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The net effect of advice on strategy-proof mechanisms: An experiment for the Vickrey auction

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Online Appendix for “The net effect of advice on strategy-proof mechanisms: An experiment for the Vickrey auction”

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December 3, 2020

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B Ausubel auction

B.1 Theoretical consideration

In the Ausubel auction (Ausubel (2004)), instead of reporting their valuations for the objects to the auctioneer, all bidders gradually reveal their demands at given prices, until the auction ends. The rule of the Ausubel auction can be described as follows.

- **Ausubel auction:** In this auction, a price is gradually increased from 0. At each price p , each bidder i reports his demand $D_i(p) \in \{0, 1, 2\}$. Note that for each bidder i , $D_i(0) = 2$ and D_i is non-increasing in p . For each price p and each bidder i , let $D(p) \equiv D_1(p) + D_2(p) + D_3(p)$ and $D_{-i}(p) \equiv D(p) - D_i(p)$ denote the aggregate demand at p and the aggregate demand of all other bidders except i , respectively. As the price p rises, the aggregate demand $D(p)$ will fall and, at a certain p^* , there is some bidder, say bidder i^* , such that $D_{-i^*}(p^*) = 1$. At this price, the competitors of bidder i^* demand one unit less than the available number of units (two units), and thus, bidder i^* gets one unit for sure. Then, we say that bidder i^* has *clinched* one unit. The bidder i^* 's payment for it is the price at which he has clinched it, p^* . Thereby, both the available number of units and the bidder i^* 's demand are reduced by one unit, respectively, and the auction continues until the available number of units becomes 0.

In the Ausubel auction, a bidder i 's sincere bidding, which consists of both reporting two demands until the price equals v_i^2 and reporting one demand until the price equals v_i^1 , is not a weakly dominant strategy (Kagel and Levin (2009)). However, it is an ex post equilibrium (Ausubel (2004); Okamoto (2018)).

B.2 Experimental procedures

We conducted an experiment to test the effect of advice for the Ausubel auction. To compare the results of the Vickrey auction and those of the Ausubel auction, the settings for each treatment are identical to the setting for the Vickrey experiment. There are two types of treatments:

1. **Treatment AA:** the Ausubel auction with advice
2. **Treatment AN:** the Ausubel auction without advice

We conducted three experimental sessions in each of AA and AN at Osaka University in February 2020. Nine, twenty-one, or twenty-four subjects participated in each

Table 10: Summary of treatments.

Treatment	Auction rule	Advice	Date	# of Sessions	# of Subjects (Groups)
AA	Ausubel	Yes	Feb-20	3	54 (18)
AN	Ausubel	No	Feb-20	3	57 (19)

session. We recruited student subjects from Osaka University through campus-wide advertisements. None of the students were experienced in this particular type of experiment. No subject attended more than one session. Table 10 summarizes the number of observations.

In each session, each subject was seated at a computer terminal assigned by a lottery.²⁶ All terminals were separated by partitions. No communication among subjects was allowed. Each subject had a set of printed instructions and a recording sheet.²⁷ The experimenter read aloud the instructions. Then, subjects answered a 17-question quiz that tested whether they understood the auction rule that they had been informed of a short time ago. Every correct answer was worth \$0.3. The experimenter read aloud the answers to the quiz. Subsequently, only in AA, the experimenter distributed a paper with written advice and also read it aloud. The text of the advice is as below:

“The following advice is about the auction in which you are participating. Please consider carefully whether this advice is true or false. It is completely up to you whether you follow the advice.

You can maximize your earnings by reducing your demands at your values as they are, regardless of the prices at which others reduce their demands.”

Note that the advice involves no deception problem for AA. The subjects were given time to ask questions before proceeding to two practice periods, which were followed by 25 successive real periods under the random matching protocol.

At the beginning of each period, all subjects were separated into groups of three. One period of the Ausubel auction proceeds as follows. The price is gradually increased from 0 to 2000, which is equal to the maximum possible bid in our Vickrey treatments. The price rises in increments of 10 JPY (= \$0.1) every two seconds.²⁸ Each subject

²⁶We used the z-Tree program.

²⁷The full set of experimental instructions (including screen shots, the quiz, and the questionnaire) is provided in [Online Appendix K](#), [Online Appendix L](#), [Online Appendix M](#), [Online Appendix N](#), and [Online Appendix P](#).

²⁸The price increased by 10 JPY every 3 seconds in the first sessions in each of AA and AN. However, to be punctual and finish one session within three hours, we subsequently modified the clock speed to 2 seconds from the second session onward.

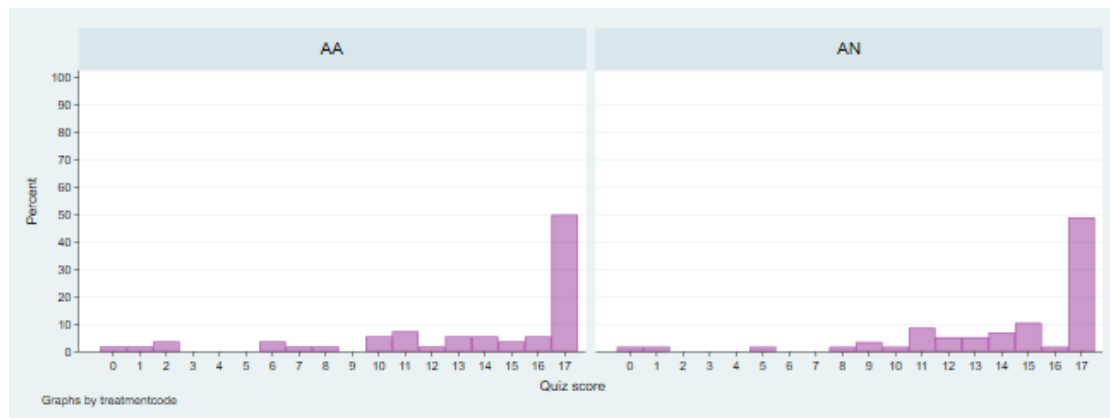


Figure 4: Distribution of quiz scores for each treatment prior to the auctions.

clicks a button on the screen to reduce his demand by one unit. The auction ends when the aggregate demand becomes two (i.e., the demand reduction button is clicked four times), unless the price reaches 2000.

After the 25 payment periods, the subjects completed a questionnaire and were immediately paid in cash. Each subject was privately paid the sum of his/her earnings over the 25 periods. The individual payments ranged from \$32.6 to \$91.5.

B.3 Level of understanding and bidding behavior

Figure 4 displays the distribution of quiz scores. The scores range from 0 to 17. In both treatments, about half of the subjects (50.0% and 49.3% in AA and AN, respectively) had a perfect score in the quiz conducted immediately after instructions had been shared. Then, we have the following result:

Result 8 (Level of understanding regarding the rule of the Ausubel auction).

In the Ausubel auction, 49.6% of the subjects had a perfect score in the quiz.

Figure 5 illustrates how bidding behavior contrasts between units in the Ausubel auction. The subjects typically bid sincerely for the first unit, while they overbid for the second unit. This behavior explains 59.0% and 52.9%, respectively, of the first and second unit bids, when combining the data of the AA and AN. A full categorization of each bid into “Over,” “Sincere,” and “Under” is summarized in Table 11. Bids were more likely to become sincere over time when advice is provided.

Interestingly, a dynamic nature of the Ausubel auction induces a unique type of overbidding, which does not prevail in the static Vickrey auction treatments: The Ausubel auction subjects tend to reduce demand for the first time when the price

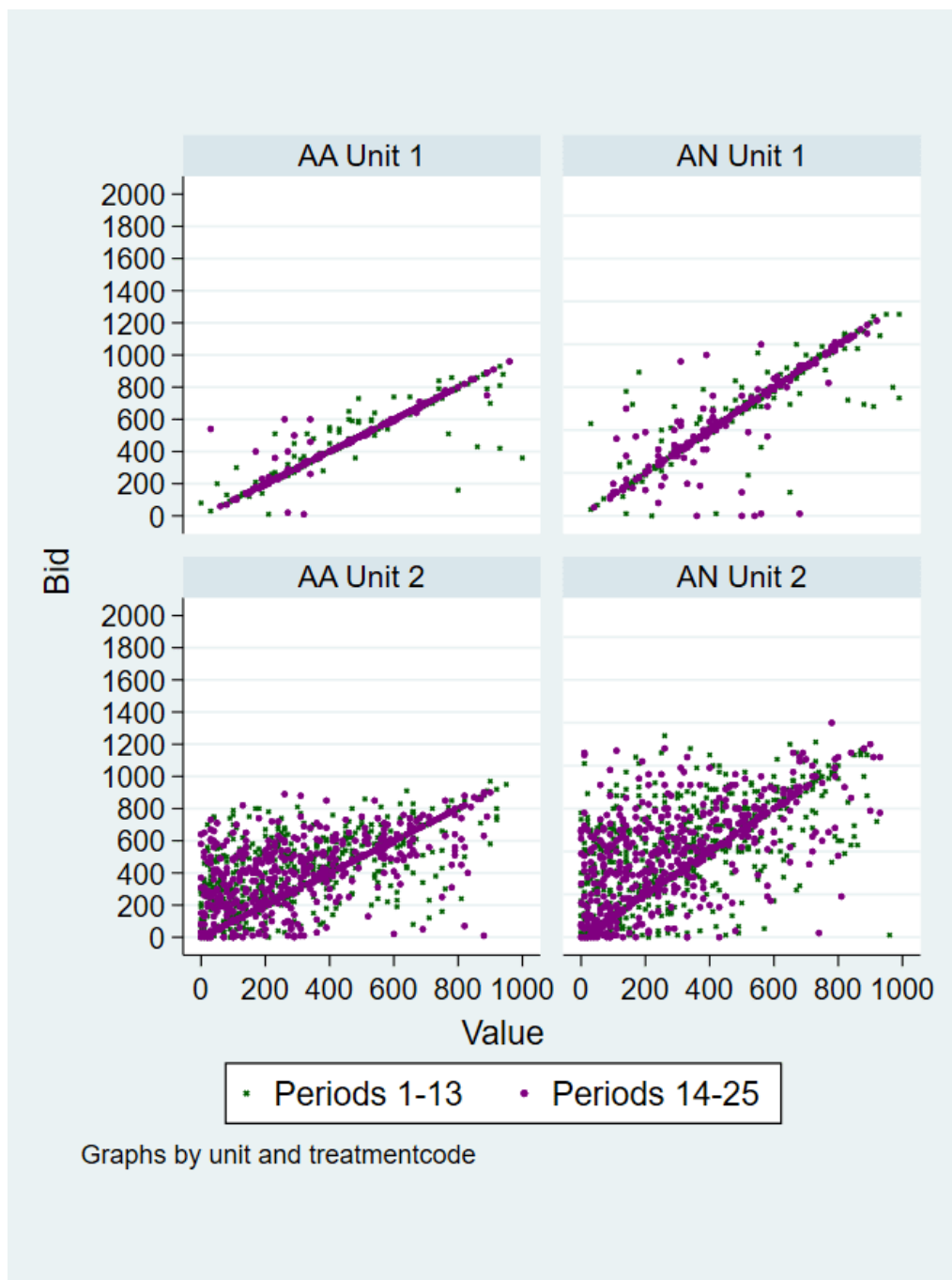


Figure 5: Scatter plots of bids. Green \times and purple \bullet indicate bids for the former 13 periods and latter 12 periods, respectively.

