunct fellow at the American Enterprise Institute argues, pro-natalist policies *can* be effective, but they typically require large government expenditures (Stone, 2020). Stone’s conclusions align with earlier academic surveys of pro-natalist policies, finding that effective pro-natalist policies appeared to be expensive and continuous (Hohn, 1988).

The reason to analyze the relationship between land-use policy, housing costs, and fertility, then, becomes apparent. If land-use deregulation, which then increases the supply of housing and reduces overall housing costs, can potentially encourage higher fertility rates, this will become a much more desirable option for governments to pursue. A pro-natalist policy focused on housing could potentially be substantially less costly than traditional pro-natalist policies, while also having other positive spillover effects in economic growth, economic opportunity, and broad housing affordability.

Housing is also an easy target because it is the largest constraint on family budgets in the United States. According to the US Bureau of Labor Statistics, the average US household spends 33.1% of their annual income on housing. The second largest expense is transportation at 15.9% of average annual spendings (BLS, 2021). Household expenditures on housing increased 5.3% between 2020 and 2021, continuing to further constrain household budgets. In theory, loosening the constraints on family budgets would potentially allow for parents to more easily have the number of children they desire. As the Niskanen Center’s Matthew Yglesias concisely points out, “the scarce supply of housing in these [American] cities is itself a cause of slow population growth because it greatly raises the costs...of having additional children” (2020, p.185).

The increasing cost of housing coincides with a general pattern of higher costs of living across the board in the United States. Middle class incomes have been largely stagnant the past few decades, while daily living costs on housing, education, health care, and child care have also been increasing (Erickson, 2014). Childcare in particular has been noted for its potential connection to a declining birthrate, as child care now accounts for 10% of household budgets on average (US Census Bureau, 2019). Each of these expenses puts a strain on household budgets, but housing costs still remain the single largest cost for households. Any policy that attempts to improve the lives of middle class families by reducing the cost of living *must* take housing into account.

Beyond narrow economic considerations, housing also influences fertility due to its cultural and personal significance. Housing policy is not only about financial decisions; instead, it should encapsulate the deeply personal relationships people have with the places they live. The home is the context in which much of family politics and family decision-making occurs, as well as the intimate details of the day-to-day lives of families. As such, the “home” is often central in family planning decisions (Mulder & Lauster, 2010).

To illustrate this point, one can easily imagine many scenarios that might influence a family’s decision to have a first kid or an additional child. One couple may choose to move into a home with an additional bedroom in anticipation of having a future child, while another couple may decide not to have an additional child because their own three children are already sharing a bedroom. A couple without children who face unstable housing through rising rents and eviction notices may decide that the instability is inhospitable to raising a child, even if raising children were their natural preference. Even financially stable, upwardly mobile individuals may choose to offset childbearing until later, not even due to financial insecurity, but because the American family “ideal” is deeply tied to suburbia (Miller, 1995). These personal and immaterial details are often missing in high-level policy analysis, but they are crucial for understanding family planning behaviors.

Beyond the physical characteristics of the home itself, other aspects related to housing may also influence childbearing. Concerns about neighborhood safety may incentivize families to accept higher housing costs to avoid higher crime neighborhoods. Additionally, educational quality is an important determinant of where families choose to live. The relationship between school quality and housing prices is well-documented, and the literature indicates that many homebuyers place a premium on quality education (Machin, 2011) (Mitchell, 200). Furthermore, the perceived or even real instability of rental housing may act as a deterrent to childbearing, especially in the American context where “no fault” evictions are accepted (Desmond, 2016). The negative associations with renting, combined with American ideals of homeownership as the appropriate context for childrearing, may discourage fertility among current renters (Mulder & Billari, 2010).

**Defining Terms**

Throughout this thesis, certain terms relevant to the question stated above will be used. For the sake of clarity, I will be defining them and how I use these terms in my thesis. Firstly, *housing costs* are understood broadly, and I will be measuring housing costs along several dimensions: home value for homeowners and monthly rent payment for renters. *Land-use regulations* refer to state and local regulations on how land can be used. These regulations include restricting the type of building that can be on that land; the minimum or maximum size of the building; how dense construction can be on the land; minimum parking lot requirements; affordable housing requirements; and the procedural requirements for constructing on a given parcel of land. *Fertility* is defined as the number of children an individual has during their lifetime, but not how many they may intend to have or how many they adopted. Finally, *metropolitan regions* are defined as Metropolitan Statistical Areas, which are delineated by the US Office of Management and Budget (OMB). They are urbanized areas with a minimum of 50,000 people and include the urban core, as well as surrounding communities, which are linked together by social and economic factors (US Census Bureau, 2021).

**The Chapters that Follow**

Chapter 2 provides the conceptual framework and literature review for this thesis, including the extensive literature on fertility decline and home prices. Chapter 3 details the data sources used to conduct this research, as well as the methodology used to ensure robustness and causality. Chapter 4 includes summary statistics, statistical analysis results, and explanations for each regression result. Finally, chapter 5 provides potential recommendations for policymakers, as well as underexplored questions researchers should pursue in the future in this literature.

**Chapter 2: Literature and Concepts**

**Literature Review**

A long literature exists examining the relationship between wealth, income, and fertility rates. A similarly large literature attempts to understand the connection between class and family formation, specifically the role of marriage, childbirth, and childcare within families across class lines. The existing literature on the interrelationship between housing costs and fertility rates has not addressed the issue of class. Similarly, while some literature exists connecting land use and fertility, the research is sparse, and more work should be done to refine methods and parse out potential omitted variable bias.

Housing Wealth & Fertility

Those who have analyzed the impacts of housing wealth have primarily focused on homeowners. Some research has found that positive wealth shocks in housing has a positive correlation with a percentage increase in the likelihood that a family will have a child, and that this relationship is becoming increasingly more responsive over time (Lovenheim & Mumford, 2013). Other research has taken a broader scope by conducting cross-regional analysis, comparing the fertility rates of those living in high housing cost areas, finding that high housing cost cities are negatively correlated with fertility rates (Florida, Mellander, King, 2020). This research also finds that women in high housing costs areas delay the time of childbirth further than other women, potentially reducing the window of time in which she will be able to conceive.

For non-homeowners, increases in housing prices have a negative impact on birth rates (Dettling & Kearney, 2014) (Lovenheim & Mumford, 2013). The disparate impact on housing prices between homeowners and renters has been noted in the literature; however, little research has been conducted specifically on renters. Even more so, there is a lack of research on low-income renters.

Economics may also play a role in *when* women will be most likely to have children. Low-income individuals, who may not have homeownership, or even stable rental housing, as expectations may respond differently to housing cost changes. Instead of delaying childbirth based on milestones, low-income women may be more likely to have children based on their own desire to have children. This is potentially a rational decision in response to the constraints low-income women face in the housing market, as well as how they analyze the opportunity cost of having children. They may also be more susceptible to unintended pregnancies due to reduced access to contraceptives, further making their fertility rates less responsive. On the other hand, low-income people may be particularly susceptible and vulnerable to housing costs shocks, making fertility rates more responsive. As such, the causal impacts of housing cost increases on low-income women’s fertility is unclear and needs further exploring by researchers.

Ongoing debates persist over the *causality* of the relationship between high housing costs and low fertility. Instead, some suggest that what is occurring is demographic sorting, where those who are less likely to have children are more likely to live in high-cost areas (Florida, 2018). This idea builds off literature that rather than decreasing overall fertility, women in high-cost areas are more likely to be well educated, further increasing the likelihood that they delay fertility into their 30s (Clark, 2015) (Dettling & Kearney, 2014).

