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RESEARCH ARTICLE

Artificial Wombs, Surplus Embryos, and Parent-Friendly IVF

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Abstract
There has been considerable discussion about the impact artificial womb technology may have on debates in reproductive ethics. Much of it has focused on abortion. Some ethicists have also proposed, however, that artificial wombs will lead to more embryo adoption, and, in doing so, that they will eliminate an alleged moral tension between opposing most abortions based on a full moral status view of fetuses/embryos but not opposing the use of surplus embryos in fertility medicine. This article evaluates this argument, what I will call the artificial womb argument. It defends two main claims. First, artificial womb technology is unlikely to lead to embryo adoption on the scale needed to resolve the moral tension between opposing abortion but tolerating the use of surplus embryos in what has been termed "parent-friendly" in vitro fertilization (IVF). Second, artificial womb technology is more likely to increase the use of surplus embryos. The artificial womb argument backfires, therefore, on abortion opponents. Far from mitigating the moral tensions between opposing abortion but tolerating parent-friendly IVF, artificial womb technology is more likely to exacerbate these tensions.

Keywords Artificial wombs · Ectogenesis · Abortion · In vitro fertilization · Fertility medicine

1 Introduction

There has been considerable discussion about the impact artificial wombs may have on various debates in reproductive ethics. One area of discussion has been whether they will lead to more embryo adoption, and, in doing so, whether they will alleviate an apparent moral inconsistency between opposing most abortions based on a full moral status view of embryos/fetuses but not opposing the use of surplus embryos in fertility medicine. This article assesses this argument, what I call *the artificial womb argument*. It defends two main claims. First, artificial wombs are

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unlikely to lead to embryo adoption on the scale needed to eliminate the tension between opposing most abortions but accepting the use of surplus embryos in what has been termed "parent-friendly" in vitro fertilization (IVF). Second, they are more likely to *increase* the use of these embryos. The argument backfires, therefore, on abortion opponents. Far from mitigating the inconsistency between opposing most abortions but accepting parent-friendly IVF, artificial wombs will exacerbate this inconsistency.

My own view, which I shall not defend here, is that the more reasonable response to this inconsistency is to forgo the idea that embryos and early fetuses have full moral status.[1] Here, I see this article as indirectly supporting an observation that has been made by Jeff McMahan, Rob Lovering, and Kate Greasley, all of whom have noted that full moral status views seem to be inconsistent with widely accepted practices involving IVF embryos[2] or widely held moral intuitions about them.[3] This article shows that artificial womb argument cannot resolve these inconsistencies.

2 Artificial Wombs and the Artificial Womb Argument

Let me begin by providing some context for this article's main claims.

Much of the discussion in bioethics about artificial womb technology was sparked by a 2017 article in *Nature Communications*, in which researchers at the Children's Hospital of Philadelphia reported that they had successfully transferred several lamb fetuses to "Biobags" in which electrolyte-laden liquid was used to simulate amniotic fluid and in which these fetuses' umbilical cords were connected to external systems that oxygenated their blood (Partridge et al., 2017). The researchers' success led them to apply for approval to begin human clinical trials. Since then, other types of artificial wombs have been developed by other research teams (Kozlov, 2023, 460), and many experts now predict that we are only decades away from being able to transfer human fetuses to artificial wombs in the later weeks or even months of pregnancy.

The original aim of this technology was to aid in the treatment of extremely premature babies. Much of the discussion in bioethics has focused, however, on other upshots. Some bioethicists have suggested that artificial wombs should be seen as similar incubators—a tool for rescuing viable fetuses. Others claim that they will fundamentally alter the point of viability itself. This divergence has led to debates over whether transferring fetuses to artificial wombs should be considered to be a form of childbirth, thus whether killing transferred fetuses should be considered tantamount to infanticide.[4] There has also been considerable discussion about this

[1] See Shaw (2023).
[2] See McMahan (2007, 172–176).
[3] See Lovering (2014) and Greasley and Kaczor (2018, 27–37).
[4] See Romanis (2018), Colgrove (2019), Kingma and Finn (2020), and Rodger et al. (2021).

technology's implications for the abortion debate.[5] One of the leading arguments for abortion rights holds that women have a right, based on moral considerations such as bodily autonomy and self-defense, to end pregnancies even when doing so leads to the deaths of fetuses.[6] Artificial wombs would seem to provide a way to exercise this right without these deaths. Thus, some have speculated that their invention will "essentially conclude" the abortion debate.[7]

My focus will be a different discussion. Some bioethicists have proposed that artificial wombs will lead to vastly more embryo adoption, and, in doing so, that they will eliminate an apparent moral inconsistency between opposing most abortions but *not* opposing the use of surplus IVF embryos in fertility medicine. Let me explain, first, this inconsistency. Then I will explain why some abortion opponents have held the artificial wombs will eliminate it.

Many anti-abortion arguments assume what has been called a *full moral status view of embryos/fetuses*. A full moral status view claims that *all* embryos and fetuses possess the same basic moral rights, claims, or interests as ordinary adult human beings.[8] Many arguments have been made for this view.[9] For my purposes, however, I wish to bracket my direct engagement with this secondary literature. I have two reason for wishing to limit my engagement with it. First, the secondary literature on the moral status of the embryo/fetus is voluminous, and I lack the space to sufficiently discuss it. For clarity's sake, I should state that I do *not* accept a full moral status view. My belief is that fetuses do not acquire full moral status until later in their fetal development, some time prior to birth, perhaps prior to the point of viability. However, it is beyond this article's scope to defend this stance or to directly contest the various arguments that have been given for the full moral status view. Second, it seems to me that these arguments can be bracketed, for my purposes, as the objection to them that interests me does not directly target them but takes the form of a kind of *modus tollens*, one that points out that *if* one opposes most abortions based on a full moral status view, *then* one must regard a certain type of IVF as morally objectionable. However, most do *not* regard this type of IVF as morally objectionable. Thus, there are grounds for doubting abortion opposition that relies on a full moral status view.