Table 11: Bid category by treatments and units in the Ausubel auction.

(a) All			
Bid category	AA	AN	AA–AN
Over	747 (41.50%)	785 (42.66%)	–1.16%
Sincere	700 (38.89%)	561 (30.49%)	8.40%
Under	353 (19.61%)	494 (26.85%)	–7.24%
Total	1,800	1,840	

(b) Periods 1–13			
Bid category	AA	AN	AA–AN
Over	422 (45.09%)	413 (41.8%)	3.29%
Sincere	317 (33.87%)	291 (29.45%)	4.42%
Under	197 (21.05%)	284 (28.74%)	–7.70%
Total	936	988	

(c) Periods 14–25			
Bid category	AA	AN	AA–AN
Over	325 (37.62%)	372 (43.66%)	–6.04%
Sincere	383 (44.33%)	270 (31.69%)	12.64%
Under	156 (18.06%)	210 (24.65%)	–6.59%
Total	864	852	

reaches the average of two drawn values, $(v_1 + v_2)/2$. We now regard the average bidding as the demand reduction within 0.1 UDS of the average of two valuations. It then appears that 16.9% ($= 213/1263$) and 11.2% ($= 143/1276$) of the overall first demand reductions in AA and AN, respectively, are due to such average bidding behaviors.²⁹

Sincere bidding for the first unit, which is described in page 5, has a justification both from the theoretical and experimental viewpoint. Baisa (2020) theoretically shows that two kinds of bids dominate in the multi-unit static Vickrey auction: non-sincere

²⁹A bid observation can simultaneously be interpreted as both the average bid and a sincere one. For example, consider the case where a subject has $(v_1, v_2) = (500, 490)$ and reduced demand to one at $p = 490$.

bidding for the first unit and underbidding for the second unit. Moreover, we can regard the situation for the Ausubel subject after his/her first demand reduction as the single-unit English auction. Recall that subjects in English auction experiments have revealed to recognize easily that it is beneficial to remain the auction up to their own value (Li (2017); McGree and Levin (2019); and Breitmoser and Schweighofer-Kodritsc (2019)). Accordingly, it is natural that most subjects bid sincerely for the first unit in our Ausubel auction treatments.

B.4 Advice effect

We now apply a normal approximation to examine whether the following three factors affect sincere bidding behavior: auction rule, advice, and unit. Suppose that sincere bidding in treatment $j \in \{\text{AA}, \text{AN}\}$ is a realization of a random variable X_j with a Bernoulli distribution that takes 1 (= sincere bidding) with a success rate of p_j . That is,

$$X_j \equiv \begin{cases} 1 & \text{with prob. } p_j, \\ 0 & \text{with prob. } 1 - p_j. \end{cases}$$

Let \bar{X}_j denote the sample mean for n_j realizations of X_j and let

$$S_j \equiv \frac{\bar{X}_j(1 - \bar{X}_j)}{n_j}.$$

Table 12 summarizes the frequencies of sincere bidding by treatments, whether the quiz score is perfect, and by units. In this table, superscripts “*all*,” “*per*,” and “*im*” correspond to all subjects, the subjects whose quiz scores are perfect, and the subjects whose quiz scores are imperfect, respectively. Hereafter, capital letters indicate random variables while small letters indicate realized values. Table 13 summarizes the frequency of sincere bidding in the former periods (periods 1–13) and in the latter periods (periods 14–25).³⁰

Using mainly both units’ data shown in Panel (a) of Table 12, we first test whether the advice increases sincere bidding in the Ausubel auction. We summarize our findings as follows:

Result 9 (Advice effect in the Ausubel auction).

³⁰We will examine whether the subjects’ bidding behaviors change over time in Online Appendix Q.

Table 12: Frequency of sincere bidding, by treatments, quiz scores, and units.

(a) Both units

Data		Ausubel		(1)	Vickrey		(2)	(1) – (2)
		AA	AN	AA–AN	VA	VN	VA–VN	
All	\bar{x}_j^a	0.389	0.305	0.084***	0.549	0.241	0.308***	–0.224***
	s_j^a	(1.32×10^{-4})	(1.15×10^{-4})		(1.18×10^{-4})	(1.14×10^{-4})		
Perfect	\bar{x}_j^p	0.427	0.295	0.132***	0.602	0.256	0.346***	–0.214***
	s_j^p	(2.71×10^{-4})	(2.32×10^{-4})		(1.65×10^{-4})	(1.92×10^{-4})		
Imperfect	\bar{x}_j^i	0.351	0.314	0.037**	0.431	0.216	0.215***	–0.178***
	s_j^i	(2.54×10^{-4})	(2.29×10^{-4})		(3.78×10^{-4})	(2.78×10^{-4})		

(b) Unit 1

Data		Ausubel		(1)	Vickrey		(2)	(1) – (2)
		AA	AN	AA–AN	VA	VN	VA–VN	
All	\bar{x}_j^a	0.672	0.512	0.160***	0.574	0.231	0.344***	–0.184***
	s_j^a	(4.10×10^{-4})	(4.43×10^{-4})		(3.87×10^{-4})	(3.59×10^{-4})		
Perfect	\bar{x}_j^p	0.427	0.295	0.144***	0.618	0.256	0.362***	–0.218***
	s_j^p	(7.99×10^{-4})	(9.20×10^{-4})		(5.12×10^{-4})	(6.41×10^{-4})		
Imperfect	\bar{x}_j^i	0.659	0.486	0.173***	0.456	0.193	0.263***	–0.090**
	s_j^i	(8.41×10^{-4})	(8.50×10^{-4})		(1.45×10^{-3})	(7.90×10^{-4})		

(c) Unit 2

Data		Ausubel		(1)	Vickrey		(2)	(1) – (2)
		AA	AN	AA–AN	VA	VN	VA–VN	
All	\bar{x}_j^a	0.268	0.213	0.055***	0.538	0.245	0.293***	–0.238***
	s_j^a	(1.55×10^{-4})	(1.31×10^{-4})		(1.69×10^{-4})	(1.67×10^{-4})		
Perfect	\bar{x}_j^p	0.316	0.189	0.127***	0.594	0.255	0.339***	–0.212***
	s_j^p	(3.42×10^{-4})	(2.45×10^{-4})		(2.44×10^{-4})	(2.74×10^{-4})		
Imperfect	\bar{x}_j^i	0.220	0.236	–0.016	0.423	0.228	0.195***	–0.211***
	s_j^i	(2.72×10^{-4})	(2.78×10^{-4})		(5.10×10^{-4})	(4.26×10^{-4})		

Notes: * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level.

Table 13: Frequency of sincere bidding by quiz scores and periods.

(a) Former 13 periods

Data		Ausubel		(1)	Vickrey		(2)	(1) – (2)
		AA	AN	AA–AN	VA	VN	VA–VN	
All	\bar{x}_j^{all}	0.339	0.295	0.044***	0.559	0.219	0.340***	–0.296***
	s_j^{all}	(2.39×10^{-4})	(2.10×10^{-4})		(2.26×10^{-4})	(2.05×10^{-4})		
Perfect	\bar{x}_j^{per}	0.390	0.289	0.101***	0.603	0.216	0.386***	–0.285***
	s_j^{per}	(4.90×10^{-4})	(4.30×10^{-4})		(3.15×10^{-4})	(3.31×10^{-4})		
Imperfect	\bar{x}_j^{im}	0.284	0.300	–0.016	0.459	0.223	0.235***	–0.251***
	s_j^{im}	(4.51×10^{-4})	(4.12×10^{-4})		(7.48×10^{-4})	(5.42×10^{-4})		

(b) Latter 12 periods

Data		Ausubel		(1)	Vickrey		(2)	(1) – (2)
		AA	AN	AA–AN	VA	VN	VA–VN	
All	\bar{x}_j^{all}	0.443	0.317	0.126***	0.538	0.245	0.274***	–0.148***
	s_j^{all}	(2.86×10^{-4})	(2.54×10^{-4})		(2.47×10^{-4})	(2.53×10^{-4})		
Perfect	\bar{x}_j^{per}	0.470	0.302	0.168***	0.601	0.298	0.303***	–0.135***
	s_j^{per}	(5.97×10^{-4})	(5.02×10^{-4})		(3.47×10^{-4})	(4.38×10^{-4})		
Imperfect	\bar{x}_j^{im}	0.418	0.331	0.087***	0.404	0.210	0.194***	–0.107***
	s_j^{im}	(5.44×10^{-4})	(5.13×10^{-4})		(7.59×10^{-4})	(5.69×10^{-4})		

Notes: * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level.

- (i) *Providing advice increases sincere bidding in the Ausubel auction when using all data. The mean increase is 8.4% (95% confidence interval, 5.3% to 11.5%).*
- (ii) *The advice is effective even when only focusing on the data of the subjects with perfect quiz scores only or of those with imperfect quiz scores.*

Support. We first establish (i). Let $Y_A^{all} \equiv (\bar{X}_{AA}^{all} - \bar{X}_{AN}^{all})$. The test statistic is

$$\tilde{Y}_A^{all} \equiv \frac{Y_A^{all} - \mathbb{E}(Y_A^{all})}{\sqrt{S_{AA}^{all} + S_{AN}^{all}}}.$$

By the central limit theorem, Y_A^{all} approximately follows a standardized normal distribution. Hence, in what follows, we evaluate probabilities by a standardized normal distribution unless noted otherwise. The following null hypothesis states that providing advice does not increase sincere bidding in the Ausubel auction.

Null hypothesis (H_0^{A1}): $\mathbb{E}(Y_A^{all}) = 0$.

By a direct calculation, $\tilde{y}_A^{all} = 5.342$. This yields $\text{Prob}(\tilde{Y}_A^{all} \geq \tilde{y}_A^{all}) < 0.0001$. Hence, advice significantly increased sincere bidding in the Ausubel auction. Moreover, the 95% confidence interval of $\mathbb{E}(Y_A^{all})$ is $[0.053, 0.115]$.

To establish (ii), we divide the data into two: Data of subjects with perfect quiz scores and those of subjects with imperfect quiz scores. Given $h \in \{per, im\}$, Y_A^h and \tilde{Y}_A^h are defined similarly. We then formulate two null hypotheses:

Null hypothesis (H_0^{A1p}): $\mathbb{E}(Y_A^{per}) = 0$.

Null hypothesis (H_0^{A1i}): $\mathbb{E}(Y_A^{im}) = 0$.

Then, by direct calculations, we obtain $\tilde{y}_A^{per} = 5.872$, $\tilde{y}_A^{im} = 1.664$, yielding $\text{Prob}(\tilde{Y}_A^{per} \geq \tilde{y}_A^{per}) < 0.0001$ and $\text{Prob}(\tilde{Y}_A^{im} \geq \tilde{y}_A^{im}) < 0.05$, respectively. Hence, both $\mathbb{E}(Y_A^{per}) = 0$ and $\mathbb{E}(Y_A^{im}) = 0$ are rejected. \square

We next test whether quiz scores affect the responsiveness to advice in the Ausubel auction. The following result demonstrates that a better understanding of the rule increases the effect of advice in the Ausubel auction.

