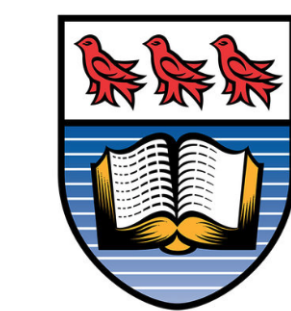


COST-EFFECTIVENESS & LABOUR MARKET OUTCOMES IN IN-VITRO FERTILIZATION

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Abstract

This work uses two techniques to explore cost-effectiveness and labour market outcomes of provincial IVF funding policy. First, I conduct a cost-effectiveness analysis of IVF using a commonly accepted framework of Canadian health technology assessment from the perspective of the publicly-funded healthcare payer. Second, I construct a novel Conception Timing Model that represents the decision problem of a hypothetical Canadian individual who must weigh the tradeoff between having a child and the future income associated with furthering a career. The Conception Timing Model is developed under the rationale that the potential parent must incur an opportunity cost of lost wages when they decide to have a child. Results from the first approach suggests that a positive amount of IVF funding is cost-effective when constrained to the publicly funded healthcare payer perspective. The combination of the first and second approaches suggest that IVF policy may be used as both a health program and a social program that addresses inequities within the labour market. Results also speak to the importance of government ministries acting multilaterally to create effective welfare-improving policy.

* In keeping with the scope of current economic literature, I have chosen to use female pronouns as the primary pronoun in this paper.

Infertility & IVF Funding in Canada

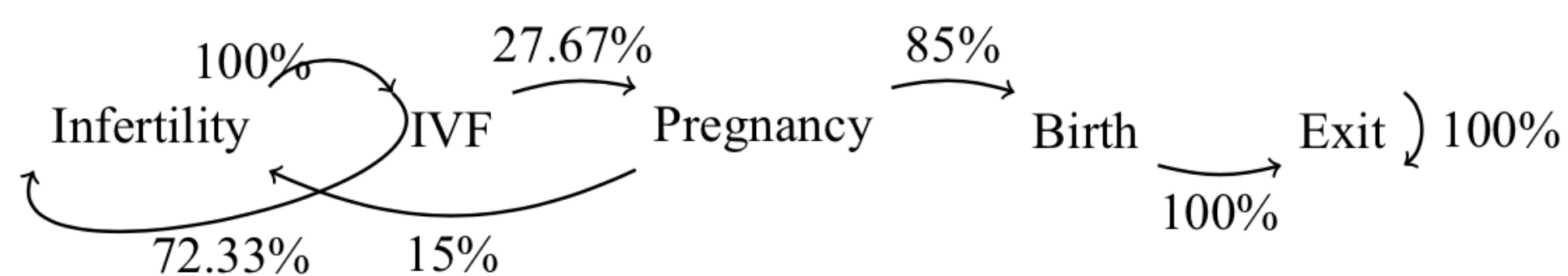
Infertility affects one in six Canadian couples (Statistics Canada, 2020). In-Vitro Fertilization treatments utilize laboratory settings to fertilize eggs outside of the body for a fee of at least \$10,000 per cycle with a live birth rate of around 27% (Canadian Fertility and Andrology Society, 2019). IVF is often utilized by infertile couples who are able to afford it and by women who want to wait to conceive a child. By waiting to conceive, a woman can continue to earn income, and build a career with the peace of mind that IVF is available if her declining fertility introduces a barrier to conception in the future.

Methods

I use two methods to inspect the IVF funding debate. Firstly, I measure the cost-effectiveness of IVF by following the Canadian Agency for Drugs and Technology in Health (CADTH) guidelines. Secondly, I create a theoretical Conception Timing Model to understand how a hypothetical parent decides to postpone pregnancy or start to conceive by weight costs and benefits of leaving their career.