Land Use and Fertility

There is very little previous research on the role of land use in fertility decisions. Shoag and Russell (2018) find a broadly negative correlation between increased land use restrictions and fertility rates. They find that, more specifically, increased land use regulations reduce fertility for teenagers and women in their early 20s, while they are associated with increased fertility for older women; however, they have an overall negative effect. Policies that increase the age at which women begin childbearing may have an overall negative impact on fertility. As such, it is significant that Shoag and Russell find that adult women in their early 20s are having fewer children as this reduces their overall timeframe for childbearing.

Aksoy (2016) studies the impacts of refusal to build new housing in UK localities (acting as a proxy for land use restrictions) to connect increased housing costs and lowered fertility. The research found that reductions in housing construction, and the associated rise in housing costs, caused a 4.9% decrease in births among renters and 2.8% increase in births among homeowners.

Gaps in the Literature

More research needs to be done to better understand the relationship between high housing costs (as caused by land use regulations) and fertility rates. Questions still remain as to how long these effects will remain. Furthermore, the existing literature lacks a comprehensive approach to heterogeneous effects of land use restrictions. This thesis seeks to better understand not only the fertility effects on homeowners and renters, but also on low-income households, racial minority households, and immigrant households.

**Conceptual Framework**

Economic Analysis of Fertility

My analysis is heavily influenced by the work of Gary Becker, specifically his 1960 paper, *An Economic Analysis of Fertility.* Becker applies an economic model for understanding fertility decisions, understanding children as “normal goods” within the family. This conceptual framework has two implications. Firstly, households have a tradeoff between “quantity” and “quality”. For wealthy households, they may have fewer children but dedicate more resources to that child, making each child more resource-intensive. Secondly, and more relevant to this analysis, if children are “goods” in some sense, then decisions surrounding childbearing face economic constraints. If a household budget is severely constrained by housing costs, it then follows that the number of children they choose to have may drop. Furthermore, if each square foot becomes progressively more expensive, having more children may become even more cost-prohibitive as it typically requires more household space.

Demographic transition theory

Simultaneously, one of the most widely accepted theories in the social sciences is the *demographic transition theory.* The theory was first coined and refined by demographer Frank Notestein (Notestein, 1953), and the theory has been corroborated and further refined by researchers in the future. Essentially, the theory posits that pre-industrial societies are defined by high birth rates and high rates of death (due to war, famine, and disease). As countries grow wealthier, their deaths begin to decline, but births will still remain high for a substantial amount of time. However, as countries enter the late stages of demographic transition, their birth rates will also begin to fall, and overall population growth will likely also fall (Notestein, 1953). The rate at which the demographic transition occurs may vary between countries, but the overall trend from high-birth, high-death to low-birth, low-death remains steady.

Building off of the original demographic transition theory, a *second* demographic transition (SDT) was proposed by Lesthaeghe and van de Kaa (1986). This development incorporated a more contemporary analysis of changes in fertility and mortality. Furthermore, it rejected the first demographic transition theory’s proposal of an endpoint equilibrium with replacement-level fertility, stationary populations, and life expectancies just over 70 years of age (Lesthaeghe, 2014). SDT argues that biomedical advancements in contraception technologies and cultural value shifts in regards to gender, marriage, and sex have led to sustained subreplacement level fertility rates and an aging population (Lesthaeghe, 2014). This analysis indicates that a full range of factors beyond just economic or material interests are at play when analyzing fertility decisions.

Becker’s rational choice analysis of fertility and demographic transition theory are not in contradiction. The causes of the demographic transition are the result of rapidly developing economies demanding new schools and forms of labor from citizens. An industrializing country, for example, is likely to value highly educated individuals who can innovate and develop new technologies to further economic growth. This shifts the family “budget” as formal childhood education becomes a new, and increasing, cost on families. Furthermore, unlike in agrarian societies where children often acted as forms of labor for the family, children were less likely to have the time to contribute in these ways, reducing the strict economic value they may have provided parents.

This is where Becker's “quality-quantity” tradeoff becomes clear. Children begin to cost more to allow them to become members of society. Increasing levels of both compulsory and expected education; parental occupational shifts pushing families into urban centers; and the decline in childhood mortality allowed families to dedicate more resources to an individual child (Lee, 2016). Each additional child increases the marginal cost of childrearing, incentivizing many parents to reduce fertility and focus on the few children they do have. In terms of housing, this would include additional square footage or extra bedrooms. It may also include an interest in moving to areas with the “best” educational programs or the least amount of crime, potentially pushing families into areas with higher housing costs.

This paper synthesizes past work analyzing the relationship between housing costs and fertility rates; however, it incorporates a heterogeneous effects approach. Building off research indicating that low-income women delay marriage and begin motherhood regardless, largely due to real and perceived economic and cultural barriers to successful marital relations, low-income women make similar decisions regarding housing (Edin & Kefalas, 2005). Low-income women often highly value marriage, but the realities of poverty make marriage potentially less viable. Additionally, the US tax code disincentivizes marriage, such as low-income individuals receiving *less* from the Earned Income Tax Credit (EITC) after they are married. These realities include criminal activity, criminalization, substance abuse, and adultery. The improbability of marriage, alongside distinct courtship patterns where fathering a child, is perceived as an act of love, leads to a decoupling between marriage and childbirth for low-income women (Edin & Kefalas, 2005). This poses potential risks that a housing-focused pro-natalist policy would inequitably improve outcomes for higher income women rather than lower income women.

Poverty, Homeownership Regimes, & Fertility

*Homeownership regimes* are built on normative claims of the value of homeownership, but these normative claims are not equally distributed within the population. If class stratification prevents portions of the population from owning a home, or even having the *expectation* of ever owning a home, these normative claims fall to the wayside. In a similar manner as the marriage example above, homeownership becomes decoupled from childbirth.

For low-income women, owning a home, and potentially having stable rental housing, is *not* a prerequisite to childbirth. Under the Financial Expectations and Family Formation theory (Gibson-Davis, 2009), low-income couples delay marriage because of its association with a level of economic stability they have not attained, but they do not delay childbirth because it is an assumed part of the lifecycle, so childbirth is not as constrained by financial status. This dynamic indicates that low-income women’s fertility may be *less* affected by rising housing costs and that low-income women may pursue childbearing regardless of economic circumstances caused by the budget constraints of housing.

Implications of this Framework

This premise has implications for researchers who attempt to understand the relationship between housing costs and fertility rates. Under traditional economic models, children act as a *normal good*, so an increase in housing wealth (whether in the form of increased home equity for homeowners, a decrease in rents for renters, or a housing voucher for voucher recipients) should lead to an increase in childbirth. This model for low-income women; however, implies that low-income women may be responding to different incentives. This is not to say they are not rational actors, or that rational choice theory does not apply, but that traditional economic models may be insufficient for understanding the relationship between housing costs and fertility for low-income women. There may be a minimum threshold of housing security and access required before individuals begin to take housing prices into account for childbearing.

This theoretical model also has implications for policymakers. As pro-natalist ideas begin to circulate in policy and political circles, and as policymakers consider potential solutions for below replacement-level birth rates, the realities of low-income women’s decision-making processes should be considered. An inability to recognize these realities can potentially produce ineffective or morally dubious policy. If women’s fertility decision-making processes are less responsive to housing prices than previously assumed, public monies spent trying to encourage increased fertility are potentially wasted. Furthermore, if low-income women are particularly unresponsive to housing cost changes, then any policy attempting to encourage increased childbirths would be potentially inequitable, favoring higher earners over low-income women. This scenario may not be disastrous, but it may be an inefficient use of public tax dollars being primarily spent on high earners, rather than the mothers who need it most.

Chapter 3: Data and Methods

**Research Design**

Quantitative

This thesis utilizes an instrumental variable (IV) design. This design is modeled after previous research utilizing IV design to exploit planning restrictions as instruments to examine the causal impact of housing prices on fertility (Askoy, 2016). This analysis will use land-use restrictions in particular to exploit exogenous variation in housing costs. Land use is a useful instrument as it is unlikely that relatively obscure and technical policy changes would directly affect the decisions families making about childbearing. However, land-use regulations *do* decrease the supply of housing units, create a preference for the construction of more expensive, single-family units, and increase the costs of development by creating a more arduous and lengthy development process. This, in turn, increases the overall costs of housing. First stage regressions demonstrating the relationship between housing costs and land-use regulations are provided in Chapter 4.