Result 10 (Relationship between quiz scores and advice effects). *Within the Ausubel auction, the subjects with perfect quiz scores are more responsive to advice than are subjects with imperfect quiz scores. The mean difference between the two groups in terms of an increase in the sincere bidding rate is 9.5% (95% confidence interval, 3.4% to 15.7%).*

Support. Let $W_A = (Y_A^{per} - Y_A^{im})$. The test statistic is

$$\widetilde{W}_A \equiv \frac{W_A - \mathbb{E}(W_A)}{\sqrt{S_{AA}^{per} + S_{AN}^{per} + S_{AA}^{im} + S_{AN}^{im}}}.$$

We formulate the null hypothesis as follows:

Null hypothesis (H_0^{A2}): $\mathbb{E}(W_A) = 0$.

By a direct calculation, we obtain $\widetilde{w}_A = 3.03$. This yields $\text{Prob}(\widetilde{W}_A \geq \widetilde{w}_A) < 0.001$. Moreover, the 95% confidence interval of $\mathbb{E}(W_A)$ is $[0.034, 0.157]$. \square

We finally compare our Ausubel auction data with our Vickrey auction data. According to the rule of the Ausubel auction, winners' demand reductions are censored in the Ausubel auction. For this reason, we focus on non-winning bids in the Vickrey treatments for a fair comparison.

Result 11 (Comparison of non-winning bids with the Vickrey treatments).

- (i) *When advice is provided, the rate of sincere bidding for non-winning bids is significantly higher in the Vickrey auction compared with the Ausubel auction.*
- (ii) *The advice has negligible effect in mitigating overbidding for the second unit in the Ausubel auction, while it decreases overbidding for the second unit more than 10% in the Vickrey auction.*
- (iii) *The effect of advice on the rate of sincere bidding for non-winning bids is significantly higher in the Vickrey auction compared with the Ausubel auction.*

Support. Table 14 summarizes non-winning bids in the Vickrey and Ausubel auctions. Support for (i) is given in Panel (a) of Table 14. We see that the rates of sincere bidding in AA and VA are 38.9% and 54.9%, respectively.

Support for (ii) is given by finding the majority bid categories in Table 14, shown in bold. In Panel (c) for the second unit, the rate of overbidding is nearly equal between AA and AN, while it decreased by about 18% in the Vickrey treatments.

Support for (iii) is given by a normal approximation test, as we did for the Vickrey and pay-your bid auction. Let $Z_A^{all} = (Y_A^{all} - Y_V^{all})$. The test statistic is

$$\widetilde{Z}_A^{all} \equiv \frac{Z_A^{all} - \mathbb{E}(Z_A^{all})}{\sqrt{S_{AA}^{all} + S_{AN}^{all} + S_{VA}^{all} + S_{VN}^{all}}}.$$

We formulate the null hypothesis as follows:

Table 14: Non-winning bid category by treatments and units.

(a) Both units

Bid category	Ausubel		AA–AN	Vickrey		VA–VN
	AA	AN		VA	VN	
Over	747 (41.50%)	785 (42.66%)	–1.16%	717 (34.14%)	857 (53.56%)	–19.42%
Sincere	700 (38.99%)	561 (30.49%)	8.50%	1,153 (54.90%)	385 (24.06%)	30.84%
Under	353 (19.61%)	494 (26.85%)	–7.24%	230 (10.95%)	358 (22.38%)	11.43%
Total	1,800	1,840		2,100	1,600	

(b) Unit 1

Bid category	Ausubel		AA–AN	Vickrey		VA–VN
	AA	AN		VA	VN	
Over	78 (14.53%)	110 (19.50%)	–4.97%	236 (37.34%)	293 (59.31%)	–21.97%
Sincere	361 (67.23%)	289 (51.24%)	15.99%	363 (57.44%)	114 (23.08%)	34.36%
Under	98 (18.25%)	165 (29.26%)	–11.01%	33 (5.22%)	87 (17.61%)	–12.39%
Total	537	564		632	494	

(c) Unit 2

Bid category	Ausubel		AA–AN	Vickrey		VA–VN
	AA	AN		VA	VN	
Over	669 (52.97%)	675 (52.90%)	0.07%	481 (32.77%)	564 (50.99%)	–18.22%
Sincere	339 (26.84%)	272 (21.32%)	5.52%	790 (53.81%)	271 (24.50%)	29.31%
Under	255 (20.19%)	329 (25.78%)	–5.59%	197 (13.42%)	271 (24.50%)	–11.08%
Total	1,263	1,276		1,468	1,106	

Notes: Bold indicates the majority category.

Table 15: Frequency of sincere bidding in period one of the Ausubel treatment by quiz scores.

Data		AA	AN	AA–AN
All	\bar{x}_j^{all}	0.319	0.237	0.083
	s_j^{all}	(3.02×10^{-3})	(2.39×10^{-3})	
Perfect	\bar{x}_j^{per}	0.297	0.231	0.067
	s_j^{per}	(5.64×10^{-3})	(4.56×10^{-3})	
Imperfect	\bar{x}_j^{im}	0.343	0.243	0.100
	s_j^{im}	(6.43×10^{-3})	(4.97×10^{-3})	

Notes: * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level.

Null hypothesis (H_0^{A3}): $\mathbb{E}(Z_A^{all}) = 0$.

By a direct calculation, we obtain $\tilde{z}_A^{all} = -10.261$ under $\mathbb{E}(Z_A^{all}) = 0$. This yields $\text{Prob}(\tilde{Z}_A^{all} \leq \tilde{z}_A^{all}) < 0.0001$. Moreover, the 95% confidence interval of $\mathbb{E}(Z_A^{all})$ is $[0.182, 0.267]$. \square

Remark 4. When we restrict our attention to the first period only and use both units' data, as shown in Table 15, H_0^{A1} and H_0^{A3} are accepted. \diamond

Remark 5. The post experimental questionnaire is a multiple-choice questionnaire and asks subjects whether they believe the advice, and if yes, when they started believing it. We use subjects' responses to analyze how they perceive the advice in AA.³¹ Then the same results as VA subjects hold for AA subjects. That is, 1) the subjects who believed the advice bid significantly more sincerely compared with the subjects who never believed it, and 2) the rate of sincere bidding among the subjects who never believed the advice is not significantly different from that of all AN subjects. \diamond

Remark 6. We performed a regression analysis to check the robustness of the results. Almost all results are confirmed. The dependent variable is a dummy variable of sincere bidding that takes 1 if subject i in period t bids sincerely. The three independent variables are what we have examined independently in previous sections: *Advice* is a dummy for treatments with advice; *Latter* is a dummy for periods more than thirteen; and *Perfect* is a dummy for the subjects with a perfect score in the quiz.

We also included the interaction terms of these three variables. Table 16 summarizes the result from linear probability models of sincere bidding by units. Specifications from

³¹ The number of subjects who chose (a) believed the advice before practice periods, (b) believed the advice after practice periods but before real periods, (c) believed the advice during real periods, and (d) never believed were, respectively, 13, 6, 7, and 28.

Table 16: Regression analysis of sincere bidding in the Ausubel auction.

	Unit 1			Unit 2		
	(13)	(14)	(15)	(16)	(17)	(18)
<i>Advice</i>	0.173*** (0.041)	0.083** (0.039)	0.052 (0.057)	-0.016 (0.024)	0.030 (0.023)	-0.034 (0.033)
<i>Perfect</i>	0.054 (0.041)		0.054 (0.055)	-0.047* (0.024)		-0.038 (0.033)
<i>Advice</i> \times <i>Perfect</i>	-0.028 (0.059)		0.050 (0.079)	0.143*** (0.034)		0.127*** (0.047)
<i>Latter</i>		0.067 (0.040)	0.066 (0.056)		0.007 (0.024)	0.016 (0.034)
<i>Advice</i> \times <i>Latter</i>		0.162*** (0.058)	0.225*** (0.081)		0.053 (0.034)	0.035 (0.048)
<i>Latter</i> \times <i>Perfect</i>			0.001 (0.081)			-0.018 (0.048)
<i>Advice</i> \times <i>Latter</i> \times <i>Perfect</i>			-0.115 (0.116)			0.035 (0.068)
<i>Constant</i>	0.486*** (0.028)	0.482*** (0.027)	0.456*** (0.038)	0.236*** (0.017)	0.210*** (0.016)	0.229*** (0.023)
Observations	1,101	1,101	1,101	2,539	2,539	2,539
Adjusted R^2	0.026	0.052	0.053	0.011	0.005	0.012

Notes: * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level.

(13) to (18) jointly clarify how the advice changes sincere bidding behavior toward each unit. For the first unit, the advice effect appears as the subjects play repeatedly, regardless of their understanding level of the auction rule. By contrast, the advice mitigates overbids and underbids for the second unit only for subjects with a high level of understanding, and thus, overbids and underbids remain common until the end of the real periods. \diamond

B.5 Efficiency, bidders' payoffs, and seller's revenue

Here, we normally approximated to examine the effect of auction rules, advice, and experience on efficiency. We use the following two kinds of efficiency measures: One is the efficiency ratio introduced in Section 3.4, and the other is the binary efficiency introduced in Appendix A.

Result 12 (Advice effects on efficiency). *Providing advice does not increase (value-based) efficiency in the Ausubel auction. However, a marginally significant increase in the binary efficiency of the Ausubel auction in the former periods.*

Support. Table 17 summarizes the results on efficiency with a focus on experience. In this table, the upper (respectively, middle, bottom) panel collects the results obtained

Table 17: Efficiency and binary efficiency by treatments and periods.

(a) Efficiency					
Data		AA	AN	AA–AN	(AA–AN) – (VA–VN)
All periods	\bar{r}_j^{ap}	0.986	0.982	0.005	–0.005
	t_j^{ap}	(5.647×10^{-6})	(6.324×10^{-6})		
Period 1–13	\bar{r}_j^{fp}	0.981	0.975	0.006	–0.009
	t_j^{fp}	(1.669×10^{-5})	(1.525×10^{-5})		
Period 14–25	\bar{r}_j^{lp}	0.992	0.989	0.003	–0.003
	t_j^{lp}	(4.697×10^{-6})	(8.566×10^{-6})		

(b) Binary efficiency					
Data		AA	AN	AA–AN	(AA–AN) – (VA–VN)
All periods	\bar{e}_j^{ap}	0.878	0.839	0.039**	–0.035
	f_j^{ap}	(2.38×10^{-4})	(2.94×10^{-4})		
Period 1–13	\bar{e}_j^{fp}	0.850	0.794	0.057*	–0.042
	f_j^{fp}	(5.44×10^{-4})	(6.63×10^{-4})		
Period 14–25	\bar{e}_j^{lp}	0.907	0.892	0.015	–0.031
	f_j^{lp}	(3.89×10^{-4})	(4.52×10^{-4})		

Notes: * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level.

for all periods (respectively, periods 1–13, periods 14–25). In Panel (a) of Table 17, every mean difference is statistically non-significant. In Panel (b) of Table 17, we have significance at the cells of (AA–AN, All periods) and (AA–AN, Periods 1–13). \square

Next, we ask whether providing advice affects bidder’s payoff in the Ausubel auction. Table 18 summarizes the results on bidders’ payoffs and seller’s revenue. We then observe that in the Ausubel auction, the advice does not affect both the bidders’ payoffs and the seller’s revenue.