Here is a fuller explanation of this argument. Suppose one opposes most abortions based on the belief that *all* embryos/fetuses possess the same moral status as ordinary adult human beings. It follows that embryos created through IVF must possess it too. Currently, the United States allows would-be parents to engage in what has been termed "parent-friendly IVF," which occurs when surplus oocytes are extracted and fertilized to create a supply of backup embryos that can be used

[5] See Blackshaw and Rodger (2019), Kaczor (2014, chapter 12), Kaczor (2018), Mathison and Davis (2017), Pruski and Playford (2022), Räsänen (2017), and Rodger (2021).

[6] Judith Jarvis Thomson's "Defense of Abortion" (1971) is the *locus classicus* for this defense of abortion rights.

[7] See Mathison and Davis (2017, 314), Kaczor (2018, 634), and Blackshaw and Rodger (2019, 76).

[8] I borrow this definition from Devolder (2015, 14).

[9] For some of the most important examples, see Marquis (1989), Lee (2004), Beckwith (2007), George and Tollefsen (2008), and Kaczor (2014).

should an attempt at pregnancy fail.[10] Most of these embryos, however, are never used. A fraction are given up for adoption. Most are discarded or frozen indefinitely, which has led to a massive stockpile, around a million in storage in the United States according to many estimates.[11] Presumably, one should regard this situation as morally objectionable given a full moral status view. If embryos have full moral status, then destroying or discarding them must be highly immoral, akin to homicide or to allowing innocents to die, and freezing them indefinitely would appear to be highly immoral as well as it would deprive them of a conscious existence in perpetuity.[12]

Yet many do *not* find it objectionable to allow parents to create surplus IVF embryos, including many abortion opponents. A timely example can be found in reactions to the Alabama State Supreme Court's 2024 ruling that IVF embryos are protected by Alabama's Wrongful Death of a Minor Act. Many ostensibly pro-life Republicans responded to the public outcry over this ruling by declaring their support for IVF, despite the fact that the ruling echoed a Life at Conception Act that many of these same Republicans had supported for years (Blake, 2024). Indeed, the outcry was so strident that Alabama lawmakers almost immediately passed a countervailing law that protected IVF providers from civil and criminal liability, despite the fact that the state has some of the most stringent anti-abortion prohibitions in the United States, including some whose language would seem to entail comparable prohibitions on IVF.[13] The controversy over Alabama State Supreme Court ruling nicely illustrates, then, both how prohibitions on parent-friendly IVF seem to be directly implied by certain anti-abortion stances, ones grounded in full moral status views, yet also run counter to widely held moral intuitions about IVF.[14]

[10] Devolder refers to this type of IVF as "woman-friendly" because it helps women avoid the discomfort of multiple rounds of egg retrieval (2015, 62). I prefer the phrase "parent-friendly" because studies have shown that the main reason why individuals choose it is because of the reassurance it provides at the start of IVF—the comfort of knowing they can try again without delay should an attempt at pregnancy fail (Nachtigall et al., 2005).

[11] See Lester (2019).

[12] See McMahan (2007, 172–176) for a defense of this claim. See also Shaw (2023).

[13] See, for example, Alabama's 2019 Human Life Protection Act.

[14] An anonymous reviewer points out that this case illustrates a broader tension in our thinking about IVF embryos. The circumstances that led Alabama Supreme Court's ruling are telling. A patient at a hospital in Alabama tried to grab cryopreserved embryos, burned their hand, and dropped them, causing them to be destroyed. Many people regard IVF embryos as property owned by parents, which they can discard or freeze indefinitely, but the parents in this case sued the hospital for violating Alabama's Wrongful Death of a Minor Act. At the heart of this case, then, is a question about whether IVF embryos should be considered property or unborn children.

This question has been discussed by Eric Mathison and Jeremy Davis, who raise several objections against the idea that embryos should be considered property (2017, 317–319). My view is different—that they are, at least, more property-like in their moral status. There is not sufficient space to discuss my concerns about Mathisons's and Davis's reasons for denying that IVF embryos can be property. However, I would suggest that there may be an underlying rapport between our views. Mathison and Davis are expressly agnostic about the moral status of embryos/fetuses (2017, 314). They also indicate that allowing them to die *might be permissible* if they lack "intrinsic value" (2017, 32). We seem to be in agreement, then, that it may be permissible to destroy cryopreserved IVF embryos or to freeze them indefinitely *if they lack a certain type of moral status*. Here, however, I would make the additional argument, which I borrow from McMahan, that our general willingness to accept these practices, even among many

A few versions of this type of inconsistency argument have been made by bioethicists. Rob Lovering has argued based on it that it is inconsistent for some abortion opponents not to adopt at least one surplus embryo (2020). Similalrly, Jeff McMahan has argued that if one genuinely thinks that all embryos/fetuses possess full morals status, then one would need to regard oneself as morally obliged to shoulder some significant sacrifices to bring surplus embryos into a conscious existence, which, he notes, few appear to be willing to do (2007, 176).

For my part, I have argued, that those who accept a full moral status view are obliged to outright oppose parent-friendly IVF.[15] To be fair, some do.[16] However, many do not, as evidenced, again, by the backlash to the recent Alabama Supreme Court ruling. Against this group, I have argued that they must either rethink their commitment to the full moral status view, which would allow them to take a more lenient stance toward parent-friendly IVF, but would also entail reassessing their opposition to abortion, or they can adhere to it, which would support their opposition to abortion but would require them to also oppose parent-friendly IVF.[17] My own view, again, is that it makes more sense to forgo the idea that all embryos/fetuses have full moral status. Technically, though, my argument is consistent with an opposing stance—that abortion opponents should also oppose parent-friendly IVF. The key point is that abortion opponents cannot avoid this thorny either/or dilemma: either they must rethink the idea that all embryos/fetuses have full moral status or they must accept that it obliges them to oppose to parent-friendly IVF.