In contrast to previous research that utilizes IV regressions, this design also looks closely at the heterogeneous effects these restrictions have on homeowners and renters. It also controls for differences in state housing markets by comparing results for relatively high housing costs states (California) to relatively low housing cost states (Alabama).

**Data and Data Collection**

Data Sources

*American Community Survey*

This thesis utilizes two secondary data sources. The first is the 2019 American Community Survey (ACS) by the US Census and made available to researchers through IPUMS. This data is used for its geographic, demographic, and socioeconomic variables. Included in this are variables for income, monthly mortgage payment, monthly rent, home value census tract location, race/ethnicity, immigration status, age, and the number of children under the age of six. Geographically, I use data from the top 50 metropolitan statistical areas (MSAs) by population size. This data source allows us to track where households with the largest number of children are and how much their housing costs.

*Wharton Residential Land Use Survey Index*

The second data source I use is the Wharton Residential Land Use Survey Index (WRLUI). This index is based on survey data collected in 2018 from different public officials. This index includes information for thousands of localities in the United States. This index has a primary index that indicates the degree of land use regulation severity. This index encompasses a wide range of potential restrictions, including formal zoning rules, density maximums, and parking minimums. WRLUI also provides subindices that indicate the nature of the restriction, including state political involvement, local court involvement, and local political pressure. This dataset allows us to sort our metropolitan areas by degrees of restriction. One category would be highly restrictive (based on the index), moderately restrictive, and mildly restricted. This allows us to see how policy shifts affect fertility within similar contexts. Table 1 outlines each of the WRLUI variables used for this analysis and their associated descriptions.

|  |  |
| --- | --- |
| **Policy Variable Name** | **Description of policy variable** |
| Local Political Involvement Index (LPPI18) | The LPPI measures the degree to which local political processes and organization influence development outcome. This measure includes the influence of formal actors (local councils, managers, and commissioners), as well as local public pressure. It also includes within the index measures of the importance of budget constraints in development approvals and both political and public opposition to population growth. Finally, it includes within it the number of conservation initiatives proposed. |
| Court Involvement Index (CII18) | Local appellate court’s tendency to uphold or restrict municipal land use regulation. |
| Local Project Approval Index (LPAI18) | The LPAI measures how difficult it is for a developer to build a new residential development even when rezoning is not necessary. This includes local planning commission approvals, approvals from elected officials, approval from county-level officials, and requirements for review from design boards, environmental review boards, and public health boards. |
| Local Zoning Approval Index (LZAI18) | Measures whether certain approvals are required for rezoning requests, including from local planning commissions, local elected officials, county-level officials, county zoning board, environmental review boards, and citizen approval. |
| Local Assembly Index (LAI18) | Dummy variable indicating if a local assembly or town meeting is involved in land use regulation. |
| Supply Restrictions Index (SRI18) | The SRI measures whether local governments limit the number of allowable building permits per year for different types of dwellings, including single family, multi-family. It also measures if government restrict the number of allowable dwelling units in a multi-family development, limits on the number of dwelling constructions that can occur each year, and general limits on the number of multi-family dwelling units in a locale. |
| Density Restrictions Index (DRI18) | The DRI measures whether the local government has a restriction on the minimum lot size allowable for development. It includes individual measures for minimum lot size requirements of 1 acre or more or 2 acres or more. |
| Open Space Index (OSI18) | The OSI is a dummy variable indicating if developers are required to supply open space with their development project *or* pay a fee in lieu of compliance. |
| Exactions Index (EI18) | The EI is a dummy variable indicating if developers are required to pay a fee for building or infrastructure improvements in order to build their own development plan. |
| Affordable Housing Index (AHI18) | A dummy variable indicating if developers were required to build affordable housing in order to build their own development projects. |
| Approval Delay Index (ADI18) | The ADI measures how long project approval takes, accounting for the length of residential review for multi-family and single family developments; rezoning application time; and subdivision approval time. |

Table 1. Each policy variable used as an instrument for this analysis and its description. Information for this table is provided by Gyuorko, Hartley, & Krimmel (2019) <https://real-faculty.wharton.upenn.edu/gyourko/land-use-survey/>.

Relevant Variables

My thesis uses a range of demographic, geographic, socioeconomic, and policy variables. Variables relating to household-level information are sources from the ACS and include: *incwage*, which documents the household’s annual income; *nchild,* which is the number of children in the household; *age,* which is the age of the head of household; *race*, which is a categorical variable for the self-identified race or ethnicity of the head of household; and *immigrant*, which is a binary variable for whether or not the interviewee immigrated to the US or not.

My thesis uses two variables to understand housing costs. The first is *valueh*, which is the appraised value of the home the individual being interviewed occupies, and it is used to understand the role housing costs *and housing wealth* may play in fertility decisions for homeowners. The next is *rent*, which is documented for renters and is the monthly monetary amount of rent they pay. These variables provide multiple perspectives on housing costs in the United States and allow me to disaggregate the fertility effects of high housing costs for renters and homeowners.

Finally, my instrumental variables are policy variables from the WRLUI. To calculate the instrumental variable regression, I use each individual policy variable provided as an instrument. My overall results include all eleven of these variables as instruments, as well as additional regressions I run for individual states (Alabama and California). However, I also run additional IV regressions for home value and rent for *each* individual policy instrument to better understand which land-use restrictions act as the best instrument and are likely driving up housing costs the most.

Within the WRULI dataset are several subindices, which will allow me to disaggregate and determine which types of interventions are likely to have the largest effects on fertility. Each of these variables is described in Table 1. LPPI18 is the Local Political Involvement Index, which refers to the degree that local political actors influence permitting decisions for housing. The CII18 is the Court Involvement Index, which is how involved state and local courts are in restricting land uses. LPAI18 is the Local Project Approval Index, which includes all the permitting and procedural requirements for developers to get a project approved. LZAI18 is the Local Zoning Approval Index, which denotes how many agencies are involved with zoning rule changes. LAI18 is the Local Assembly Index and measure whether a community requires a public hearing or public vote before approving a project. SRI18 is the Supply Restrictions Index and measures whether there are explicit restrictions on the number of new housing units that can be added to the local housing market. DRI18 is the Density Restrictions Index. It is a binary dummy variable where 1 indicates that a community has a minimum lot size requirement and 0 indicates that they do not. OSI18 is the Open Space Index which indicates whether an area requires developers to provide a certain amount of open space for a new project or must pay a fine in lieu of meeting the requirements. EI18 is the Exactions Index which is a binary dummy variable where 1 indicates that developers must cover a certain amount of “costs” associated with a new project and 0 if such fees do not exist. AHI18 is the Affordable Housing Index and indicates the degree to which a community requires affordable housing units be included in new developments. Finally, the ADI18 variable is the Approval Delay Index and indicates, on average, how much of a time lag exists between a project being proposed and being approved.

**Methodology**

My thesis utilizes an Instrumental Variable (IV) regression approach to statistical analysis. I do this in contrast to using a typical ordinary least squares (OLS) linear regression model to account for confounding variables that may be influencing housing costs and fertility rates. For example, individuals less inclined to have any children, or multiple children, may choose to live in areas with higher costs of living. Incorporating the land-use policy instruments allow this model to exploit the variation in housing costs caused by restrictive land-use regulations to better understand the role housing plays in fertility decisions.

The IV design is run using two stage least square (2SLS) regressions. In the first stage, *xk* is regressed on the other independent variables and the instrument, *Z.* This first stage essentially determines the relevance condition necessary for running a valid IV regression. The second stage regresses the new *xk* that excludes the problematic variation from before to determine the final estimates.