B.6 Comparison with Kagel and Levin (2009)

In this section, we compare the Ausubel auction experimental data of Kagel and Levin (2009) (hereafter, KL) and that of this paper because the appendix of KL includes the Ausubel treatments that best resemble ours. Among several settings KL use, we focus on the periods wherein subjects were given information feedback and competed for two units, similar to our design.³²

We carefully deal with the increment of value and bid/price to allow a reasonable comparison. We focus on the Ausubel treatment in the appendix of KL, where each

³²KL vary the number of bidders in one auction and the number of units sold, within one session.

Table 18: Average bidder’s payoff and average seller’s revenue in the Ausubel auction.

(a) Bidder’s payoff				
Data		AA	AN	AA–AN
All periods	$\bar{\pi}_j^{ap}$	165.711	158.007	7.704
	ξ_j^{ap}	(35.442)	(33.555)	
Period 1–13	$\bar{\pi}_j^{fp}$	158.376	154.399	3.977
	ξ_j^{fp}	(66.724)	(61.496)	
Period 14–25	$\bar{\pi}_j^{lp}$	173.657	162.191	11.466
	ξ_j^{lp}	(75.445)	(70.463)	

(b) Seller’s revenue				
Data		AA	AN	AA–AN
All periods	$\bar{\pi}_j^{ap}$	1075.111	1060.935	14.176
	ξ_j^{ap}	(279.044)	(276.805)	
Periods 1–13	$\bar{\pi}_j^{fp}$	1095.897	1090.283	5.614
	ξ_j^{fp}	(586.458)	(478.992)	
Periods 14–25	$\bar{\pi}_j^{lp}$	1052.593	1026.901	25.691
	ξ_j^{lp}	(521.002)	(639.573)	

Notes: a) * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level; and b) Given $j \in \{\text{AA}, \text{AN}\}$, let $\bar{\Pi}_j$ denote the sample mean for n_j' realizations of an observation of the bidder’s payoff (or the seller’s revenue) Π_j . Ξ_j is defined similarly to T_j introduced in Section 3.4.

value v is drawn with one cent increment from the uniform distribution over $[0, 7.50]$ (USD) across any treatments and each human subject competes with sincere bidding programmed bidders. Similar to our design, the price increment is identical to the value increment, one cent. KL categorize a demand reduction as sincere if the reduction occurred within five cents of true value.³³

Owing to KL design detail mentioned above and our \$0.1 bid/price increment, we redefine sincere bidding in our Ausubel treatments as the remand reduction within \$0.3 from true value. We denote this category by “KL Sincere.” Also, both “KL Over” and “KL Under” are defined accordingly. Table 19 shows that the frequency of KL Sincere observed in our Ausubel treatments is similar to that observed in the corresponding

³³In another Ausubel auction treatment of KL, the price increment was set as \$0.25, which is much larger than the value increment. All bidders were human subjects. Then, KL categorize a demand reduction as sincere if the reduction occurred either at the nearest two price grids. By this categorization, the authors obtained values of 83% and 77% for unit 1 and 2, respectively (See Table 2 of KL).

Table 19: Comparison with KL Ausubel treatments.

Bid category	AA	AN	AA–AN	KL Ausubel	
				Unit 1	Unit 2
KL Over	628 (34.9%)	627 (34.1%)	0.8%	30%	17%
KL Sincere	966 (53.7%)	960 (52.2%)	1.5%	54%	58%
KL Under	206 (11.4%)	253 (13.8%)	–2.3%	17%	26%
Total	1,800	1,840			

Notes: See Table A2 of Kagel and Levin (2009) for KL Ausubel treatment statistics.

treatments in KL. We then observe that the frequencies of sincere bidding observed in our Ausubel treatments are quite close to, unit by unit, those observed in the corresponding treatments in KL. This suggests that our results on the Ausubel auction are neither subject-pool specific nor design detail such as information feedback during the auction.

C Treatment comparison of seller’s revenue and bidders’ payoffs

Several existing literature shows that the static Vickrey auction yields a higher revenue than the English/Ausubel auction (Kagel et al. (1987) for a single unit sold, Manelli et al. (2006) for multiple units sold). We thus determine whether the transparency of dynamic format mitigates overbidding, and thus increases (respectively, decreases) the bidders’ payoffs (respectively, the seller’s revenue). Table 20 shows the comparison of the seller’s revenue and bidders’ payoffs across different auction rules.³⁴

Since the valuations of unit 1 are higher than those of unit 2, the overbids in unit 1, when rejected, often determine the prices in the Vickrey auction. Thus, the more overbids in unit 1 could make the prices higher and bidders’ payoffs smaller in the Vickrey auction. This is also true in the Ausubel auction. Panel (b) of Table 14 reports that the overbids in the Vickrey auction is much more than in Ausubel auction in unit 1. This would be the factor of the observations in Table 20 that when the two auctions are compared, bidders’ payoffs in the Vickrey auction is smaller than in Ausubel auction regardless of whether the advice is provided.

Table 6 in the main text and Table 17 report that the Vickrey and Ausubel auctions are both almost efficient, implying that both auctions generate almost equal surpluses. Thus, the sellers’ revenues in the two auctions are reversed from bidders’ payoffs, that is, the sellers’ revenues in the Vickrey auction are larger than in Ausubel auction. However, since the sample number of revenues is smaller than payoffs, these reversed relationships are less significant in Table 20.

We also observe from Table 20 that that the bidders’ payoffs in the pay-your-bid auction are less than those in the Vickrey and Ausubel auctions, regardless of whether the advice is provided. It is a well-known theoretical result that, in single-object auctions, the bidders’ payoffs in the pay-your-bid auction (first-price auction) are less than in the Vickrey auction when bidders are risk-averse (Holt (1980); Krishna (2009), Ch. 4.2). Table 20 reports similar phenomena in bidders’ payoffs, and the reversed relationships in sellers’ revenues for multi-unit auctions.

³⁴It is well known that the revenue equivalence result does not generally hold when multiple units are sold (Krishna (2009)). In this table, we do not evaluate how much observed payoffs and revenues are close to the predicted ones.

Table 20: Treatment comparison of seller's revenue and bidders' payoffs.

	Seller's revenue				Bidders' payoffs			
	PA	PN	AA	AN	PA	PN	AA	AN
All periods	VA	<***	>*** (**)	>***	VA	>*** (N.Sig.)	<***	<***
	VN	<***	>* (N.Sig.)	>**	VN	>*** (*)	<***	<***
	PA		>***	>***	PA		<***	<***
	PN		>***	>***	PN		<***	<***
Periods 1-13	VA	<***	N.Sig.	>* (N.Sig.)	VA	>*** (N.Sig.)	<***	<* (***)
	VN	<***	N.Sig.	N.Sig.	VN	>*** (*)	<***	<***
	PA		>***	>***	PA		<***	<***
	PN		>***	>***	PN		<***	<***
Periods 14-25	VA	<***	>**	>***	VA	>*** (*)	<***	<* (**)
	VN	<***	N.Sig.	>** (*)	VN	>*** (N.Sig.)	<***	<***
	PA		>***	>***	PA		<***	<***
	PN		>***	>***	PN		<***	<***

Notes: a) * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level; b) “>” (respectively, “<”) indicates the treatment in the row (respectively, column) has a larger value; c) We used normal approximation test. Nonparametric Wilcoxon rank sum test replicates all results in seller revenue; and d) The star in parenthesis indicates how Nonparametric Wilcoxon rank sum test results differ.

D Nonparametric tests

Almost pairwise comparison results are consistent with normal approximation tests. Some PA–PN and AA–AN results become non-significant (see, for example, Panel (a) of Table 21, AA–AN, Perfect).

Table 21: Nonparametric test results.

(a) All periods					
Data		VA–VN	PA–PN	AA–AN	VA–VN ^{d)}
Both	All	4214***	5337*	3341*	4255***
	Perfect	1832***	3702.5*	831.5	1844.5***
	Imperfect	501**	159.5	842.5	513.5***
Unit 1	All	4204.5***	5403***	3439.5**	4276.5***
	Perfect	1842***	3706***	868.5*	1869***
	Imperfect	488*	166	862.5	497**
Unit 2	All	4199.5***	5263.5	3269	4218.5***
	Perfect	1825***	3655*	802.5	1826.5***
	Imperfect	499**	155	845	509.5**

(b) Period one					
Data		VA–VN	PA–PN	AA–AN	VA–VN ^{d)}
Both	All	0.000***	0.001***	0.273	0.000***
	Perfect	0.001***	0.002***	0.294	0.001***
	Imperfect	0.018**	0.423	0.616	0.002***

(c) Former 13 periods					
Data		VA–VN	PA–PN	AA–AN	VA–VN ^{d)}
Both	All	4278***	5564.5***	3203	4294***
	Perfect	1865***	3900.5***	820.5	1886***
	Imperfect	505**	155	797.5	497.5**

(d) Latter 12 periods					
Data		VA–VN	PA–PN	AA–AN	VA–VN ^{d)}
Both	All	4075***	4975.5	3422.5**	4114***
	Perfect	1796***	3493	837	1803***
	Imperfect	469	138	883.5*	477.5*

Notes: a) The numbers in the cells in panels (a), (c), and (d) are rank sum of the first groups (i.e., treatments with advice) for a Wilcoxon rank sum test for the difference between two groups; b) The numbers in the cells in panel (b) is a Fischer exact p -value; c) * denotes significant at the 10% level, ** at the 5% level, and *** at the 1% level; and d) We focus on non-winning bids in the Vickrey treatments.

E Additional table

Table 22: Bid category by treatments and units.

(a) Both units

Bid category	Vickrey		VA–VN	Pay-your-bid		PA–PN
	VA	VN		PA	PN	
Over	1,427 (45.3%)	1,519 (63.29%)	–17.99%	19 (0.55%)	33 (0.92%)	–0.37%
Sincere	1,478 (46.92%)	495 (20.63%)	26.30%	287 (8.32%)	209 (5.81%)	2.51%
Under	245 (7.78%)	386 (16.08%)	–8.31%	3,144 (91.13%)	3,358 (93.28%)	–2.15%
Total	3,150	2,400		3,450	3,600	

(b) Unit 1

Bid category	Vickrey		VA–VN	Pay-your-bid		PA–PN
	VA	VN		PA	PN	
Over	875 (55.56%)	876 (73.00%)	–17.6%	2 (0.12%)	2 (0.12%)	0.00%
Sincere	655 (41.59%)	210 (17.50%)	24.09%	35 (2.03%)	11 (0.61%)	1.42%
Under	45 (2.86%)	114 (9.50%)	–6.64%	1,688 (97.86%)	1,787 (99.28%)	–1.42%
Total	1,575	1,200		1,725	1,800	

(c) Unit 2

Bid category	Vickrey		VA–VN	Pay-your-bid		PA–PN
	VA	VN		PA	PN	
Over	552 (35.05%)	643 (53.58%)	–18.54%	17 (0.99%)	31 (1.72%)	–0.74%
Sincere	823 (52.25%)	285 (23.75%)	28.50%	252 (14.61%)	198 (11.00%)	3.61%
Under	200 (12.70%)	272 (22.67%)	–9.97%	1,456 (84.41%)	1,571 (87.28%)	–2.87%
Total	1,512	1,200		1,725	1,800	

F Experimental instructions (VA and VN)

Note: In this experiment, please remember that you cannot communicate with other subjects. If there is communication, this experiment will be stopped at that point.