Cost-Effectiveness Model

The cost-effectiveness model weighs costs and benefits of funding IVF treatments from the perspective of the government public payer. I use the below model to measure costs. Hypothetical agents begin in the "Infertility" state, and move around the system based on the given probabilities until all are in the "Exit" state. As they move through each of the states, the costs of each procedure are added. The costs of each state are obtained from BC Physicians Fee Schedules and the Patented Medicine Prices Review Board.



Cost-Effectiveness Model

Benefits are measured in Quality Adjusted Life Years (QALY) gained from treating infertility. QALY values are anchored between 0 and 1 where 0 represents the utility for someone who is dead and 1 for someone who is of perfect health. I use World Health Organization estimates to measure loss in QALY (WHO, 2017). Per year, the loss of QALY from infertility is estimated between 0.056 and 0.18 QALY. By dividing by the CADTH discount rate, 1.5% I find that treating infertility produces a lifetime QALY gain of **0.53 - 12 QALY**.

The conversion of QALY into dollars requires c , a \$/QALY value that allows comparison between costs and benefits in dollar terms. The true value of c is up to the choice of the assessor. I use \$/QALY thresholds of 2020 \$CAD 32 600, \$81 500 (the traditional \$50 000/QALY value inflated to 2020 dollars) and \$163 000 as three different threshold values (Grosse, 2008, Laupacis et al., 1992). For the complete cost-effectiveness calculation, I find a solution for c in Equation 1 with NPV being set to 0.

$$NPV = c * \Delta QALY - \Delta Costs \quad (1)$$

At the most commonly used threshold, 2020 CAD\$81 500 (\$50 000 inflated), **IVF is cost effective 11 out of 12 estimates**.