The first stage regressions look like this:

The second stage uses the predicted housing cost measure from the first stage,

In this design, the *independent variable* is the cost of housing units; the *dependent variable* is household fertility rates; and the *instrument* is land use regulations. For this thesis, several regressions will be run to analyze the impacts of different “instruments” on housing costs to better understand which regulations would potentially have the largest impacts on fertility. Firstly, for the general analysis, an IV regression is run analyzing the impact of home value on number of children using all the policy variables from the WRLUI dataset as instruments. This is followed by individual IV regressions for each policy to understand which policies appear to be important instruments in the equation. This same analysis is used for the “home value” and “rent” variables to understand the fertility effects for homeowners and renters.

These equations also include 4 controls: race, Hispanic identity, annual income, educational attainment, and states. These controls are at the household level and aggregated to the MSA level. Due to the higher proportion of recent immigrants among self-identified Hispanics, who tend to have higher fertility rates than native residents, Hispanic identity is included to account for this variation. Similarly, we assume that controlling for race will pick up on endogenous variation in fertility, ensuring the results are robust. Educational attainment and annual income are also included to account for the fertility effects of these factors, specifically increased education as potentially slowing or reducing fertility, while income potentially creates endogenous variation as those with higher incomes are less likely to be as sensitive to price changes in housing. Finally, state FIPS are included to account for state fixed effects, as well as to account for some amount of “self-selection” bias that Florida (2018) suggest drives these fertility differences.

The 2SLS regressions are run in Stata, which includes a robustness check in the code to check for heteroskedasticity in the data. The analysis also tests for the strength for the first-stage regression and the F-statistic, whether IV regressions are necessary using the Durbin-Wu-Hausman test, and also tests for overidentification of variables in the IV model using all of the instruments. Manual beta coefficient testing is also conducted to understand the effects of a dollar increase in either rent or home value on fertility. Additionally, the results are magnified for clarity. Instead of measuring rent or home value at the one dollar level, this analysis attempts to reflect how housing prices are likely to shift in practice. As such, we analyze the fertility effects of $500 increases in monthly rent and $1,000 increases in home value.

**Justification**

Valid instrumental variable (IV) design requires two assumptions to be met: the *relevance* condition and the *exclusion* condition. In this analysis, land use regulations have a demonstrable impact on housing costs. As discussed previously, extensive literature exists connecting land-use restrictions with higher housing costs. At the theoretical level, land use restrictions typically reduce the supply of land, and therefore decrease the supply of housing and raise housing costs. This relationship justifies using land-use restrictions as the *Z* variable, as it directly affects *X.*

This IV design also meets the exclusion condition, as land use does not have an obvious direct impact on fertility rates. The policies themselves are often inaccessible to the public, as they are complicated and jargon-laden, so individuals are unlikely to change fertility expectations in response. Furthermore, there is no obvious connection between the two variables - literature on the direct relationship is nonexistent, and no historical connection has been made.

**Strengths and Limitations**

One strength of this approach is the data is highly representative of the US population, making the results generalizable. Furthermore, the analysis includes metropolitan areas from across the United States, allowing the results to better demonstrate the impacts of fertility rates in different urban forms, as well as to control for other factors that might affect fertility (such as proximity to an urban center). This increases generalizability, as well as provides more direct guidance for policymakers in different localities.

A potential limitation of this design is the *Z* variable. Other instruments could potentially be more valid or useful, and there are other variables that might have a greater impact on housing costs. Theoretically, land use could potentially have a direct impact on fertility by encouraging land uses that allow for more and fewer children. Simply put, dense land use regulations potentially could discourage childbearing, and lower density regulations could encourage more. However, even under these circumstances, that relationship is mediated by the *size* of housing permitted, not the land use regulation itself.

Another potential limitation of this design is in the measurement of the fertility variable. Firstly, the ACS variable used as a proxy for fertility is the “number of children in households under the age of 6”. What this variable may not capture is *who* in the household birthed those children, if they did at all. Furthermore, because the data is not a time series, it may be difficult to capture fertility lags. Responding to shifts in housing costs through fertility likely takes time, as children are often planned for, and housing prices might not immediately shift in response to policy changes. However, this variable still provides a broad view of what population growth looks like in a metropolitan area for young children.

**Chapter 4: Results**

**Summary Statistics**

Table 2 below includes each variable from the datasets used for this analysis, including instrumental variable regressions and data visualizations.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **VARIABLES** | **N** | **mean** | **sd** | **min** | **max** |
| **rent** | 242,206 | 483.6 | 788.2 | 4 | 4,000 |
| **valueh** | 408,153 | 434,507 | 520,283 | 1,000 | 7.681e+06 |
| **nchild** | 699,001 | 0.814 | 1.161 | 0 | 9 |
| **age** | 699,001 | 33.77 | 9.536 | 18 | 50 |
| **Race: White** | 484,145 | 69.2 | 2.157 | 1 | 9 |
| **Race: Black/African American** | 77,173 | 11.04 | -- | -- | -- |
| **Race: American Indian or Alaska Native** | 4,578 | 0.65 | -- | -- | -- |
| **Race: Chinese** | 18,132 | 2.59 | -- | -- | -- |
| **Race: Japanese** | 1,796 | 0.26 | -- | -- | -- |
| **Race: Other Asian or Pacific Islander** | 50,189 | 7.18 | -- | -- | -- |
| **Race: Other race, nec** | 37,941 | 5.43 | -- | -- | -- |
| **Race: Two major races** | 22,107 | 3.16 | -- | -- | -- |
| **Race: Three or more major races** | 2,940 | 0.42 | -- | -- | -- |
| **Hispanic Origin: Not Hispanic** | 560,661 | 80.21 | -- | -- | -- |
| **Hispanic Origin: Mexico** | 86,529 | 12..38 | -- | -- | -- |
| **Hispanic Origin: Puerto Rico** | 13,418 | 1.92 | -- | -- | -- |
| **Hispanic Origin: Cuban** | 3,793 | 0.54 | -- | -- | -- |
| **Hispanic Origin: Other** | 34,600 | 4.95 | -- |  |  |
| **Educational Attainment: Grade 11** | 15, 646 | 2.24 | -- | -- | -- |
| **Educational Attainment: Grade 12** | 223,732 | 32.01 | -- | -- | -- |
| **Educational Attainment: 1 year of college** | 117,550 | 16.82 | -- | -- | -- |
| **Educational Attainment: 2 years of college** | 57,564 | 8.24 | -- | -- | -- |
| **Educational Attainment: 4 years of college** | 182,120 | 26.05 | -- | -- | -- |
| **Educational Attainment** | 102,389 | 14.65 | -- | -- | -- |
| **incwage** | 699,001 | 45,550 | 65,682 | 0 | 717,000 |
| **LPPI18** | 699,001 | 8.919 | 0.858 | 4 | 13.50 |
| **CII18** | 699,001 | 3.469 | 0.600 | 2 | 8 |
| **LPAI18** | 699,001 | 2.316 | 0.863 | 0 | 12 |
| **LZAI18** | 699,001 | 2.847 | 0.584 | 1 | 9 |
| **LAI18** | 699,001 | 0.440 | 0.219 | 0 | 1 |
| **SRI18** | 699,001 | 0.186 | 0.398 | 0 | 4 |
| **DRI18** | 699,001 | 2.098 | 0.623 | 0 | 4 |
| **OSI18** | 699,001 | 0.673 | 0.211 | 0 | 1 |
| **EI18** | 699,001 | 0.667 | 0.280 | 0 | 1 |
| **AHI18** | 699,001 | 0.237 | 0.276 | 0 | 1 |
| **ADI18** | 699,001 | 7.184 | 3.069 | 1.312 | 18.25 |

Table 2. Summary statistics, including mean, median, standard deviation, maximum value, and minimum value. The statistics for home value and rent variables are at the $1 unit.

