



# Menstrual cycle and competitive bidding <sup>☆</sup>

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## ABSTRACT

In an experiment using two-bidder first-price sealed-bid auctions with symmetric independent private values and 400 participants, we collected information on the female participants' menstrual cycles and the use of hormonal contraceptives. We find that naturally cycling women bid significantly higher than men and earn significantly lower profits than men except during the midcycle when fecundity is highest. We suggest an evolutionary hypothesis according to which women are predisposed by hormones to generally behave more riskily during their fecund phase of their menstrual cycle in order to increase the probability of conception, quality of offspring, and genetic variety. We also find that women on hormonal contraceptives bid significantly higher and earn substantially lower profits than men. This may be due to progestins contained in hormonal contraceptives or a selection effect. We discuss how our study differs from Chen et al. (2013).

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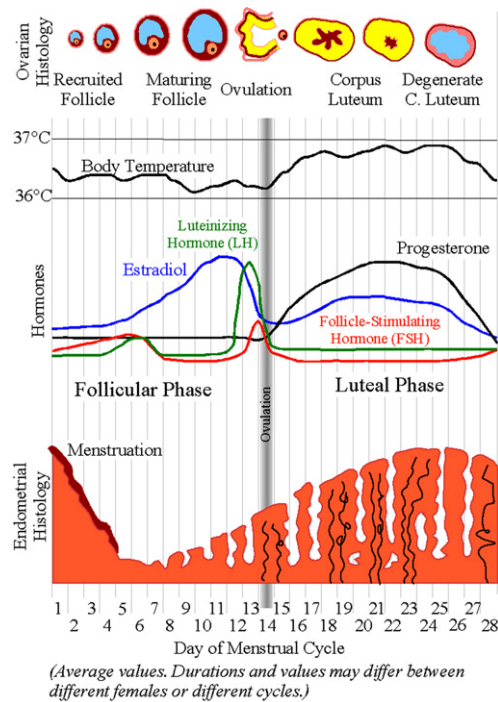
## 1. Introduction

We are interested to what extent biological factors may explain variations in competitive bidding in auctions. Casari et al. (2007) report significant different bidding behavior between men and women in sealed-bid first-price common value auctions. Initially, women bid significantly higher than men and thus are more prone to the winner's curse. However, women also learn bidding much faster than men, thus eventually their earnings may slightly surpass those of the men. Ham and Kagel (2006) report that females bid significantly higher than men in two-stage first-price private value auctions. Chen et al. (2013) show that women bid significantly higher and earn significantly less than men in first-price auctions with independent symmetric private values, while no such differences are observed in second-price auctions. The authors go a

<sup>☆</sup> This work was inspired by Chen et al. (2013). We are grateful to them for providing us the z-tree programs of their experiment. Financial support from the Institute of Governmental Affairs, UC Davis, and the UC Davis Hellman Fellowship is gratefully acknowledged. We thank three referees and an advisory editor for very useful suggestions. We also thank Coren Apicella, Thomas Buser, Scott Carrell, David Cesarini, Yan Chen, Doug Miller, Marianne Page, Jeff Schank, Robert Slonim, Barbara Sommer, Ann Stevens, as well as participants in the Workshop on Neuroeconomics & Endocrinological Economics 2009 for very helpful comments. Moreover, we thank Gabriel Mathy, Wen Yong Tang, and Nick Zolas for excellent research assistance.

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**Fig. 1.** Menstrual cycle. From <http://en.wikipedia.org/wiki/File:MenstrualCycle2.png>. Derived from image: MenstrualCycle.png, an image made by the user Chris 73. This file is licensed under the Creative Commons Attribution-ShareAlike 3.0 unported license.

step further by studying how bidding and profits differ across the menstrual cycle. Women differ from men in circulating levels of certain hormones, and some of those hormones change across the menstrual cycle. Estradiol, progesterone, the luteinizing hormone, and the follicle-stimulating hormone all change over the menstrual cycle (see Fig. 1). Thus menstrual cycle information provides relative easy to observe within-female measures of some hormones. Chen et al. (2013) report that women bid higher than men in *all* phases of their menstrual cycle in the first-price auction but not in the second-price auction. Moreover, for first-price auctions they infer that higher bidding in the follicular phase and lower bidding in the luteal phase are driven entirely by oral hormonal contraceptives.

Higher bidding of women in first-price auctions with independent private values may be due to risk aversion. The effects of risk aversion in this standard auction are well established in theory (see Krishna, 2002, Chap. 4.1). Risk aversion increases equilibrium bids in first-price auctions with independent private values but not in second-price auctions. In first-price auctions with independent private values, a higher bid translates into a higher probability of winning the auction, but it also leads to a lower profit conditional on winning the auction. In the symmetric equilibrium in weakly dominant strategies of second-price auctions, risk aversion has no effect on bids. Surveying recent experimental and empirical work on gender, risk, and competition, Croson and Gneezy (2009) conclude that despite some caveats there is “clear evidence that men are more risk-taking than women in most tasks and populations” (see also Eckel and Grossman, 2008) and that on average women prefer less competitive situations than men. We would like to point out though that various dispositions towards uncertainty like anticipated regret from losing the auction (see Filiz and Ozbay, 2007), overconfidence in the winning probability of a bid, ambiguity aversion, joy of winning, relative payoff concerns (Morgan et al., 2003), etc., lead to similar behavioral predictions in first-price auctions with independent private values. Thus, gender or hormones may affect bidding in first-price auctions with independent private values through a number of those dispositions that are behaviorally indistinguishable from risk aversion.<sup>1</sup>

To our knowledge, Chen et al. (2013) is one of the first papers in economics using menstrual cycle information as a proxy for the effect of certain hormones on economic behavior. As such, it warrants an independent replication, which is the goal of our study. Potentially, robust findings on the endocrinology of economic behavior could profoundly influence our understanding of the biological basis of economic outcomes including the gender wage gap (for a survey, see Blau and Kahn, 2000).<sup>2</sup> Our study focuses on the first-price auctions only. We thank Yan Chen for providing us with the

<sup>1</sup> Therefore, we will use in this paper the term “risk aversion” to refer more generally to any disposition that is behaviorally indistinguishable from risk aversion in first-price auctions. For a discussion of the experimental evidence on risk aversion in first-price auctions we refer to Kagel (1995, Chap. 7 I.G).

<sup>2</sup> Using data from a large Italian bank, Ichino and Moretti (2008) conclude that the women’s higher levels of absenteeism in the workplace due to their menstrual cycle explains at least 14% of the gender wage gap. But Rockhoff and Herrmann (2012) do not find that absenteeism is due to the menstrual cycle for a data set of teachers and show that the result by Ichino and Moretti (2008) is not robust to the correction of coding errors.

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