What I will call *the artificial womb argument* (AWA) has been proposed as a means of escape from this either/or. Earlier, I characterized my inconsistency argument as a kind of *modus tollens*. Crudely put, it has something like the following form:

P1. If embryos have full moral status, then parent-friendly IVF is morally objectionable.
P2. Parent-friendly IVF is not morally objectionable.
C1. Therefore, it is not the case that embryos have full moral status.

Elsewhere, Nicholas Colgrove, Bruce Blackshaw, and Daniel Rodger have argued that this type of inconsistency argument can be rebutted by identifying "other beliefs" held by abortion opponents, or "other actions" available to them, that provide them with a means to deny P1 (Colgrove et al., 2020, 2–4). The AWA has been advanced as an example. Its thrust is that the prospect of artificial womb technology

Footnote 14 (continued)
abortion opponents, signals that "we really do not believe that embryos have the same status as children and adults" (McMahan, 2007, 171).

[15] Shaw (2023).

[16] See Lovering (2020, 242–243) for more discussion of this subgroup.

[17] To be clear, I do not claim that abortion opponents must oppose *all* IVF. Devolder has helpfully coined the phrase "embryo-friendly IVF" to refer to IVF treatments in which a limited number of oocytes are fertilized and *all* the resulting embryos are transferred to a woman's uterus (2015, 62). I see no necessary contradiction between opposing abortion but tolerating embryo-friendly IVF. See Shaw (2023, 367) for more discussion of this claim.

relieves abortion opponents from needing to view parent-friendly IVF as morally objectionable. Here are a few examples:

[The] claim is that consistency of beliefs demands adopting at least one frozen embryo. The argument is deceptive, however, as it omits other possible actions available to [abortion opponents]. For example, rather than adopt frozen embryos, [abortion opponents] might pay storage costs for cryopreserved embryos until they can be rescued by artificial womb technology (Colgrove et al., 2020, 3).

Technology should also be considered—ectogenesis is developing rapidly, and it may be that in a few years it is possible to gestate surplus embryos without requiring a human uterus…. [This] is a possibility well worth exploring because it promises to remove the physical sacrifices required by gestation away from prospective adoptive parents. Also, intercountry adoption is rapidly declining and may eventually be curtailed, presumably making adoption more difficult and strengthening demand. It is likely there will be little difficulty finding adoptive parents for surplus embryos gestated via ectogenesis (Blackshaw & Colgrove, 2020, 859).

Nicholas Colgrove's, Bruce Blackshaw's, and Daniel Rodger's target in these passages is Lovering's embryo adoption argument. Their reply in the first is that abortion opponents need not adopt surplus embryos as the prospect of artificial womb technology gives them an alternative way to express their beliefs, paying the storage costs for surplus embryos until they can be rescued through this technology.

Their reply in the second can be extended to my argument. I claim that abortion opponents should be committed to eliminating the supply of surplus embryos by opposing parent-friendly IVF. Artificial wombs will provide another way to eliminate this supply. One of the main barriers to embryo adoption is gestation. Some prospective parents may not be able to gestate a child; others may be reluctant because of the sacrifices it requires. If it becomes possible to gestate embryos *ex utero*, then, the argument goes, there will be little difficulty finding enough prospective parents. Or, to frame it in terms of the above *modus tollens*, if one opposes abortion based on a full moral status view of embryos/fetuses, then one need *not* regard parent-friendly IVF as morally objectionable. For it would *only* be objectionable if it led to the deaths of embryos, either by being destroyed or discarded, or to denying them a conscious existence in perpetuity. Yet it need not require either of these things *if* artificial wombs will promote sufficient embryo adoption to ensure that surplus embryos can be brought into a conscious existence.

It is this argument I wish to assess. I shall argue that there are good reasons to doubt whether it succeeds in eliminating the moral tension between opposing most abortion but tolerating parent-friendly IVF.

3 Total Ectogenesis and the Challenge

A few more clarifications before I share my arguments.

First, it will be important to distinguish two types of artificial womb technology. There is, first, the type described earlier in discussing how researchers at the Children's Hospital of Philadelphia successfully transferred lamb fetuses to artificial wombs. This type of technology, in which a partially developed fetus is transferred

from a natural to an artificial womb for *part of its gestation*, has been termed "partial ectogenesis."[18] There is also a more speculative version, in which it is hypothesized that we may one day be capable of transferring IVF embryos *directly* to artificial wombs, in which case they will be *entirely gestated* in *ex utero* environments. This second type of artificial womb technology has been termed "total ectogenesis."[19] This distinction will be important because the AWA expressly assumes total ectogenesis; that is, it envisions a future in which gestation is *entirely removed* as a barrier to embryo adoption. Unlike partial ectogenesis, however, total ectogenesis is still speculative. There is no estimate as to when it will be developed, let alone when it will become widely available.[20]

I also wish to add an element to the inconsistency argument I proposed earlier. Previously, I said that there are estimated to be around one million embryos in storage in the United States. However, this estimate is conservative. The actual number is likely to be higher. Let me explain, first, why this should be the case. Then I will introduce a corresponding proposal, what I will call *The Challenge*, which will function as a benchmark for the AWA, the target level of embryo adoption that artificial wombs must facilitate to eliminate the moral inconsistency between opposing most abortions but not opposing parent-friendly IVF.