First, please confirm the following items. If any of the items are missing, please contact the experimenter.

- Instructions (this handout)
- Record sheet
- Ballpoint pen, pencil, and eraser
- Calculator

F.1 Overview

In this experiment, you will act as bidders in a sequence of auctions. Three bidders will participate in each auction. At the beginning of each period of the auction, the experimenter will randomly match you with two persons from the other subjects. The three of you will form a group. This experiment consists of 25 periods. The individuals you are matched with will change every period. You will not know who you are matched with either during or after the experiment.

The rewards you receive after the experiment are determined based on the decisions you and others make in the experiment. Your rewards will be paid to you in cash at the end of the experiment. A detailed explanation of the rewards you will receive will be provided later in **F.3. Rewards**.

F.2 Auction

F.2.1 Procedure in each period

1. Two units of an identical object will be auctioned off in every period. Three bidders, including yourself, will participate in an auction.
2. Each bidder will be assigned a value for the first unit (“first unit’s value”) and another value for the second unit (“second unit’s value”). For each bidder, values will be randomly drawn from the interval 0 JPY to 1,000 JPY with increments of 10 yen. Any value within this interval has an equally likely chance of being

drawn and being assigned as a value. The higher of these two values will be the “first unit’s value” while the lower will be the “second unit’s value.” Each of the other two bidders will be assigned values for two units in the same way that your values were assigned. The particular values assigned to the other two bidders will typically be different from yours. Please note that for each bidder, the second unit’s value will always be lower than the first unit’s value. In addition, your “first unit’s value” and “second unit’s value” are only for your private information. The other bidders will not know your values.

3. You will submit your “bid for the first unit” and “bid for the second unit” to the experimenter. Then, please note the following three points:
 - “Your bid for the first unit” must be higher than “your bid for the second unit.”
 - Your bid must exceed 0 yen.
 - Your bid must be increments of 10 yen.
4. Each of the three bidders will submit two bids. Therefore, there will be a total of six bids. The two highest bidders will each win an item. In case of a tie among the high bids, the experimenter will randomly determine who wins an item. This described procedure determines the number of units earned by each bidder.
5. The “earnings” for a bidder who wins an item are equal to his/her value of the item less his/her payment. The “earnings” for a bidder who has not earned any units are 0.

F.2.2 Earnings calculation

We first explain how to calculate a bidder’s earnings if the bidder wins an item using examples. There are three bidders, A, B, and C. Here, we focus on bidder A. In the following examples, amounts are displayed in Japanese yen.

(1) The case where a bidder wins one unit: A bidder who wins one unit will pay the amount of the highest bid from among the other bidders’ losing bids.

Example F.1. Suppose that A’s value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	600	450
B	500	300
C	400	250

Here, the winning bids are A's 600 and B's 500. The losing bids are A's 450, B's 300, C's 400, and C's 250. When A's 450 is excluded from the losing bids, B's 300, C's 400, and C's 250 are left. Bidder A pays the highest amount among these, which is 400. Please note that the payment differs from the winning bid. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} - 400 \text{ (payment)} = 280$$

Example F.2. Suppose that A's value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	800	350
B	750	300
C	700	250

Here, the winning bids are A's 800 and B's 750. Thus, bidder A wins one unit. Excluding A's other bid, the losing bids were B's 300, C's 700, and C's 250. Bidder A pays 700, the highest bid. Please note that the payment differs from the winning bid. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} - 700 \text{ (payment)} = -20$$

(2) The case where a bidder wins two units: A bidder who wins two units will pay the sum of the highest and second-highest bids from among the other bidders' losing bids.

Example F.3. Suppose that A's value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	600	550
B	500	300
C	400	250

Here, the winning bids are A's 600 and A's 550. The losing bids are B's 500, B's 300, C's 400, and C's 250. Thus, bidder A pays 900, the sum of the highest bid of 500 and the second-highest bid of 400 from the losing bids. Please note that A's payment differs from A's own bids. A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} + 480 \text{ (second unit's value)} - 900 \text{ (payment)} = 260$$

Example F.4. Suppose that A's value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	900	850
B	800	600
C	700	550

Here, the winning bids are A's 900 and A's 850. The losing bids are B's 800, B's 600, C's 700, and C's 550. Thus, bidder A pays 1,500, the sum of the highest bid of 800 and the second-highest bid of 700 from the losing bids. Please note that A's payment differs from A's own bids. A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} + 480 \text{ (second unit's value)} - 150 \text{ (payment)} = -340$$

The earnings calculation method may be summarized as follows:

- When you win one unit, and the third-highest bid is yours:

$$\text{Your earnings} = \text{your first unit's value} - \text{fourth highest bid}$$

- When you win one unit, and the third-highest bid is not yours:

$$\text{Your earnings} = \text{your first unit's value} - \text{third highest bid}$$

When your payment is higher than your first unit's value, please note that your earnings will be negative.

- When you win two units:

$$\begin{aligned}\text{Your earnings} &= (\text{your first unit's value} + \text{your second unit's value}) \\ &\quad - (\text{third highest bid} + \text{fourth highest bid})\end{aligned}$$

When your payment is higher than the sum of your first and second units' values, please note that your earnings will be negative.

- When you do not win anything, your earnings will be 0.

F.3 Rewards

We will explain the rewards you receive after the experiment. Your rewards are the sum of your earnings over all 25 periods plus a participation fee of 1,000 yen.

For example, if the sum of your earnings is 2,580 yen, your rewards will be 3,580 yen. In other words, the more you earn from each period, the higher your rewards will be.

Recording Sheet							Seat Number	
Period	Value for the first unit	Value for the second unit	Bid for the first unit	Bid for the second unit	Payment (first unit)	Payment (second unit)	Payment (total)	Your earnings
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Recording Sheet							Seat Number	
Period	Value for the first unit	Value for the second unit	Bid for the first unit	Bid for the second unit	Payment (first unit)	Payment (second unit)	Payment (total)	Your earnings
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

G Experimental instructions (PA and PN)

Note: In this experiment, please remember that you cannot communicate with other subjects. If there is communication, this experiment will be stopped at that point.

First, please confirm the following items. If any of the items are missing, please contact the experimenter.

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- Record sheet
- Ballpoint pen, pencil, and eraser
- Calculator

G.1 Overview

In this experiment, you will act as bidders in a sequence of auctions. Three bidders will participate in each auction. At the beginning of each period of the auction, the experimenter will randomly match you with two individuals from the other subjects. The three of you will form a group. This experiment consists of 25 periods. The persons you are matched with will change every period. You will not know who you are matched with either during or after the experiment.

The rewards you receive after the experiment are determined based on the decisions you and others make in the experiment. Your rewards will be paid to you in cash at the end of the experiment. A detailed explanation of the rewards you will receive will be provided later in **G.3. Rewards**.

G.2 Auction

G.2.1 Procedure in each period

1. Two units of an identical object will be auctioned off in every period. Three bidders, including yourself, will participate in an auction.
2. Each bidder will be assigned a value for the first unit (“first unit’s value”) and another value for the second unit (“second unit’s value”). For each bidder, values will be randomly drawn from the interval 0 JPY to 1,000 JPY with increments of 10 yen. Any value within this interval has an equally likely chance of being

drawn and being assigned as a value. The higher of these two values will be the “first unit’s value” while the lower will be the “second unit’s value.” Each of the other two bidders will be assigned values for two units in the same way that your values were assigned. The particular values assigned to the other two bidders will typically be different from yours. Please note that for each bidder, the second unit’s value will always be lower than the first unit’s value. In addition, your “first unit’s value” and “second unit’s value” are only for your private information. The other bidders will not know your values.

3. You will submit your “bid for the first unit” and “bid for the second unit” to the experimenter. Then, please note the following three points:
 - “Your bid for the first unit” must be higher than “your bid for the second unit.”
 - Your bid must exceed 0 yen.
 - Your bid must be increments of 10 yen.
4. Each of the three bidders will submit two bids. Therefore, there will be a total of six bids. The two highest bidders will each win an item. In case of a tie among the high bids, the experimenter will randomly determine who wins an item. The described procedure determines the number of units earned by each bidder.
5. The “earnings” for a bidder who wins an item are equal to his/her value of the item less his/her payment. The “earnings” for a bidder who has not earned any units are 0.

G.2.2 Earnings calculation

We first explain how to calculate a bidder’s earnings if the bidder wins an item using examples. There are three bidders, A, B, and C. Here, we focus on bidder A. In the following examples, amounts are displayed in Japanese yen.

(1) The case where a bidder wins one unit: A bidder who wins one unit will pay the amount of his/her bid for the first unit.

Example G.1. Suppose that A’s value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	600	450
B	500	300
C	400	250

Here, the winning bids are A's 600 and B's 500. Bidder A pays the amount of A's bid for the first unit, which is 600. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} - 400 \text{ (payment)} = 280$$

Example G.2. Suppose that A's value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	800	350
B	750	300
C	700	250

Here, the winning bids are A's 800 and B's 750. Thus, bidder A wins one unit. A pays 800, which is A's bid for the first unit. A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} - 800 \text{ (payment)} = -120$$

(2) The case where a bidder wins two units: A bidder who wins two units will pay the sum of his/her bid for the first unit and second unit.

Example G.3. Suppose that A's value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	600	550
B	500	300
C	400	250

Here, the winning bids are A's 600 and A's 550. Bidder A pays 1,150, the sum of the bid of 600 for the first unit and 550 for the second unit. A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} + 480 \text{ (second unit's value)} - 1150 \text{ (payment)} = 10$$

Example G.4. Suppose that A’s value for the first unit is 680 and 480 for the second unit. The bids from the three bidders are shown below.

Bidder	Bid for the first unit	Bid for the second unit
A	900	850
B	800	600
C	700	550

Here, the winning bids are A’s 900 and A’s 850. Bidder A pays 1,750, the sum of the bid of 900 for the first unit and 850 for the second unit. A’s earnings are calculated as follows:

$$680 \text{ (first unit's value)} + 480 \text{ (second unit's value)} - 1750 \text{ (payment)} = -590$$

The earnings calculation method may be summarized as follows:

- When you win one unit:

$$\text{Your earnings} = \text{your first unit's value} - \text{your bid for the first unit}$$

When your payment is higher than your first unit’s value, please note that your earnings will be negative.

- When you win two units:

$$\begin{aligned} \text{Your earnings} &= (\text{your first unit's value} + \text{your second unit's value}) \\ &\quad - (\text{your bid for the first unit} + \text{your bid for the second unit}) \end{aligned}$$

When your payment is higher than the sum of your first and second unit’s values, please note that your earnings will be negative.

- When you do not win anything, your earnings will be 0.

G.3 Rewards

We will explain the rewards you receive after the experiment. Your rewards are the sum of your earnings over all 25 periods and a participation fee of 1,000 yen plus you score in the quiz to check your understanding of each instruction.

For example, if the sum of your earnings is 2,580 yen and your score on the quiz is 420, your rewards will be 4,000 yen.