These results are split between the effects on fertility for renters and homeowners. This approach allows us to understand the differences, if any, in fertility outcomes for renters and homeowners.

**Establishing relevance**

A core component of a “valid” instrument is referred to as *relevance.* Relevance establishes that there is a relationship between the independent variable and the instrumental variable. Table 3 below is a linear regression output that includes the coefficient for the comprehensive instrumental variable (WRLURI18) effect on rent. WRULI18 is a weighted index that includes all eleven of the previously mentioned instrumental variables and allows us to understand the broad effects of land use regulations on housing costs.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | |  | (1) | | VARIABLES | rent | |  |  | | WRLURI18 | 286.9\*\*\* | |  | (3.604) | | Constant | 694.7\*\*\* | |  | (12.66) | |  |  | | Observations | 242,206 | | R-squared | 0.363 | |

Table 3. OLS Regressions for the comprehensive instrumental variable's effect on monthly rent. This regression includes controls for educational attainment, income, race, Hispanic identity, and state fixed effects. This regressions is at the $1 unit.

Table 3 indicates that there is a significant positive relationship between land use regulations and rental costs. Each additional unit increase in regulatory barriers increases monthly rent by $286.90. This establishes relevance for the instrument for renters. This outcome also follows the hypothesis that land-use regulations *increase* rental costs.

Table 4 is a linear regression output that includes the coefficient for WRULI18’s effect on home value.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | |  | (1) | | VARIABLES | valueh | |  |  | | WRLURI18 | 153,819\*\*\* | |  | (1,873) | | Constant | 251,929\*\*\* | |  | (7,414) | |  |  | | Observations | 408,153 | | R-squared | 0.204 | |

Table 3. OLS Regression for the comprehensive instrumental variable's effects on home value. This regression includes controls for income, educational attainment, race, Hispanic identity, and state fixed effects.

Table 3 indicates that each additional unit increase in land use regulations increases home values by $153,819. This results aligns with the hypothesis that land use regulations increase home values, potentially increasing barriers to homeownership for younger families, increasing mortgage costs for new homeowners, and increasing wealth for long-time homeowners.

**Effects on renters**

Table 4 shows the results of the IV regression used to understand the relationship between fertility and monthly contract rent prices. In this regression, the “instrument” includes every policy variable in the Wharton Residential Land Use Index. The regression also includes controls for race, Hispanic identity, annual income, and state fixed effects.

The large F-statistic (1671.81>10) indicates a strong first-stage regression. The OLS results in column 1 indicate that there is a positive relationship between increased rents and fertility. An endogeneity test is conducted to test if the IV regression is finding results meaningfully distinct from the OLS. The endogeneity test results in a chi2 score of 380.162, indicating that the results are likely statistically significant and not just picking up on statistical “noise”.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | (1) | | (2) |
|  | | OLS | | IV |
| VARIABLES | | nchild | | nchild |
| rent | | 0.0178\*\*\* | | -0.1165\*\*\* |
|  | | (3.80e-06) | | (1.44e-05) |
| N | | 242,206 | | 242,206 |
| F-stat (first stage) | | -- | | 1671.87 |
| Beta Coefficient | | .0230882 | | -.15096731 |
| Endogeneity Test | -- | | 376.725  (p = 0.0000) | |

Table 4. OLS and instrumental variable regression on the role of increased rents on the number of children in the household. Both OLS and IV regressions include controls for race, income, Hispanic identity, educational attainment, and state fixed-effects.

The results in Table 4 indicate that increased rents have a statistically significant negative impact on fertility. An additional $500 increase decreases the number of children a household has by 0.1165 with an R-squared of 0.39. Beta coefficient testing was conducted to understand the full effect size, and an additional one standard deviation increase in rent is associated with a -.15 standard deviation decrease in the number of children a family will choose to have. The regression’s overidentification chi2 score equaled 112.022 (Appendix A). The overidentification chi2 score is relatively high, which may raise concerns about internal validity of the results.

**Effects on homeowners**

Table 5 shows the results of the IV regression used to understand the relationship between housing costs and fertility using the “home value” variable through the ACS. It should be clarified that increased home values for homeowners are not experienced as direct increases in costs; instead, this variable acts as a proxy for increased mortgage costs and property taxes. This is potentially offset by the wealth creation benefits of homeownership; however, these costs still represent a barrier for low-income homeowners, new buyers, and future buyers. The regression includes control variables for race, Hispanic identity, education, annual income, and state fixed effects.

For Table 5, the OLS regression results in column 1 in a slightly positive relationship, and the F-statistic is high (1145.64>10), indicating that there is a statistically significant relationship between the value of a home and the number of children in a given household. An endogeneity test was also conducted, resulting in a relatively large coefficient (418.606), indicating that OLS is biased.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | (1) | | (2) |
|  | | OLS | | IV |
| VARIABLES | | nchild | | nchild |
| valueh | | .0000774\*\*\* | | -.000317\*\*\* |
|  | | (4.10e-09) | | (1.99e-08) |
| N | | 408,153 | | 408,153 |
| F-stat (first stage) | | -- | | 1145.64 |
| Beta Coefficient | | .0335386 | | -.13730866 |
| Endogeneity Test | -- | | 418.606  (p = 0.0000) | |

Table 5. OLS and instrumental variable regression on the role of increased home value in number of children in the household for homeowners.

Table 5 indicates that a $1,000 increase in home value are associated with a 0.000317 decrease in the number of children in the home. The beta coefficient test indicates that each standard deviation increase in home values is associated with a 0.14 standard deviation decrease in the number of children in the home. This result contradicts previous research indicating that homeowners’ fertility is positively affected by increases in home value (Lovenheim & Mumford, 2013).

**State-level analysis: Alabama and California**

To provide a more granular analysis of the fertility effects of housing costs, the same instrumental variable regressions are conducted for two states: California and Alabama. These states were chosen because California has comparably high housing costs compared to the rest of the country, while Alabama’s housing costs have remained relatively low. The same controls used for the previous regressions (race, education, Hispanic identity, and annual income) were also included for the state-level results. Full tables that include the F-statistics, endogeneity tests, and beta coefficients can be found in the Appendix.

*Alabama*

Table 6 includes the results of both the OLS and IV regressions conducted for renters only in Alabama. A similar pattern at the national level appears to occur at the state level; however, the external validity of these results is questionable due to the relatively smaller sample size. Additional information on tests for endogeneity and overidentifying variables, as well as the F-statistic, can be found in the appendix (Appendix C).

|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| rent | 0.05855\*\*\* | -.00162\*\*\* |
|  | (.0000877) | (.0002718) |
| N | 1,370 | 1,370 |
| F-statistic |  | 24.8229 |
| Beta coefficient | .0433161 | -.00118691 |

Table 6. OLS and IV regressions for renters in Alabama.

Table 6 indicates that, before including the policy instruments, increased rents appear to have a slightly positive effect on the number of children in the home (0.05855 increase). However, after incorporating the policy instruments, the relationship becomes negative (0.00162 decrease). This mirrors the results for the US representative sample. However, it should be noted that the beta coefficient is small, and quite a lot smaller than the beta coefficients for the parallel regression done for California renters.

Table 7 provides the OLS and IV regression results for homeowners just in Alabama. The sample size (3,343) is slightly larger for homeowners than renters; however, similar concerns over external validity remain. Additional information on the endogeneity and overidentifying variable tests, as well as the F-statistic, can be found in the appendix (Appendix D).

|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| valueh | 0.000289 \*\*\* | -.000743\*\*\* |
|  | (9.34e-08) | (6.69e-07) |
| N | 3,343 | 3,343 |
| F-statistic |  | 15.5796 |
| Beta coefficient | .0662351 | -.16909871 |

Table 7. OLS and IV regressions for homeowners in Alabama.