It should be noted, first, that there is a precedent for underestimating the number of embryos in storage. The first credible study on this issue was published in *Fertility and Sterility* in 2003. Previously, the number of embryos in storage in the United States was thought to be around 100,000. The 2003 report by Hoffman et al. found the actual number to be more than four times higher, over 400,000 (Hoffman et al., 2003). Given this tendency to underestimate, it would not be surprising if the current number is higher than the often-cited one-million-in-storage estimate.

This is especially likely given the growth of fertility medicine over the past few decades. The first "test tube baby" was not created until 1978, and IVF remained a somewhat experimental technology well into the 1980s. Today, it is more widespread. A recent report by the Centers for Disease Control and Prevention (CDC) found that 326,468 fertility treatments involving IVF occurred in the United States in 2020 (CDC, 2021).[21] Of these, 203,164 were embryo transfers that resulted in 91,453 pregnancies and 75,023 live-birth deliveries. The other 123,304 were "banking cycles" in which eggs or embryos were stored for future use. The CDC report also found that around 2.3% of all infants born in the United States each year are conceived using IVF.

[18] See, for example, Räsänen (2017, 697), Kingma and Finn (2020, 356), and Pruski and Playford (2022, 36).

[19] See Cannold (1995, 55).

[20] One neonatologist has stated that total ectogenesis is "so far in the distant future that it is not worth discussing its implications in relation to the current technology" (Kozlov, 2023, 440).

[21] Technically, the CDC report says that "326,468 new ART cycles [were] reported in 2020" (2021). However, it defines "ART" as "[all] treatments or procedures that include the handling of human eggs or embryos to help a woman become pregnant" and emphasizes that "[in] general, ART procedures involve surgically removing eggs from a woman's ovaries, combining them with sperm in the laboratory, and returning them to the woman's body or donating them to another woman.".

These numbers should raise doubts about the one-million-in-storage estimate. If the first two decades of IVF had *already* produced *nearly half a million* surplus embryos, in a time when IVF was *not widely available*, it is not farfetched to think that *more than half a million* have been produced in the two decades since it became *more widely available*. Recall, too, that parent-friendly IVF is the norm in the United States. This complicates the CDC statistics in the previous paragraph. Presumably, the 123,304 banking cycles would have produced more than 123,304 surplus embryos, assuming they were on-balance successful in producing either multiple storable eggs, a subset of which would be converted into IVF embryos, or multiple embryos. Presumably, too, a significant stockpile of surplus embryos was left unused for the 203,164 embryo transfers, recalling again that most Americans opt to have extras created in case these attempts at pregnancy fail. Finally, the CDC report only takes into consideration IVF treatments that occurred in 2020. Absent from it are the surplus embryos left over from previous years by individuals who did not participate in new treatments, such as parents who had already successfully achieved childbirth and had abandoned further attempts at pregnancy.

The actual number of embryos in storage is likely to be much higher, then, than one million. Possibly, many more than 123,000 surplus embryos are added to the fertility system each year. Possibly, considerably more than 200,000 are, as it were, "on deck" in any given year. Finally, there is a large and growing stockpile of leftover embryos from previous years' successful attempts. This stockpile was already nearly half a million two decades ago, when IVF was less commonly used, from which it seems reasonable to infer that it should be considerably larger given the explosive growth of fertility medicine over the previous two decades.

There are also good reasons to think that these numbers will continue to grow steadily if not exponentially. A recent study by the Pew Research Center found that 42% of Americans have either used fertility treatments or know someone who has, a considerable uptick from a previous Pew study, conducted just five years prior, which found the number to be 33% (Goddard & Aragao, 2023). The Pew study still lists IVF as the least commonly used form of fertility medicine. However, its use is increasing in line with the overall growth of fertility medicine. We should expect, therefore, that the number of embryos in storage will continue to grow at a greater rate than what has transpired thus far. Other factors support this prediction too. There is, first, the ongoing trend of more U.S. citizens waiting until later in life to have children, thereby increasing the likelihood that they may need to use assisted reproductive technology. There is also the legalization of same-sex marriage and, with it, the increased interest among same-sex couples in raising children with whom they share genetic connections, something they can achieve through IVF, particularly in cases of same-sex male couples.

My claim, then, is that *if* one opposes most abortions based on a full moral status view, *then* one should regard this situation as an urgent moral crisis. Only a fraction of surplus embryos are brought into a conscious existence through embryo adoption. Most are discarded or frozen indefinitely. If each has full moral status, then discarding them should be highly immoral, and freezing them in perpetuity would seem to seriously wrong them by denying them a conscious existence. That at least a million are being wronged in these ways should give abortion opponents pause. Given

that the actual number is likely to be higher, possibly much higher, and that it can be expected to grow steadily if not exponentially, should be a cause of tremendous alarm.[22]

Let me refer to this problem as *The Challenge*. The Challenge is not necessarily a challenge if one does not accept a full moral status view. If one regards embryos as "genetically human" but not "morally human," at least not until a later stage of fetal development, to borrow Mary Anne Warren's distinction (1973), then there is not necessarily anything wrong with allowing would-be parents to create a supply of backups. But if one regards them as having full moral status, then it is difficult to see how The Challenge could not be an urgent moral crises, one that obliges abortion opponents to oppose parent-friendly IVF.

Here, I would draw a comparison between The Challenge and Toby Ord's idea of "The Scourge." Like myself, Ord's aim in "The Scourge: Moral Implications of Natural Embryo Loss" is to point out a problematic implication of anti-abortion arguments that rely on a full moral status view. Most embryos die of natural causes within weeks of conception. If one accepts a full moral status view, then one should regard these deaths as an extraordinary crisis. To help concretize it, Ord invites readers to imagine a fictional illness, *The Scourge*, that kills two hundred million newborns each year, his estimate of the number of embryos that die annually from natural embryo loss (2008, 12). Would we not consider ourselves to have an overwhelming obligation to combat The Scourge? But shouldn't abortion opponents who accept a full moral status view regard natural embryo loss as a comparable crisis? The fact that most do not raises doubts, in turn, about their purported commitment to the full moral status view.