Recording Sheet							Seat Number	
Period	Value for the first unit	Value for the second unit	Bid for the first unit	Bid for the second unit	Payment (first unit)	Payment (second unit)	Payment (total)	Your earnings
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Recording Sheet							Seat Number	
Period	Value for the first unit	Value for the second unit	Bid for the first unit	Bid for the second unit	Payment (first unit)	Payment (second unit)	Payment (total)	Your earnings
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

H Text of advice (**VA** and **PA**)

Advice on decision making

The following advice is about the auction in which you are participating. Please consider carefully whether this advice is true or false. It is completely up to you whether you follow the advice or not.

You can maximize your earnings by bidding your valuations as they are, regardless of what others bid.

I Auction screens and procedures (VA, VN, PA, and PN)

I.1 Bidding screen

When you are ready to submit your bid, the following screen will be displayed. The upper-left corner of the screen displays the experiment period. The following screen shows the first period in a total of 25 periods. In the center of the screen, “Your value for the first unit” and “Your value for the second unit” are displayed. First, please transcribe this information into the corresponding columns on the record sheet.

Next, you submit “Your bid for the first unit” and “Your bid for the second unit,” both in increments of 10 yen. Please input your bids into the corresponding cells on the screen. *Please note that your bid for the first unit must be higher than your bid for the second unit.* After that, please transcribe your bids into the corresponding columns on the record sheet. After the transcription, click the “OK” button.

You will have 60 seconds to finalize your bid on this screen.

The screenshot shows a bidding interface with a yellow border. At the top left, a box contains '回数' (Number of rounds) and 'Period' with the value '1 / 25'. At the top right, a box shows '残り時間 [秒]: 5' (Time remaining [Sec]: 5). The main area contains four rows of labels and input fields: 'Your value for the first unit 1つ目への評価額' with a dropdown showing '?', 'Your value for the second unit 2つ目への評価額' with a dropdown showing '?', 'Your bid for the first unit 1つ目への入札額' with a text input field containing '1', and 'Your bid for the second unit 2つ目への入札額' with an empty text input field. Below these is a red instruction: '1つ目への入札額を2つ目への入札額以上にしてください。 Your bid for the first unit must be higher than your bid for the second unit.' At the bottom right is a red 'OK' button.

I.2 Auction results screen

After all the subjects have clicked the “OK” button, the following screen will be displayed. On the left side of the screen, all the bids will be ranked from highest to lowest. The right side will be divided into three sections. The top section will show “Your bid for the first unit,” “Your bid for the second unit,” and the number of units you win in this auction. In the middle section, your payment will be displayed in the following order: the amount you pay for the first unit, the amount you pay for the first unit, and the total amount you pay in this auction. Please transcribe this information into the corresponding columns on your record sheet. Finally, the bottom section will show the amount of “Your earnings from this auction.” Please transcribe this information into the corresponding column on your record sheet. After the transcription, click the “Next” button.

回数 Period		残り時間 [秒]: 0	
		Time remaining [Sec]	
Bids are ranked from highest to lowest. 入札は高い順から次のとおりでした。	Your bid for the first unit 1つ目への入札額	?	
	Your bid for the second unit 2つ目への入札額	?	
	あなたは 個の財を得ました。 You have obtained ___ units.		
	支払額(1つ目) Your payment (first unit)	支払額(2つ目) Your payment (second unit)	支払額(合計) Your payment (total)
	?	?	?
	Your earnings from this auction 今回の獲得金額		
	?		
<div>Next</div>			

After all the subjects have clicked the “Next” button, the next auction will start. This marks the end of one auction period. This experiment includes a series of 25 auctions.

J Quiz (VA, VN, PA, and PN)

Please answer all questions below.

The bids from three bidders are shown in the following table. Suppose that B's value for the first unit is 900, and B's value for the second unit is 700. Suppose that C's value for the first unit is 600.

Bidder	Bid for the first unit	Bid for the second unit
A	800	550
B	800	700
C	600	500

- (1) Find (two) winning bids.
- (2) Calculate B's payment.
- (3) Calculate B's earnings.
- (4) Calculate C's payment.
- (5) Calculate C's earnings.

Suppose that B's bid for the first unit is 900; all other bids are shown in the table above.

- (6) Find (two) winning bids.
- (7) Calculate B's payment.
- (8) Calculate B's earnings.

Suppose that B's bid for the first unit is 700 and 300 for the second unit; all other bids are shown in the table above.

- (9) Find (two) winning bids.
- (10) Calculate B's payment.
- (11) Calculate B's earnings.

Suppose that C's bid for the first unit is 1,000; all other bids are shown in the table above.

- (12) Find (two) winning bids.
- (13) Calculate C's payment.
- (14) Calculate C's earnings.

Suppose that C's bid for the first unit is 500; all other bids are shown in the table above.

- (15) Find (two) winning bids.
- (16) Calculate C's payment.
- (17) Calculate C's earnings.

K Experimental instruction (AA and AN)

Note: In this experiment, please remember that you cannot communicate with other subjects. If there is communication, this experiment will be stopped at that point.

First, please confirm the following items. If any of the items are missing, please contact the experimenter.

- Instructions (this handout)
- Record sheet
- Ballpoint pen, pencil, and eraser
- Calculator

K.1 Overview

In this experiment, you will act as bidders in a sequence of auctions. Three bidders will participate in each auction. At the beginning of each period of the auction, the experimenter randomly matches you with two persons from the other subjects. The three of you will form a group. This experiment consists of 25 periods. The individuals you are matched with will change every period. You will not know who you are matched with either during or after the experiment.

The rewards you receive after the experiment are determined based on the decisions you and others make in the experiment. Your rewards will be paid to you in cash at the end of the experiment. A detailed explanation of the rewards you will receive will be provided later in **K.3. Rewards**.

K.2 Auction

K.2.1 Procedure in each period

1. Two units of an identical object will be auctioned off in every period. Three bidders, including yourself, will participate in an auction.
2. Each bidder will be assigned a value for the first unit (“first unit’s value”) and another value for the second unit (“second unit’s value”). For each bidder, values will be randomly drawn from the interval 0 JPY to 1,000 JPY with increments of 10 yen. Any value within this interval has an equally likely chance of being

drawn and being assigned as a value. The higher of these two values will be the “first unit’s value” while the lower will be the “second unit’s value.” Each of the other two bidders will be assigned values for two units in the same way that your values were assigned. The particular values assigned to the other two bidders will typically be different from yours. Please note that for each bidder, the second unit’s value will always be lower than the first unit’s value. In addition, your “first unit’s value” and “second unit’s value” are only for your private information. The other bidders will not know your values.

3. In the auction, a price will start at 0 and rise in increments of 10 JPY every 2 seconds. For each price, please indicate how many units you are willing to buy (that is, your demand) at that price. When the price is 0, your demand is two units. You must decide whether to reduce your demand as the price increases. As is later explained, please click the “demand reduction button” displayed on your screen once to reduce your demand by one unit at that ongoing price. Likewise, please click the demand reduction button again to reduce one more unit when suitable. In short, if you click the demand reduction button twice, your demand becomes 0.
4. When the price is 0 at the beginning of the auction, each of the three bidders is willing to buy two units, and thus, the “aggregate demand” is six units. As the price increases, aggregate demand decreases. When the aggregate demand becomes two units, the auction is over. That is, the auction ends as soon as the demand reduction buttons are clicked four times. Please note that even if the aggregate demand does not become two units, the auction ends as soon as the price hits the maximum limit of 2,000 JPY.
5. Each of the two units will be allocated to the demands displayed at the end of the auction. We explain the number of units you win, and your payments in each of the four cases as follows:
 - a) The case where your demand becomes 0 (that is, you clicked the demand reduction button twice) during the auction: Then, both the number of units you win, and your payment are 0.
 - b) The case where your demand is one unit (that is, you clicked the demand reduction button once) while the aggregate demand becomes three units during the auction: Then, the auction ends as soon as someone first clicks

the demand reduction button, and the outcome of the auction is determined as follows:

- (1) If the auction ends due to your demand reduction, then both the number of units you win, and your payment are 0.
 - (2) If the auction ends due to another bidder's demand reduction, then you win one unit. Your payment is "the price at the time the auction is over."
- c) The case where your demand remains two units (that is, you never clicked the demand reduction button) while the aggregate demand becomes three units during the auction: Then, you are assured to earn at least one unit. The price you pay for this one unit will be equal to the current price. Then, the auction ends as soon as someone first clicks the demand reduction button, and the outcome of the auction is determined as follows:
- (1) If the auction ends due to your demand reduction, then you win only one unit and your payment is "the price at the time you were assured to win one unit."
 - (2) If the auction ends due to another bidder's demand reduction, you can win two units and your payment is "the price at the time you were assured to win one unit" + "the price at the time the auction is over."
- d) The case where the price rises to the maximum limit price while the aggregate demand remains at least three units: After the auction, each unsold unit will be allocated with equal probability to the unfulfilled demands that are displayed at the end of the auction.
- (1) If none of the bidders are assured to win one unit until the price rises to the maximum limit price, each of the two units will be allocated to the unfulfilled demands with equal probability. You then pay the maximum limit price for each unit you win. If you do not win anything, your payment is 0. That is, your payment is "the number of units you win (0, 1, or 2)" \times "the maximum limit price."
 - (2) If there is a bidder who is assured to win one unit until the price rises to the maximum limit price, one remaining unit will be allocated to the unfulfilled demands with equal probability. If you win one unit, you pay the maximum limit price. If you have been assured to win one unit until the price hits the maximum limit price, you also pay the price at

the time you were assured to win one unit. That is, if you have not been assured to win one unit, your payment is “the number of units you win (0 or 1)” \times “the maximum limit price.” If you have been assured to win one unit during the auction, your payment is “the price at the time you were assured to win one unit” + “the number of units you win (0, 1, or 2)” \times “the maximum limit price.”

K.2.2 Earnings calculation

First, we explain how to calculate a bidder’s earnings if the bidder wins some units using these examples. There are three bidders, A, B, and C. We focus on bidder A. In the following examples, amounts are displayed in JPY. A price at the time a bidder intends to click the demand reduction button is called a “demand reduction price.” Now, consider the case where demand reduction buttons are clicked four times before the price hits the maximum limit price.

(1) For a bidder whose demand is one unit at the end of the auction: A bidder who earns one unit will pay the amount of the highest bid from among the other bidders’ losing bids.

Example K.1. Suppose A’s value for the first unit is 680 and 480 for the second unit. The table below displays prices at the time each of the three bidders intends to click the demand reduction button. In the following examples, the demand reduction prices include those that are scheduled. This means that some demand reduction prices might not be observed because the auction ends before the demand reduction buttons are clicked at those prices.

Bidder	First demand reduction price	Second demand reduction price
A	450	600
B	300	500
C	250	400

If the observable demand reduction prices are sorted in ascending order, then “C’s is 250,” “B’s is 300,” “C’s is 400,” and “A’s is 450.” That is, the auction ends as soon as A clicks the demand reduction button. Since A’s demand at the end of the auction is one unit and the auction ends due to A’s own demand reduction, A’s payment is the

third demand reduction price, 400. Please note that this payment is different from A's own demand reduction price. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} - 400 \text{ (payment)} = 280$$

Example K.2. Suppose A's value for the first unit is 680 and 480 for the second unit. The table below displays the bidders' demand reduction prices.