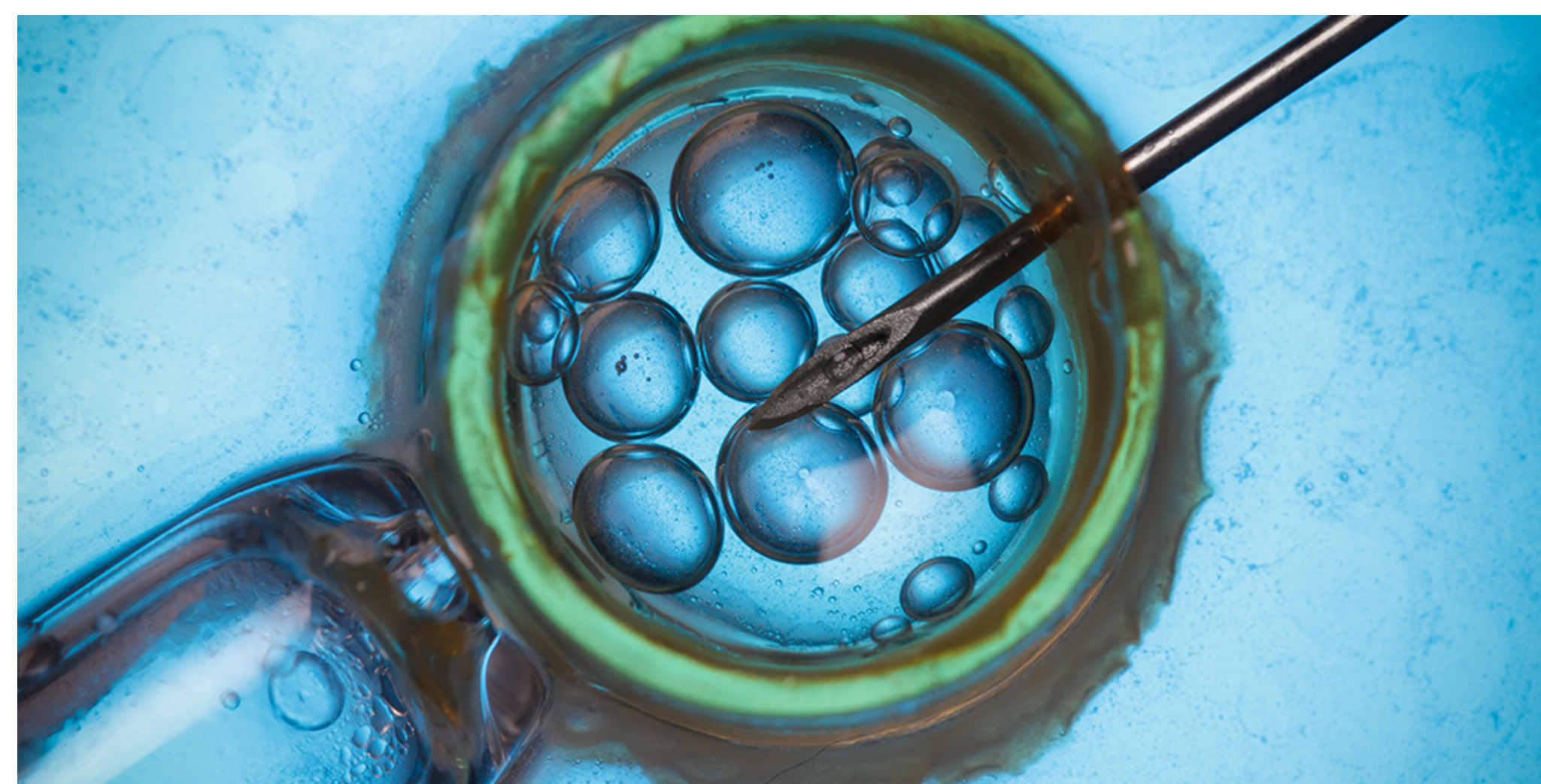


Fig. 2: IVF Procedures. Source: Policy Options (Scala, 2019)

Conception Timing Model

The Conception Timing model mathematically explains the decision problem of a potential mother when she decides whether or not to conceive a child. Three equations must be stated. Equation 2 measures the increasing expected cost of IVF as the potential mother gets older. Equation 3 measured the change in income per year of not waiting to conceive. Equation 4 measures extraneous decreasing "benefits" of waiting as a function of age suggesting that benefits of waiting continually decrease as the potential mother ages.

$$E(IVF_{cost}|Age) = (1 - fert(age)) * IVF_{cost} \quad (2)$$

$$\Delta Income_{nowait} = \%IncomeLost_{nowait} * OriginalIncome \quad (3)$$

$$B(waiting|age) = f(fert(age)) \quad (4)$$

These three equations can be combine to measure the "net benefit of waiting to conceive" as see below in Equation 5. When the value of the function is negative, the parent will try to conceive.

$$NPV_{wait} = \Delta Inc - E(IVF_{cost}) + f(fert(age)) \quad (5)$$

The exercise of assigning appropriate values and properties to each function are discussed in the paper. Importantly, if IVF were funded, $E(IVF_{cost})$ would disappear and alter the decision of the mother.

Results

One key result from the Cost-Effectiveness model and three key results from the Conception Timing Model are listed below:

- **IVF treatments are likely to be cost effective at common \$/QALY thresholds.**
- **Lower income women will choose to conceive earlier than higher income women.**
- **Those who value having a child the most will conceive the earliest.**
- **Decreasing the cost of IVF will result in women having children later.**

Policy Implications

The results of the Conception Timing Model suggest that IVF funding has an impact on the labour market decisions of a potential parent who must weigh the marginal costs and marginal benefits of having a child at each point in time. Furthermore, the results provide an insight into how government departments must operate. That is, the government sectors must be aware of the policy actions in other sectors— just as someone in labour market equity policy must be aware of IVF's potential effect on the labour market supply.

Conclusion

The findings of the two analyses update existing IVF cost-effectiveness literature and contribute to theoretical healthcare decision making frameworks. Results suggest that a positive amount of IVF funding may encourage later conception by decreasing the expected cost of infertility treatments. Therefore, IVF funding may have a direct impact on the labour market, and the total future income of the parents.

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