My argument is similar: if one opposes abortion based on a full moral status view, then one should regard The Challenge as an extraordinary moral crisis. The fact that many do not would suggest that they are not consistently committed to a full moral status view of embryos/fetuses. More importantly, The Challenge is helpful for conceptualizing what the AWA must show to alleviate the moral inconsistency between opposing most abortions but accepting parent-friendly IVF, or, put otherwise, to successfully deny P1 in the *modus tollens* argument I described earlier.

[22] An anonymous reviewer asks why these numbers should matter to someone who accepts a full moral status view. Even if there were only, say, one hundred thousand embryos in storage, wouldn't it be urgent to save them if one regards them as having full moral status? Moreover, couldn't one also object that the artificial womb argument is on shaky ground in assuming that artificial wombs will promote enough embryo adoption to accommodate an even lower estimated number of surplus IVF embryos?

I suspect the reviewer is right to make these observations. Surely, if we could save one hundred thousand innocent children's lives, it would be urgent to do so. Given that someone who accepts a full moral status view sees IVF embryos as morally analogous to children, it seems reasonable to think that they should regard parent-friendly IVF as an urgent moral dilemma even if there are fewer embryos in storage. I also agree that there may be good reasons to question whether ectogestation would promote enough embryo adoption to accommodate a lower estimate number of surplus IVF embryos. My argument is that the artificial womb argument is unlikely to succeed even if we assume that artificial wombs could accommodate these numbers given that actual number of IVF embryos in need of rescue is likely to be exponentially higher by the time ectogestation becomes available.

The AWA must show that artificial wombs will lead to enough embryo adoption to overcome The Challenge.

4 Five Problems with the Artificial Womb Argument

I turn now to voicing my worries about the AWA.

4.1 Supply and Demand (I)

Here is my first worry: there are good reasons to be skeptical about whether there are enough prospective parents to surmount The Challenge.

Obviously, the AWA's defenders will reject this claim. Here, they can point to a longstanding problem in United States of an apparent oversupply of prospective adoptive parents. Indeed, the Supreme Court made this point in *Dobbs v. Jackson*. The majority opinion notes that "a woman who puts her newborn up for adoption today has little reason to fear that the baby will not find a suitable home" and cites as evidence a 2008 CDC study that found that nearly "1 million women were seeking to adopt children in 2002… whereas the domestic supply of infants relinquished at birth or within the first month of life and available to be adopted had become virtually nonexistent" (2022, 34). Shouldn't I be more optimistic, therefore, about overcoming The Challenge through artificial womb technology? If there is a very large group of would-be parents who want to adopt but face an uphill battle in doing so, and if artificial wombs will remove a major barrier to embryo adoption, why not conclude that The Challenge can be resolved through embryo adoption?

A problem with this response is that it relies on an oversimplified picture of the adoption system. I do not deny that parents who want to adopt newborns face long wait times. However, it is misleading to claim that there is a clearcut *undersupply* of children or a clearcut *oversupply* of prospective parents. Instead, there is longstanding contradiction at the heart of the adoption system. Elisabeth Landes and Richard Posner give a blunt description of it in their in landmark study, "The Economics of the Baby Shortage":

Students of adoption agree on two things. The first is that there is a shortage of white babies for adoption; the second is that there is a glut of black babies, and children who are no longer babies (particularly if they are physically or mentally handicapped), for adoption (1978, 324–325).

It is not entirely accurate to say, then, there are more than enough prospective parents to meet our adoption needs. The situation is more complex. Viewed from one angle, there appears to be an *oversupply* of parents *for a specific type of child*. Viewed from another, there appears to be an *undersupply* for *all the children* in need of adoption.

A defender of the AWA could insist that the argument should still apply. If there is an oversupply of parents for healthy newborns, then artificial wombs will enable more to realize this goal while reducing the stockpile of surplus embryos. Perhaps there is a moral tradeoff if it leads to fewer adoptions of older children, children

of color, or children with disabilities, but someone who accepts a full moral status view could argue that the tradeoff is worth it. Of course, it will be lamentable if fewer children end up adopted. Yet having more children receive potentially less-than-ideal childhoods in foster care is still preferable, ethically speaking, to allowing millions to die or to be wholly deprived of a conscious existence.

I do not want to be too quick to dismiss this objection. I will return to it later. However, I would propose that the adoption system's complexities should elicit some initial skepticism about the AWA. It is *extremely* difficult to make accurate predictions about adoption. To give a few examples, Landes and Posner note that the availability of contraceptives did not impact adoption in the ways experts anticipated, nor did abortion's legalization after *Roe v. Wade* (1978, 325). They also note that it is technically inaccurate to say that there is an *oversupply* of prospective parents in contrast to an *undersupply* of adoptable newborns. Because of the hefty regulations on adoption, few adoptions occur in the United States without the help of adoption agencies. But these same regulations mean that parents working through these agencies face long wait times, three to seven years, at which point the newborns they hoped to adopt are no longer newborns, hence "no longer appealing to prospective adoptive parents" (1978, 326, 327). Landes and Posner famously (perhaps infamously) conclude that the only way to fix adoption is to deregulate it and allow some form of "baby selling." If they are right, then it is unclear whether artificial wombs would produce a groundswell in adoption since the limiting barrier does not appear to be a lack of adoptable newborns but restrictive regulations.