Table 7 indicates that an additional $1,000 increase in the value of a home results in a -.000743 *decrease* in the number of children in the household. Once again, these results mirror the US representative sample. The beta coefficient is larger for homeowners than for renters in Alabama; however, it is still smaller than the beta coefficient for California homeowners. This is likely due to Alabama having more homeowners than renters, but still being a much smaller sample size than California.

*California*

Table 8 provides the OLS and IV regression results for the effects of increased rents on the number of children in the household for renters. The same controls used for the US representative sample – race, annual income, education, and Hispanic identity – were also used for these regressions. Tests for endogeneity, overidentifying variables, and the F-statistic can be found in the appendix (Appendix E).

|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| rent | 0.00745\*\*\* | -0.15625\*\*\* |
|  | (6.32e-06) | (.0000192) |
| N | 61,396 | 61,396 |
| F-statistic |  | 1105.98 |
| Beta coefficient | .0102441 | -.21526447 |
| Endogeneity Test |  | 343.125  (p = 0.0000) |

Table 8. OLS and IV Regression results for renters in California.

As with Alabama, the results mirror the results of the entire country. Before the land-use instrument is included, every $500 increase in rents *increases* fertility by 0.00745. After the land-use instrument is included, the relationship becomes negative where every additional dollar increase in rents decreases fertility by 0.15625. However, unlike Alabama, the effect sizes are larger, indicating that housing may be a higher budget constraint for California’s residents and therefore they may be more sensitive to price increases. Every standard deviation increase in rent is associated with a 0.22 decrease in fertility.

|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| valueh | 0.00001\*\*\* | -0.000428\*\*\* |
|  | (5.80e-09) | (2.29e-08) |
| N | 73,779 | 73,779 |
| F-statistic |  | 785.391 |
| Beta coefficient | .0067521 | -.28643268 |
| Endogeneity test |  | 414.093  (p = 0.0000) |

Table 9. OLS and IV Regression results for homeowners in California.

The results in Table 9 follow the same pattern from before, but for homeowners. Every additional $1,000 increase in home value results in a slight increase in fertility (0.00001) before the land-use instrument is included. However, once the instrument is included, this relationship reverses, and homeowners experience a slight decrease in fertility (0.000428) for every additional $1,000 increase in their home’s value. Every standard deviation increase in home value is associated with a 0. 29 standard deviation decrease in fertility.

**Effects of Specific Policies**

To better understand which of these policy instruments have the largest effects sizes, and therefore may be the most effective tool for influencing fertility outcomes, IV regressions are conducted for each policy variable. These regressions include the same controls used for the comprehensive regressions. Table 10 includes the results of the IV regressions for each policy variable for homeowners.

|  |  |  |
| --- | --- | --- |
|  | **IV Coefficient for each policy instrument** | **Robust Standard Error** |
| **VARIABLES** | nchild | -- |
| **valueh** | -- | -- |
| **LPPI18** | -0.000494 | (4.78e-08) |
| **CII18** | -0.000623 | (1.60e-07) |
| **LPAI18** | -0.0156 | (.0000329) |
| **LZAI18** | -.000264 | (1.54e-07) |
| **LAI18** | .000272 | (5.94e-07) |
| **SRI18** | .000989 | (6.26e-07) |
| **DRI18** | -.000301 | (8.41e-08) |
| **OSI18** | -.000762 | (2.65e-07) |
| **EI18** | -.000317 | (1.10e-07) |
| **AHI18** | -.000262 | (2.34e-08) |
| **ADI18** | 0.000322 | (2.61e-08) |
| **N** | 408,153 | -- |

Table 10. OLS and IV regression results for each policy variable on the number of children in the household for homeowners.

The results in table 10 provide a useful insight into the effects of each of these land-use regulations. Notably, not all the effects are negative for homeowners. Using supply restriction regulation (SRI18) resulted in a slight positive effect on fertility (0.000989), as did the presence of community input sessions to approve and disapprove of potential housing development projects (LAI18), which saw a positive relationship at 0.000272.

In terms of the policy instruments used that resulted in negative relationships in the IV regression, the one with the largest effect size was requirements on developers for approval processes even when rezoning was not required by the project in question (LPAI18). The LPAI18 instrument was associated with a 0.0156 decrease in the number of children in the household for every additional dollar increase in home value. The next largest effects sizes were for open space requirements or in-lieu fees (OSI18), which resulted in a 0.000762 decrease in the number of children in the household for every additional dollar increase in home value.

Table 11 provides the IV regression results for each policy variable for renters. Notably, the effect sizes are larger for renters than for homeowners, reflecting the results of the comprehensive IV regression.

|  |  |  |
| --- | --- | --- |
|  | **IV Coefficient for each policy instrument** | **Robust Standard Error** |
| **VARIABLES** | nchild | -- |
| **rent** | -- | -- |
| **LPPI18** | -.1584 | (.0000307) |
| **CII18** | -.06515 | (.0000818) |
| **LPAI18** | -2.84575 | (.0039966) |
| **LZAI18** | -.1408 | (.0001397) |
| **LAI18** | 1.8167 | (.0033599) |
| **SRI18** | .3174 | (.0001398) |
| **DRI18** | -.0764 | (.0000407) |
| **OSI18** | -.1435 | (.0001195) |
| **EI18** | -.1351 | (.0000559) |
| **AHI18** | -.0823 | (.0000184) |
| **ADI18** | -.10205 | (.0000168) |
| **N** | 242,206 | -- |

Table 11. OLS and IV regression results for each policy variable on the number of children in the household for renters.

Two policies appeared to have positive effects on fertility for renters, which also happen to be the same as for homeowners – supply restriction policies and local approval requirements for new residential developments. Supply restrictions (SRI18) were associated with a 0.3174 increase in the number of children in a household for every additional $500 increase in monthly contract rent. Local approval requirements (LAI18) had a larger effect size and were associated with a 1.8167 increase in the number of children in the household for every $500 increase in monthly contract rent.

The policies associated with the largest negative effects were required approval processes for developers even when projects did not require rezoning (LPAI18) and local political pressure (LPPI18), which is associated with NIMBY activist pressure. LPAI18 was associated with a 2.84575 decrease in the number of children in a household for every $500 increase in monthly contract rents. LPPI18 had a smaller, yet still negative, effect size, with every additional $500 increase in monthly contract rent being associated with a 0.1584 decrease in the number of children in the household.

**Synthesizing these results**

As previously stated, this research confirms previous work indicating that renters’ fertility is negatively impacted by increases in monthly contract rent. However, these results contradict previously existing research that homeowners’ fertility rates are positively affected by increases in home value. These results beg the question of what the difference is between these outcomes and previous research. As these results are based on data from 2019, it may be that historical, economic, and cultural changes since 2013 have shifted substantially to allow for this variation. However, as the Lovenheim and Mumford research depended upon the “boom and bust” cycle of the housing market, this research depends upon more longer-term regulatory conditions that may have more external validity for understanding fertility decision-making across time.

**Chapter 5: Conclusion & Recommendations**

**Conclusion**

Increased housing costs, whether through increased mortgage payments or monthly rent payments, appear to have a marginal negative effect on the number of children families choose to have. While the effect sizes of these results may seem relatively small, the decision-making processes of families on the number of children they will have is made on the margins. Even relatively small increases in housing costs may play an outsized role in the decision to have even one fewer child. As such, there is probable causality that increases in housing negatively impact overall fertility rates.

Further research should be conducted to refine and disaggregate the effects of housing on fertility. Measuring fertility itself is relatively simple, but the number of children families will have may not be fully encapsulated in this measure, especially as America’s normative family models shifts and evolves. Research on the economic decision-making of families who choose to adopt or blend families is needed. Furthermore, additional research that further disaggregate the effects of immutable personality traits, geography, and fertility is needed.