Bidder	First demand reduction price	Second demand reduction price
A	350	800
B	300	750
C	250	700

If the observable demand reduction prices are sorted in ascending order, then "C's is 250," "B's is 300," "A's is 350," and "C's is 700." That is, the auction ends as soon as C finally clicks the demand reduction button. Since A's demand at the end of the auction is one unit and the auction ends due to C's demand reduction, A's payment is the fourth demand reduction price, 700. Please note that this payment is different from A's own demand reduction price. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} - 700 \text{ (payment)} = -20$$

(2) For a bidder whose demand is 2 units at the end of the auction:

Example K.3. Suppose A's value for the first unit is 680 and 480 for the second unit. The table below displays the bidders' demand reduction prices.

Bidder	First demand reduction price	Second demand reduction price
A	550	600
B	300	500
C	250	400

If the observable demand reduction prices are sorted in ascending order, "C's is 250," "B's is 300," "C's is 400," and "B's is 500." When C makes the third demand reduction, A is assured to win one unit. After that, the auction ends as soon as B clicks the demand reduction button. Thus, A's payment is 900, which is the sum of the third

demand reduction price of 400, and the fourth demand reduction price of 500. Please note that this payment is different from A's own demand reduction price. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} + 480 \text{ (second unit's value)} - 900 \text{ (payment)} = 260$$

Example K.4. Suppose A's value for the first unit is 680 and 480 for the second unit. The table below displays the bidders' demand reduction prices.

Bidder	First demand reduction price	Second demand reduction price
A	850	900
B	600	800
C	550	700

If the observable demand reduction prices are sorted in ascending order, "C's is 550," "B's is 600," "C's is 700," and "B's is 800." Then, A's payment can be similarly calculated as in Example K.3. In this example, A's payment is 1500, which is the sum of the third demand reduction price of 700, and the fourth demand reduction price of 800. Please note that this payment is different from A's own demand reduction price. Then, A's earnings are calculated as follows:

$$680 \text{ (first unit's value)} + 480 \text{ (second unit's value)} - 150 \text{ (payment)} = -340$$

In the case where demand reduction buttons are clicked four times before the price hits the maximum limit price, the earnings calculation method may be summarized as follows:

- The case where your demand is 0 units at the end of the auction:

$$\text{Your earning} = 0$$

- The case where your demand is one unit at the end of the auction:
 - If another bidder stops the auction by finally clicking the demand reduction button, your earnings will be:

$$\text{Your earning} = \text{your first unit's value} - \text{fourth demand reduction price}$$

- If you stop the auction by finally clicking the demand reduction button, your earnings will be:

Your earning = your first unit's value – third demand reduction price

- The case where your demand at the end of the auction remains two units:

$$\begin{aligned} \text{Your earning} = & (\text{your first unit's value} + \text{your second unit's value}) \\ & - \left(\begin{array}{c} \text{third demand reduction price} \\ + \\ \text{fourth demand reduction price} \end{array} \right) \end{aligned}$$

If demand reduction buttons are not clicked four times before the price reaches the maximum price, your earning is the sum of valuations for units you win minus the payment calculated as described in 5d of Section K.2.1. If you do not win anything, your earnings are 0.

K.3 Rewards

We will explain the rewards you receive after the experiment. Your rewards are the sum of your earnings over all 25 periods plus a participation fee of 1,000 yen.

For example, if the sum of your earnings is 2,580 yen, your rewards will be 3,580 yen. In other words, the more you earn from each period, the higher your rewards will be.

Recording Sheet							Seat Number	
Period	Value for the first unit	Value for the second unit	First demand reduction price	Second demand reduction price	Payment (first unit)	Payment (second unit)	Payment (total)	Your earnings
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

Note: If you reduced demand once or did not reduce at all, please denote a slash mark in the corresponding cells.

Recording Sheet

Seat Number _____

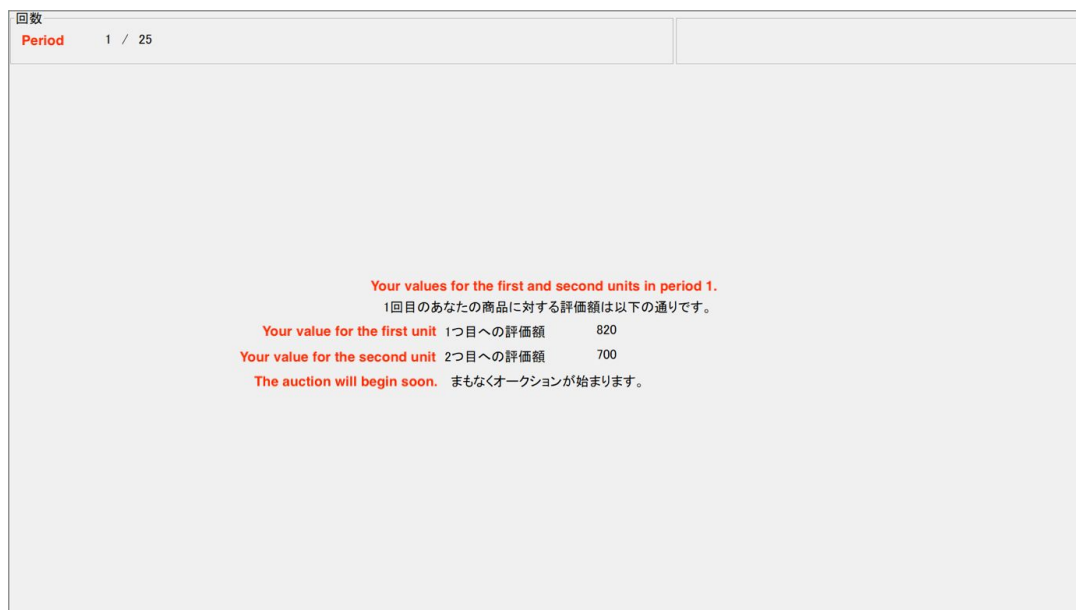
Period	Value for the first unit	Value for the second unit	First demand reduction price	Second demand reduction price	Payment (first unit)	Payment (second unit)	Payment (total)	Your earnings
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

Note: If you reduced demand once or did not reduce at all, please denote a slash mark in the corresponding cells.

L Auction screens and procedures (AA and AN)

L.1 Screen before beginning the auction

At the beginning of each period of the auction, the following screen will be displayed. The upper-left corner of the screen displays the current experiment period. The following screen shows that the current period is the first period in a total of 25 periods. In the center of the screen, “Your first unit value” and “Your second unit value” are displayed. First, please record this information in the corresponding columns on the record sheet.



L.2 Decision-making screen

When an auction starts, the following screen will be displayed. The upper-left corner of the screen displays the current experiment period. The following screen shows that the current period is the first period in a total of 25 periods. In the center of the screen, “Your first unit value” and “Your second unit value” are displayed. In the box immediately below, you will see the current price. The price will rise in increments of 10 JPY every 2 seconds. On the left of the screen, each bidder’s demand at the current price will be displayed. The screenshot below indicates that each bidder’s demand is 2 as the auction has just started. Please note that other bidders’ numbers “1” and “2” will be randomly assigned after determining the group members. Hence, you cannot identify who they are based on these numbers. On the right of the screen, you will

see an event table that shows the history, from the beginning to the current period, of which bidders have reduced demand and at what price, and whether they have been assured to win one unit and at what price. At the bottom of the screen, you can see the “demand reduction button.” If you click this button once, you can reduce your demand by one unit. Since your demand is 2 at the beginning of the auction, you can click the button a maximum of two times.

1) Screen just after the auction has begun

回数
Period 1 / 25

Your value for the first unit 1つ目への評価額 820
Your value for the second unit 2つ目への評価額 700

現在の価格
Current price 20

	あなた You	相手1 Opponent 1	相手2 Opponent 2
需要量 Demand	2	2	2

Prices 価格	Subjects 被験者	Events 事項
--------------	-----------------	--------------

需要削減
Demand reduction

2) Screen in case you are assured to win one unit

回数
Period 1 / 25

Your value for the first unit 1つ目への評価額 ?
Your value for the second unit 2つ目への評価額 ?

現在の価格
Current price ?

	あなた You	相手1 Opponent 1	相手2 Opponent 2
需要量 Demand	2	0	1

Prices 価格	Subjects 被験者	Events 事項
?	Opponent 1 相手1	需要削減 Demand reduction
?	Opponent 2 相手2	需要削減 Demand reduction
?	Opponent 1 相手1	需要削減 Demand reduction
?	You あなた	1単位確定 You win 1 unit

需要削減
Demand reduction

3) Screen in case you are assured to win one more unit

回数
Period 1 / 25

Your value for the first unit 1つ目への評価額 ?

Your value for the second unit 2つ目への評価額 ?

現在の価格
Current price ?

	あなた You	相手1 Opponent 1	相手2 Opponent 2
需要量 Demand	2	0	0

Prices 価格	Subjects 被験者	Events 事項
?	Opponent 1 相手1	需要削減 Demand reduction
?	Opponent 2 相手2	需要削減 Demand reduction
?	Opponent 1 相手1	需要削減 Demand reduction
?	You あなた	1単位確定 You win 1 unit
?	Opponent 1 相手2	需要削減 Demand reduction
?	You あなた	1単位確定(終了) You win 1 unit (end)

この回のオークションは終了しました。
The auction ends in this period.

Go to the confirmation screen

確認画面へ

When one period of the auction ends, please write a maximum of two of your demand reduction prices in the corresponding cells on the record sheet. If you reduced demand once or did not reduce at all by the end of the auction, please denote a slash mark in the corresponding cells on the record sheet. After the transcription, please click the “Go to the confirmation screen” button.

L.3 Confirmation screen

After all the subjects have finished their inputs, the following screen will be displayed. On the left side of the screen, the event table is displayed again. The right side will show information on your earnings. From the top, you will see “Your value for the first unit,” “Your value for the second unit,” the number of units you have earned in this auction, the total amount you paid in this auction, and “Your earnings from this auction.” Please transcribe your payment for the first unit, the second unit, and the total payment into the corresponding columns on your record sheet. If you paid nothing, please write 0. After the transcription, please click the “OK” button.

価格	被験者	事項	
?	Opponent 1 相手1	需要削減 Demand reduction	1つ目への評価額 Your value for the first unit ?
?	Opponent 2 相手2	需要削減 Demand reduction	2つ目への評価額 Your value for the second unit ?
?	Opponent 1 相手1	需要削減 Demand reduction	
?	You あなた	1単位確定 You win 1 unit	落札した個数 The number of units you win ?
?	Opponent 2 相手2	需要削減 Demand reduction	支払額 Your payment ?
?	You あなた	1単位確定(終了) You win 1 unit (end)	今回の獲得金額 Your earnings from this auction ?

After all the bidders have clicked the “OK” button, the next period of the auction will begin. This marks the end of one auction period. This experiment includes a series of 25 auctions.

M Quiz (AA and AN)

Please answer all questions below.

The three bidders planning demand reduction of the prices are shown in the following table. Suppose that B's value for the first unit is 900, and B's value for the second unit is 700. Suppose that C's value for the first unit is 600.

Bidder	First demand reduction price	Second demand reduction price
A	800	550
B	800	700
C	600	500

- (1) Specify winning bidders and how many unit(s) each winning bidder wins.
- (2) Calculate B's payment.
- (3) Calculate B's earnings.
- (4) Calculate C's payment.
- (5) Calculate C's earnings.

Suppose that B's second demand reduction price is 900; all other bids are shown in the table above.