To be clear, none of these observations amount to a knockdown refutation of the AWA. I offer them only as initial grounds for skepticism. The AWA interprets the alleged baby shortage as evidence that there are more than enough would-be parents to surmount The Challenge once total ectogenesis eliminates gestation as a barrier to embryo adoption. But the adoption system and the economics of the baby shortage are extremely complex matters, and it is not clear that they support the AWA's predictions. There may not be enough parents to overcome The Challenge given that, viewed from one angle, there are already not enough to meet our adoption needs. And even if there are, it is unclear whether simply increasing the supply of adoptable newborns through embryo adoption would lead to vastly more adoption, enough to overcome The Challenge, given that the main barrier appears to be a bottleneck of legal regulations, not supply or demand.

4.2 Supply and Demand (Continued)

There are other reasons to be skeptical of whether there will be enough willing parents to overcome The Challenge.

Some of my evidence for this claim has already been discussed. It is often estimated that there are around one million embryos in storage in the United States. Several adoption websites also estimate that there are between one and two million prospective parents. Defenders of the AWA could say that these numbers should encourage us to be optimistic about overcoming The Challenge once total

ectogenesis becomes available. However, the one-million-embryos-in-storage estimate is, I have argued, an overly conservative estimate.

Suppose for the sake of argument that a new study reveals our current estimates to be off to an equivalent degree as Hoffman et al.'s study revealed them to be off in 2003. It would no longer be clear that there are enough prospective parents to overcome The Challenge. The added difficulty is that the number of embryos in storage is likely to grow at a steady if not exponential rate for the foreseeable future. Finally, it should be reiterated that total ectogenesis is still very much a speculative technology. The Challenge will continue grow, therefore, for a considerable stretch of time before total ectogenesis can even begin to address it. By that point, The Challenge will simply be too large to fix through embryo adoption.

Perhaps it could be objected that there are limits to The Challenge. Perhaps we have already reached them. I claim that there are probably far more than one million embryos in storage in the United States. But there may be technical limits on the number that can be stored. There are a finite number of hospitals, labs, and commercial reproductive medicine centers, each with finite storage capacity. Perhaps we lack the infrastructure needed to store more than one million embryos. Or perhaps the financial costs become too burdensome for most parents, such that, over time, there is a gradual attrition. Perhaps, for one reason or another, the overall number in storage cannot help but remain fairly inelastic.

The problem with this reply is that it *amplifies* the inconsistency between opposing most abortions but accepting parent-friendly IVF. The AWA claims that abortion opponents can tolerate parent-friendly IVF, that, contrary to P!, they need not see it as morally objectional, because artificial wombs will eventually provide an alternative way to rescue surplus embryos. I argue that this solution is unlikely given how large The Challenge will be by the time total ectogenesis becomes available. However, if I am wrong, if Its size is inelastic, this can only be due to massive numbers of embryos being discarded or destroyed annually. And if *that's* the case, then abortion opponents would have *an even more urgent duty* to oppose parent-friendly IVF, for many millions of IVF embryos will have died long before total ectogenesis becomes available. Either The Challenge will grow to too large to fix, in which case abortion opponents should oppose parent-friendly IVF to halt its growth, or it will remain fixable but so urgent that fixing it cannot be delayed by waiting around for artificial womb technology.

4.3 Amplifying the Challenge

I turn now to a second set of objections. So far, I have argued that there are good reasons to be skeptical about whether there will be enough prospective parents to overcome The Challenge once total ectogenesis becomes available. There are also good reasons to think that total ectogenesis will amplify The Challenge, not ameliorate it.

The first of these objections relies on an assumption. The assumption is this: most people who wish to become parents *also wish* to parent children with whom they share a genetic connection. I take this assumption to be fairly uncontroversial. It is

often asserted as obviously true by others. There is also evidence for it in the explosive growth of fertility medicine. That so many infertile parents seek help from fertility medicine, often at great personal expense, rather achieve parenthood through adoption, suggests that the desire to be a parent is strongly linked for many with the desire to parent their own genetic offspring.

If this is true, then there will be a hard limit on the number of persons who can be expected to participate in embryo adoption. Here I freely admit that I have no idea what this limit is. Nor do I wish to speculate about it. My point is simple: it is unrealistic to think that most citizens, who are clearly mainly if not exclusively interested in parenting their own offspring, will undergo a change of heart and opt for embryo adoption instead. The AWA cannot be banking on this. Instead, its claim must be that there is a sizeable enough *subpopulation* that can be expected to adopt embryos once a critical barrier, gestation, is removed.

It will be helpful to have a term for this hard limit on embryo adoption. Let me refer to it as *The Subpopulation*. Here is the argument I wish to make: total ectogenesis will decrease the size of The Subpopulation.

I draw this conclusion for several reasons. First, individuals experiencing infertility are, I take, one group that comprises The Subpopulation. Adoption is an option of last resort for some of these individuals, something they are willing to consider if attempts at having a child with help from fertility medicine should fail. Artificial wombs will decrease the number of individuals in this group. Take, for example, parents who must rely on IVF and on hiring a surrogate. Both of these services are costly, and, jointly, they may be prohibitively expensive, leading some to turn to adoption.[23] But if artificial wombs capable of total ectogenesis become available, and if they are safe and inexpensive, then, presumably, some of these individuals will take advantage of this technology and will no longer choose to adopt. A similar point can be made for same-sex couples who adopt because they are physically incapable of gestation and who cannot afford commercial surrogacy. If artificial wombs remove these barriers, some will use them to parent their own offspring.