While this analysis is unique in using instrumental variable design and land-use regulations to create a causal pathway, additional research should explore other novel methods for approaching the topic. Instrumental variable designs could potentially replace the land-use regulation instrument with others, such as geography, relative density, or housing size. Other econometrics research could use synthetic control models to understand how different regulatory and housing environment “typologies” that exist throughout the US and the world influence fertility. Furthermore, as this analysis uses a representative sample of the US, it is likely not generalizable to other countries. Countries like Japan that have relatively low housing costs and steeply declining fertility rates pose a question as to what other factors may have larger effects on national fertility.

**Policy Recommendations**

Housing policy and housing costs plausibly play a role in household fertility decision-making as a budget constraint. This research indicates that housing policy could be a relatively inexpensive, but effective tool to promote increased fertility and provide families with the financial flexibility to meet their own fertility preferences. As this research looks at the impacts of land-use regulation specifically, loosening these regulations would not require government expenditures the way child allowance and more traditional pro-natalist policies would.

This research did not find substantially divergent fertility outcomes for families who were homeowners and families who were renters. This contradicts previous research (Lovenheim & Mumford, 2013) that used the “boom and bust” cycles of the US housing market to understand housing costs’ fertility impacts. Their results indicated that homeowners experienced positive fertility increases due to increased housing prices, while renters experienced negative effects. This thesis’ results indicate that more research should be conducted to fully understand potential similar and dissimilar fertility patterns among renters and homeowners; however, the land-use approach indicates that *overall,* outside of large shocks to the housing market, increased housing costs create negative fertility effects for both homeowners and renters.

Any comprehensive pronatalist policy should be multipronged and address the array of issues facing new families, including budget constraints, job commitments, increased education attainment, as well as cultural influences that may decrease fertility. This policy package would likely include provisions for decreasing housing and mortgage costs, as well as other policies like child allowances; subsidized or free childcare; increased minimum wage requirements; mandatory parental leave provisions; increased funding for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); and educational resources for new parents. Pronatalist policy should also include research and development (R & D) funding for medical advances to address infertility as well as reduce the physical costs of pregnancy.

**Bibliography**

Beaujouan, E., Berghammer, C. (2019). The Gap Between Lifetime Fertility Intentions and Completed Fertility in Europe and the United States: A Cohort Approach. *Population Research and Policy Review* 38, 507–535, <https://doi.org/10.1007/s11113-019-09516-3>.

Becker, G. (1960). An Economic Analysis of Fertility. *Demographic and Economic Changes in Developed Countries,* pps. 209-240. Columbia University Press: New York, NY. <https://www.nber.org/system/files/chapters/c2387/c2387.pdf>

Brainerd, E. (2014). Can government policies reverse undesirable declines in fertility? IZA World of Labor, doi:10.15185/izawol.23, <https://wol.iza.org/uploads/articles/23/pdfs/can-government-policies-reverse-undesirable-declines-in-fertility.pdf>.

Caplan, B. (May 2011). Population, Fertility, and Liberty. *Cato Unbound.*

<https://www.cato-unbound.org/2011/05/02/bryan-caplan/population-fertility-liberty>

Clark W. A. (2012). Do women delay family formation in expensive housing markets?. Demographic research, 27(1), 1–24. https://doi.org/10.4054/DemRes.2012.27.1

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4685765/>

Congressional Research Service. (November 4, 2019). Social Security: Demographic Trends and Funding Shortfall. <https://crsreports.congress.gov/product/pdf/R/R45990>

Curtis, M. A., & Waldfogel, J. (2009). Fertility Timing of Unmarried and Married Mothers: Evidence on Variation Across U.S. Cities from the Fragile Families and Child Wellbeing Study. Population research and policy review, 28(5), 569–588. https://doi.org/10.1007/s11113-008-9120-7

Curtis J. S., Robert T. (January 2009). Do higher rents discourage fertility? Evidence from U.S. cities, 1940–2000, Regional Science and Urban Economics, Volume 39, Issue 1, 2009, Pages 33-42, https://doi.org/10.1016/j.regsciurbeco.2008.08.002.

<https://www.sciencedirect.com/science/article/abs/pii/S0166046208000823>

Dettling, L. J. & Kearney, M. S. (June 2016). House Prices and Birth Rates: The Impact of the Real Estate Market on the Decision to Have a Baby. *National Bureau of Economic Research.* <https://www.nber.org/papers/w17485>

Desmond, M. (March 2016). Evicted: Poverty and Profit in the American City. *Crown Publishing:* New York, NY.

Erickson, J. (September 2014). The Middle-Class Squeeze. *Center for American Progress.* <https://www.americanprogress.org/article/the-middle-class-squeeze/>

European Commission. (2018). First results of Poland’s Family 500+ programme released. <https://ec.europa.eu/social/main.jsp?langId=en&catId=1246&newsId=9104&furtherNews=yes>

Florida, R. (June 2018). Don’t Blame Expensive Housing for Falling Fertility. *Bloomberg.* <https://www.bloomberg.com/news/articles/2018-06-14/the-complex-relationship-between-house-prices-and-fertility>

Florida, R., Mellander, C., & King, K. (December 2020). Housing costs, self-employment, and fertility.

<https://onlinelibrary-wiley-com.libproxy.lib.unc.edu/doi/full/10.1002/psp.2413>

Follett, C. (April 2019). Why Lower Birthrates Aren’t Always Worth Celebrating. *The Cato Institute.*

<https://www.cato.org/commentary/why-lower-birthrates-arent-always-worth-celebrating>

Greszler, R. & Marsh, E. (July 2021). Declining U.S. Birthrate Another Reason to Reign in Federal Spending. *The Heritage Foundation.*

<https://www.heritage.org/budget-and-spending/commentary/declining-us-birthrate-another-reason-rein-federal-spending>

Gyourko, J., Hartley, J., & Krimmel, J. (2019). The Local Residential Land Use Regulatory Environment Across U.S. Housing Markets: Evidence from a New Wharton Index. (No. w26573). National Bureau of Economic Research.

Hamilton, B.E., Martin, J. A., & Osterman, M.J.K. (2020). Vital statistics rapid release: provision data for 2020. *Division of Vital Statistics, National Center for Health Statistics.* <https://www.cdc.gov/nchs/data/vsrr/vsrr012-508.pdf>

Hohn C. (1988). Population policies in advanced societies: pronatalist and migration strategies. *European journal of population*, 3(3-4), 459–481. <https://doi.org/10.1007/BF01796909>

Kearney, M. S. & Levine, P. (May 2021). Will Births in the US Rebound? Probably Not. *The Brookings Institute.*

<https://www.brookings.edu/blog/up-front/2021/05/24/will-births-in-the-us-rebound-probably-not/>

Lee R. (2015). Becker and the Demographic Transition. Journal of demographic economics, 81(1), 67–74. <https://doi.org/10.1017/dem.2014.9>

Lesthaeghe, R. (2014). The second demographic transition: A concise overview of its development. Proceedings of the National Academy of Sciences, 111(51), <https://doi.org/10.1073/pnas.1420441111\>.

Lindsay, Flynn. (2013). : Housing costs and family formation: Empirical

evidence, LIS Working Paper Series, No. 585, Luxembourg Income Study (LIS), Luxembourg

<https://www.econstor.eu/bitstream/10419/95429/1/737808942.pdf>

Lovenheim, M. F. & Mumford, K. J. (2013). Do Family Wealth Shocks Affect Fertility Choices? Evidence from the Housing Market. *The Review of Economics & Statistics,* 95(2):464–475.