What's more, total ectogenesis will not only siphon off these parents; it will lead them to add to The Challenge. Recall that the whole point of the AWA is to explain how abortion opponents can oppose most abortions without opposing parent-friendly IVF. The argument envisions a future, therefore, in which parent-friendly IVF continues to be permitted—where individuals using IVF are allowed to create backup embryos on the grounds that these embryos can be expected to one day be brought into a conscious existence through embryo adoption. But if *that's the case*,

[23] For an example, see Rebecca Haimowitz's and Vaishali Sinha's documentary on transnational surrogacy, *Made in India*. The American couple in it, Lisa and Brian Switizer, desperately wish to become parents but suffer from infertility complications that require both IVF and surrogacy, which they cannot afford in the United States. They state that they are willing to consider adoption if their last-ditch effort at having a child through transnational surrogacy proves unsuccessful. The Switzers travel to a fertility clinic in India where they create several IVF embryos. My argument is similar: if total ectogenesis, like transnational surrogacy, provides an affordable way for some infertile individuals to have children, it will siphon off some would-be adoptive parents, and, what's more, these individuals will now be creating surplus embryos.

then total ectogenesis will not only decrease The Subpopulation but increase The Challenge. For some individuals who would have been potential adoptive parents will now themselves be taking advantage of parent-friendly IVF, thus adding to the stockpile of surplus embryos in need of adoption.

4.4 Ideal Ectogenesis

These objections can be sharpened. To do so, I would point out that the AWA assumes not only that we will develop total ectogenesis. It assumes a degree of what I will call *ideal total ectogenesis*.

Let me explain. Consider, first, that gestation is technically not a prohibitive barrier to embryo adoption. Proponents of the AWA have suggested that it is a major barrier because some prospective parents may be physically incapable of gestation and others may be unwilling to shoulder the sacrifices it requires. However, these obstacles can be overcome through surrogacy. The fact commercial surrogacy has not led to embryo adoption on the scale needed to overcome The Challenge would seem to imply that total ectogenesis will need to be *more convenient* to produce this result.

Suppose, for example, that the main reason why more would-be parents who are willing to consider embryo adoption do not to hire surrogates is because it is too expensive. The base compensation rate for commercial surrogates in the United States ranges from $30,0000 to $70,000 (Braverman & Segal, 2023). If artificial womb technology is going to produce a groundswell in embryo adoption, it will need to cost substantially less than these amounts, or their far-future equivalents. To be clear, I focus on these financial considerations only as an illustrative example. My point is that *whatever* the reasons why commercial surrogacy has not led to more embryo adoption, artificial wombs will need to be more convenient *in these regards* to incentivize it on the scale needed to overcome The Challenge.

The AWA assumes, then, not only that we will develop artificial wombs capable of total ectogenesis but that they will be sufficiently convenient to incentivize embryo adoption on a more massive scale. Here, we can imagine a maximally user-friendly form of total ectogenesis, something that employs the borderline magical technology found in science fiction, in which birthing a child through total ectogenesis is one hundred percent safe, effortlessly convenient, and easily affordable to all. Let me refer to this science fiction version of total ectogenesis as *ideal total ectogenesis*.

Actual total ectogenesis need not be as convenient as ideal total ectogenesis for the AWA to succeed, but it does provide a helpful benchmark. For the AWA to succeed, actual total ectogenesis will need to be *more convenient* than the options currently available to prospective parents who are willing to consider embryo adoption, such as commercial surrogacy, which have not led to embryo adoption on the scale needed to overcome The Challenge. To do so, it will need to resemble ideal total ectogenesis *to some degree*. The more it does, the more likely it will be to incentivize more prospective parents to participate in embryo adoption. The problem is that the more actual total ectogenesis resembles ideal total ectogenesis, the more likely it

will be to tempt more people *in general* to forgo sexual reproduction, gestation, and childbirth in favor of total ectogenesis. If artificial wombs will one day allow us to avoid virtually *all* the risks and sacrifices of gestation and childbirth, and if they are safe, cheap, and convenient, then a majority of people will most likely take advantage of them, not just those considering embryo adoption.

But recall that the AWA also asks us to envision a future in which parent-friendly IVF continues to be permitted. Again, the whole point of the AWA is to show how abortion opponents can go on tolerating parent-friendly IVF while opposing most abortions. Ideal total ectogenesis would lead to a situation, therefore, where many more people, perhaps a majority, procreate through a combination of IVF and total ectogenesis. We also know that parents who use IVF overwhelmingly choose to create surplus embryos when given this option, which, in turn, implies that The Challenge could balloon to unimaginable proportions once total ectogenesis is convenient enough to incentivize the predicted levels of embryo adoption.

Admittedly, elements of this argument are speculative. The point is that there is a tension in the AWA itself. To incentivize more people to adopt embryos, total ectogenesis will need to be sufficiently convenient, which involves approximating ideal total ectogenesis to some degree. Yet the more it resembles ideal total ectogenesis, the more likely it will be to increase the size of The Challenge by incentivizing more people *in general* to procreate through a combination of parent-friendly IVF and total ectogenesis.

4.5 Other Moral Problems

Let me end by identifying a final set of considerations that support my skepticism about whether artificial wombs will promote enough embryo adoption to resolve The Challenge. Artificial wombs are unlikely to produce this result without running afoul of other moral controversies, ones that may dissuade some parents from participating in embryo adoption.

My first example was discussed earlier, when I noted that more embryo adoption could exacerbate a longstanding problem in the adoption and foster care systems, namely the lack of willing parents for older children, children of color, and children with disabilities. I also suggested that abortion opponents who accept a full moral status view might be willing to accept this tradeoff. Of course, it will be lamentable if more disabled children, older children, and, possibly, more children of color end up unadopted as a result of more embryo adoption. But having more children receiving less-than-ideal childhoods in foster care is still preferable, ethically speaking, to allowing millions of innocents with full moral status to die or to be frozen indefinitely.