<https://direct-mit-edu.libproxy.lib.unc.edu/rest/article/95/2/464/58073/Do-Family-Wealth-Shocks-Affect-Fertility-Choices>

Machin, S. (2011). Houses and schools: Valuation of school quality through the housing market. *Labour Economics*, 18(6). https://doi.org/10.1016/j.labeco.2011.05.005

MacNamara, T. (March 2019). Liberal Societies have Dangerously Low Birth Rates. *The Atlantic.*

<https://www.theatlantic.com/ideas/archive/2019/03/underpopulation-problem/585568/>

Masnick, G. (May 2018). What are the Impacts of Fertility Rates on Housing Markets? *Joint Center for Housing Studies of Harvard University.* <https://www.jchs.harvard.edu/blog/what-are-the-impacts-of-fertility-rates-on-housing-markets>

Miller, L.J. (1995). Family togetherness and the suburban ideal. *Sociological Forum*, 10, 393-418. DOI:10.1007/BF02095828

Mitchell, D.M. (2000). School quality and housing values. *Journal of Economic Insight,* 26(1)

Mulder, C. H. & Billari, F. C. (2010) Homeownership Regimes and Low Fertility, Housing Studies, 25:4, 527-541, DOI: 10.1080/02673031003711469

<https://www-tandfonline-com.libproxy.lib.unc.edu/doi/full/10.1080/02673031003711469>

Mulder C. H. & Lauster, N. T. (2010) Housing and Family: An Introduction, Housing Studies, 25:4, 433-440, DOI: 10.1080/02673031003771109

<https://www-tandfonline-com.libproxy.lib.unc.edu/doi/full/10.1080/02673031003771109>

Nargund G. (2009). Declining birth rate in Developed Countries: A radical policy re-think is required. Facts, views & vision in ObGyn, 1(3), 191–193. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4255510/>

Notestein FW, editor. Economic problems of population change; Proceedings of the Eighth International Conference of Agricultural Economists; New York. 1953. pp. 13–31.

Park, C. (2005). How Effective are Pronatalist Benefits? A Literature Survey and a Study on Singapore’s Qualified Child Relief. *The Singapore Economic Review*, 50(01). <https://doi.org/10.1142/S0217590805001810\>

Poon, L. (2018). South Korea is Trying to Boost its Birth Rate. It’s not Working. *Bloomberg.* <https://www.bloomberg.com/news/articles/2018-08-03/south-korea-is-trying-to-boost-its-birth-rate-it-s-not-working>

Shoag D., Russell L. (2018) Land Use Regulations and Fertility Rates. In: Lehavi A. (eds) One Hundred Years of Zoning and the Future of Cities. Springer, Cham. <https://doi.org/10.1007/978-3-319-66869-7_7>

Skaburskis, A. (1997). Gender Differences in Housing Demand. Urban Studies, 34(2), 275–320. https://doi.org/10.1080/0042098976186

<https://journals.sagepub.com/doi/abs/10.1080/0042098976186>

Sobotka, T., Matysiak, A. & Brzozowska, Z. (May 2019). Policy responses to low fertility: how effective are they? *United Nations Population Fund.* <https://www.unfpa.org/sites/default/files/pub-pdf/Policy_responses_low_fertility_UNFPA_WP_Final_corrections_7Feb2020_CLEAN.pdf>

Stone, L. (October 2018). Higher Rent, Fewer Babies? Housing Costs and Fertility Decline. *Institute for Family Studies.*

<https://ifstudies.org/blog/higher-rent-fewer-babies-housing-costs-and-fertility-decline>

Stone, L. (December 2018). Declining Fertility in America. *American Enterprise Institute.*

<https://www.aei.org/research-products/report/declining-fertility-in-america/>

Stone, L. (March 2020). Pro-Natal Policies Work, but They Come with a Hefty Price Tag. *The Institute for Family Studies.*

<https://ifstudies.org/blog/pro-natal-policies-work-but-they-come-with-a-hefty-price-tag>

Tucker, J. (June 2018). Birth Rates Dropped Most in Counties Where Home Values Grew Most. *Zillow Research.* <https://www.zillow.com/research/birth-rates-home-values-20165/>

Tavernise, S., Miller, C. C., Bui, Q., & Gebeloff, R. (June 2021). Why American Women Everywhere are Delaying Motherhood. *The New York Times.* <https://www.nytimes.com/2021/06/16/us/declining-birthrate-motherhood.html>

Yglesias, M. (2020). One Billion Americans: The case for thinking bigger. *Penguin Random House:* New York, NY. <https://web.b.ebscohost.com/ehost/detail/detail?vid=0&sid=29b336d2-1487-4446-8e26-96ee0897fed6%40pdc-v-sessmgr03&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=2334022&db=nlebk>

Wamsley, L. (February 2020). Finland's Women-Led Government Has Equalized Family Leave: 7 Months for Each Parent. *National Public Radio.* <https://www.npr.org/2020/02/05/803051237/finlands-women-led-government-has-equalized-family-leave-7-months-for-each-paren>

**Appendix**



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | (1) | | (2) |
|  | | OLS | | IV |
| VARIABLES | | nchild | | nchild |
| rent | | .0000356\*\*\* | | -0.000233\*\*\* |
|  | | (3.80e-06) | | (1.44e-05) |
| N | | 242,206 | | 242,206 |
| F-stat (first stage) | | -- | | 1671.87 |
| Beta Coefficient | | .0230882 | | -.14901892 |
| Endogeneity Test | -- | | 380.162 | |
| Chi2 Overid Test | -- | | 112.022 | |

Table 12. OLS and IV regressions for the effects of increased rents on the number of children in the household. This table includes a Chi2 overidentification tests.



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | (1) | | (2) |
|  | | OLS | | IV |
| VARIABLES | | nchild | | nchild |
| valueh | | 7.74e-08\*\*\* | | -3.17e-07\*\*\* |
|  | | (4.10e-09) | | (1.99e-08) |
| N | | 408,153 | | 408,153 |
| F-stat (first stage) | | -- | | 1145.64 |
| Beta Coefficient | | .0335386 | | -.14495052 |
| Endogeneity Test | -- | | 420.069 | |
| Ch2 Overid Test |  | | 42.917 | |

Table 13. OLS and IV regressions for the effects of increased home values on the number of children in the household for homeowners. This table includes a Chi2 overidentification tests.



|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| rent | .0001171\*\*\* | -3.24e-06\*\*\* |
|  | (.0000877) | (.0002718) |
| N | 1,370 | 1,370 |
| F-statistic |  | 24.8229 |
| Beta coefficient | .0433161 | -.00118691 |
| Endogeneity Test |  | .214084  (p = 0.6436) |
| Overidentification Test |  | 4.37495  (p = 0.2237) |

Table 14. Full OLS and IV results for renters in Alabama.



|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| valueh | 2.89e-07 \*\*\* | -7.43e-07\*\*\* |
|  | (9.34e-08) | (6.69e-07) |
| N | 3,343 | 3,343 |
| F-statistic |  | 15.5796 |
| Beta coefficient | .0662351 | -.16909871 |
| Endogeneity test |  | 2.51347  (p = 0.1129) |
| Overidentification Test |  | .193334  (p = 0.9787) |

Table 15. Full results for homeowners in Alabama.



|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| rent | .0000149\*\*\* | -.0003125\*\*\* |
|  | (6.32e-06) | (.0000192) |
| N | 61,396 | 61,396 |
| F-statistic |  | 1105.98 |
| Beta coefficient | .0102441 | -.21526447 |
| Endogeneity Test |  | 343.125  (p = 0.0000) |
| Overidentification Test |  | 260.042  (p = 0.0000) |

Table 16. Full results for renters in California.



|  |  |  |
| --- | --- | --- |
|  | (1) | (2) |
|  | OLS | IV |
| VARIABLES | nchild | nchild |
| valueh | 1.00e-08\*\*\* | -4.28e-07\*\*\* |
|  | (5.80e-09) | (2.29e-08) |
| N | 73,779 | 73,779 |
| F-statistic |  | 785.391 |
| Beta coefficient | .0067521 | -.28643268 |
| Endogeneity test |  | 414.093  (p = 0.0000) |
| Overidentification test |  | 179.573  (p = 0.0000) |

Table 17. Full results for homeowners in California.