I promised a more complete reply to this objection. The objection strikes me as consistent given a full moral status view. The concern I would raise about it is that embryo adoption will be less appealing to some if it is perceived as amplifying racism and ableism in the adoption system, or as exacerbating the all-too-well-known failings of the foster care system. If total ectogenesis succeeds in facilitating vastly more embryo adoption, this will almost certainly come at the expense of adoption

in general. Far greater numbers of otherwise adoptable children will end trapped in the foster care system, whose flaws are widely recognized.[24] For someone who stridently opposes most abortions based on a full moral status view, this may not be enough to dissuade them from rescuing surplus embryos through embryo adoption. But for someone who does not share this view, someone who does not necessarily see IVF embryos as unborn children in urgent need of rescue, they may be dissuaded if total ectogenesis and embryo adoption come to be perceived as amplifying other social-ethical problems, such as the horrors that exist in the foster care system.

Total ectogenesis will likely run afoul of other moral controversies as well, ones that may be of greater concern to the individuals who are the AWA's target audience. The AWA is supposed to show how abortion opponents who accept a full moral status view can consistently accept parent-friendly IVF. I do not wish to overgeneralize about abortion opponents; they are not a monolithic group. Presumably, though, one subgroup that comprises this community are pro-life Christians. Yet some pro-life Christians are also wedded to beliefs about the theological significance of sexual reproduction, gestation, and childbirth that may make them reluctant to support total ectogenesis. Put simply, the idea that pro-life Christians will take up embryo adoption *en masse* seems at least somewhat questionable given that they are more likely than others to have deep-seated moral/theological reservations about total ectogenesis and IVF.

Finally, consider this conundrum: *What regulations should apply to embryo adoption if it becomes more widespread?* Currently, embryo adoption is treated similarly to traditional adoptions, with prospective parents working through adoption agencies. Here, however, it is important to recall Landes's and Posner's analysis of the baby shortage—their observation that the robust regulations on adoption are what appear to have created this shortage. If they are right, then simply increasing the supply of adoptable babies through total ectogenesis may have no impact on adoption rates as they are already bottlenecked by restrictive regulations. To promote embryo adoption on the scale needed to overcome The Challenge, it may be necessary to loosen these restriction. Yet this will almost certainly lead to a host of other controversies.

Suppose, for example, that embryo adoption comes to be treated more like gamete donations. Suppose prospective parents can simply purchase adoptable IVF embryos in something like the way in which they can purchase donor sperm or donor eggs. This type of prenatal baby-selling would expedite embryo adoption, which it must do to keep pace with The Challenge, but would open its own Pandora's box. Landes's and Posner's pitch for baby-selling was controversial enough to keep Posner from being nominated to the U.S. Supreme Court (Barthold, 2023). Presumably, the litany objections leveled against him would apply to an expedited form of embryo adoption: that it is unethical to sell human lives, that "baby selling" increases the risk that children will end up raised by abusive parents, etcetera. It would also be open charges of unfairness if vastly different standards were used in embryo adoption as opposed to traditional adoption. Why should prospective parents

[24] See Cancel (2021) for a moving discussion of these flaws.

be required to undergo extensive background investigations for traditional adoptions but not embryo adoptions? If this vetting is needed to prevent child abuse, shouldn't it be used for embryo adoption as too? But if embryo adoption is subject to the same regulations as traditional adoptions, wouldn't this lead to the same bottleneck?

5 Conclusion

What follows from this article's arguments?

For some readers, not much. For those who do *not* accept a full moral status view, who regard abortion as morally permissible in many cases because fetuses do not acquire substantial moral standing until later in their fetal development, they will not necessarily find anything objectionable about parent-friendly IVF. The Challenge will not strike them as a challenge. That said, this article's arguments do support an inconsistency argument that has been made by defenders of abortion rights. This argument points out that abortion opposition that is based on full moral status views seems to be incompatible with widely accepted practices involving IVF embryos. Here, again, the controversy over the Alabama State Supreme Court ruling provides a good illustration: if one genuinely thinks that all embryos/fetuses should be considered "unborn children," then it is difficult to see how it can be morally permissible for would-be parents to create stockpiles of backup children that will be killed or frozen indefinitely. Yet many do not regard parent-friendly IVF as morally objectionable, as evidenced, again, by the fact that even many pro-life Republicans felt compelled to voice their support for it in the face of the public outcry over the Alabama State Supreme Corut ruling. The AWA has been proposed as a solution to this inconsistency—an explanation for why abortion opponents need not regard parent-friendly IVF as morally objectionable. This article shows that AWA fails to eliminate this inconsistency.

This article's arguments are also unlikely to come as a surprise to pro-life abortion opponents who *do* stridently oppose parent-friendly IVF. Perhaps some of its arguments will sharpen their opposition. For example, if I am right that we have grossly underestimated the number of embryos in storage, then they may have added reasons to see parent-friendly IVF as an even *more urgent* moral crisis.

The main reader for whom this article is intended, however, is someone who opposes most abortions based on a full moral status view but who wishes to accept parent-friendly IVF, the type of abortion opponent who, I claim, was shown to be far more common than one might have thought in the aftermath of the Alabama State Supreme Court ruling. I have argued elsewhere that this stance is untenable. The AWA has been proposed as a counterargument, a way in which abortion opposition can be squared up with tolerating parent-friendly IVF, or, to return to the earlier *modus tollens* argument, a way that abortion opponents can reject the claim in P1 that they must consider parent-friendly IVF to be morally objectionable if they accept a full moral status view. This article shows that AWA does not succeed in this task. There are good reasons to be skeptical about whether total ectogenesis will lead to enough embryo adoption to make parent-friendly IVF tolerable to abortion opponents. There are also good reasons to think that it will increase the number

of surplus embryos generated by parent-friendly IVF, thus making it an even more urgent moral crisis for abortion opponents. There does not appear to be a way for abortion opponents to avoid this either/or dilemma: either they rethink their commitment to the full moral status view, which would allow them to take a more lenient stance toward parent-friendly IVF, but may soften their opposition to abortion, or they adhere to it but accept that it requires them to oppose parent-friendly IVF.

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