- (6) Specify winning bidders and how many unit(s) each bidder has won.
- (7) Calculate B's payment.
- (8) Calculate B's earnings.

Suppose that B's first and second demand reduction prices are 300 and 700; all other demand reduction prices are shown in the table above.

- (9) Specify winning bidders and how many unit(s) each bidder has won.
- (10) Calculate B's payment.
- (11) Calculate B's earnings.

Suppose that C's second demand reduction price is 1,000; all other demand reduction prices are shown in the table above.

(12) Specify winning bidders and how many unit(s) each bidder has won.

(13) Calculate C's payment.

(14) Calculate C's earnings.

Suppose that C's second demand reduction price is 500; all other demand reduction prices are shown in the table above.

(15) Specify winning bidders and how many unit(s) each bidder has won.

(16) Calculate C's payment.

(17) Calculate C's earnings.

N Text of advice (**AA**)

Advice on decision making

The following advice is about the auction in which you are participating. Please consider carefully whether this advice is true or false. It is completely up to you whether you follow the advice.

You can maximize your earnings by reducing your demands at your values as they are, regardless of the prices at which others reduce their demands.

O Post-experiment survey (VN, PN, and AN)

Seat Number _____

Faculty / Department _____ Age _____ Gender: Male / Female

1. Did you understand the auction rules (that is, how to calculate a bidder's earnings)?

- (a) I understood it after receiving the instructions.
- (b) I understood it after confirming the rules.
- (c) I understood it by following the practice, and before the first real period.
- (d) I understood it during the real periods (from period _____)
- (e) I did not understand it.

2. How did you decide to bid? Please write specifically.

The number of times you bid your valuations: first unit (____times), second unit (____ times).

3. What did you think about others' bids? Please circle your selection and write specific details.

(Thought deeply, Didn't think much, Didn't think at all)

4. What do you think is the optimal bidding strategy? Please write your ideas and their reasoning.

5. If you had been aware of the others' valuations, would you have changed the way you decided to bid? If so, how would it have changed? Please write your ideas and reasons.

--

Thank you for your answers.

P Post-experiment survey (**VA**, **PA**, and **AA**)

Seat Number _____

Faculty / Department _____ Age _____ Gender: Male / Female

1. Did you understand the auction rules (that is, how to calculate a bidder's earnings)?

- (a) I understood it after receiving the instructions.
- (b) I understood it after confirming the rules.
- (c) I understood it by following the practice, and before the first real period.
- (d) I understood it during the real periods (from period _____)
- (e) I did not understand it.

2. Did you trust the decision-making advice?

- (a) I trusted it before the practice.
- (b) I trusted it after the practice, and before the first real period.
- (c) I began trusting it during the real periods. (from period _____)
- (d) I did not trust it.

If you answer is (c) or (d), please write your reason(s) below.

3. How did you decide to bid? Please write specifically.

The number of times you bid your valuations: first unit (____ times), second unit (____ times).

4. What did you think about others' bids? Please circle your selection and write specific details.

(Thought deeply, Didn't think much, Didn't think at all)

5. What do you think is the optimal bidding strategy? Please write your ideas and their reasoning.

6. If you had been aware of the others' valuations, would you have changed the way you decided to bid? If so, how would it have changed? Please write your ideas and reasons.

Thank you for your answers.

Q Individual bidding data

This section provides figures showing that each subject's bidding behavior in each treatment.

Legends on the figures

- x -axis: period
- y -axis: bid value
- Green line with \circ : quiz score = 17
- Orange line with \times : quiz score < 17
- Blue dotted line: positive payoff
- Red solid line: negative payoff

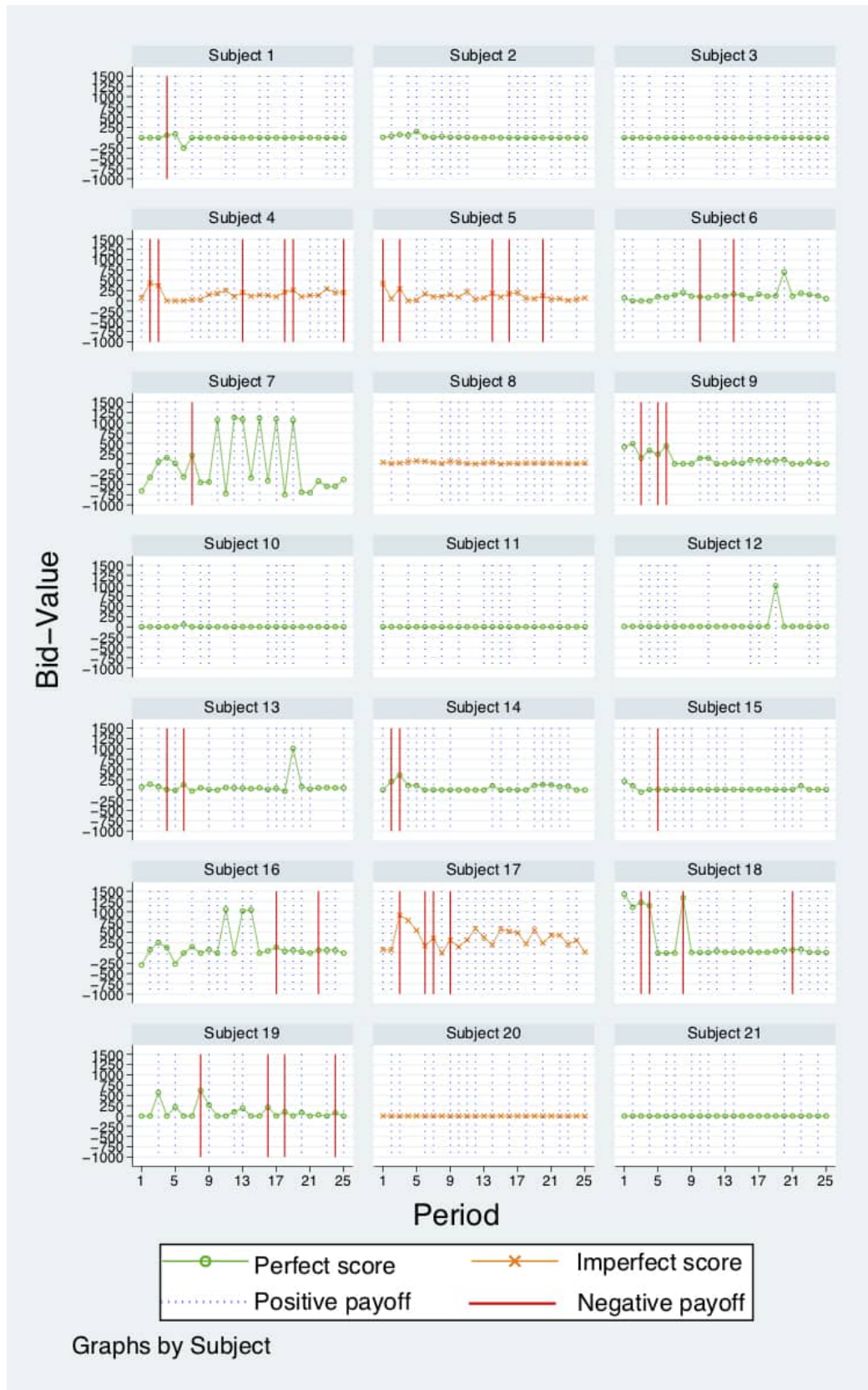


Figure 6: Time evolution of the gap between bid and value for unit 1 in VA1.

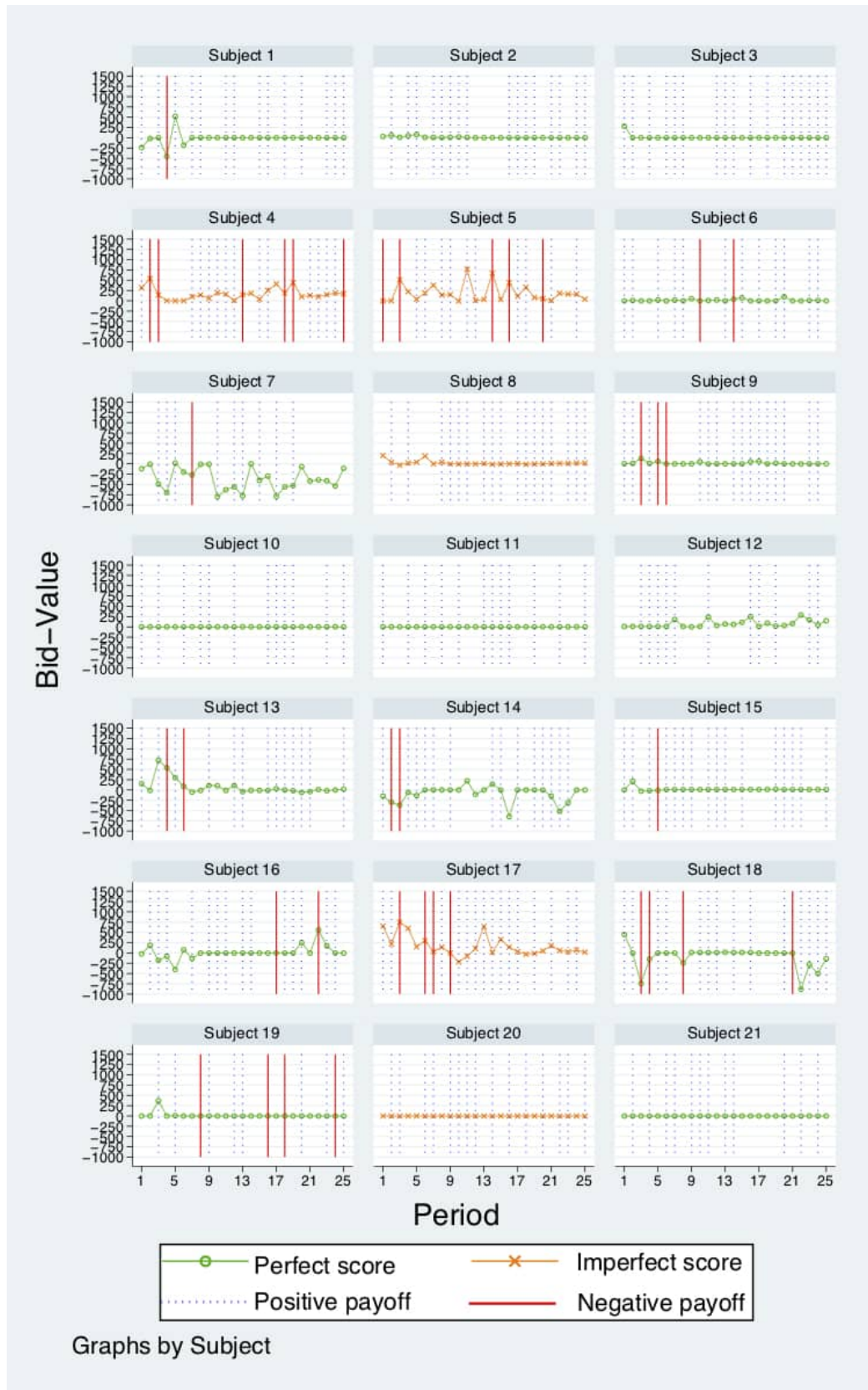


Figure 7: Time evolution of the gap between bid and value for unit 2 in VA1.

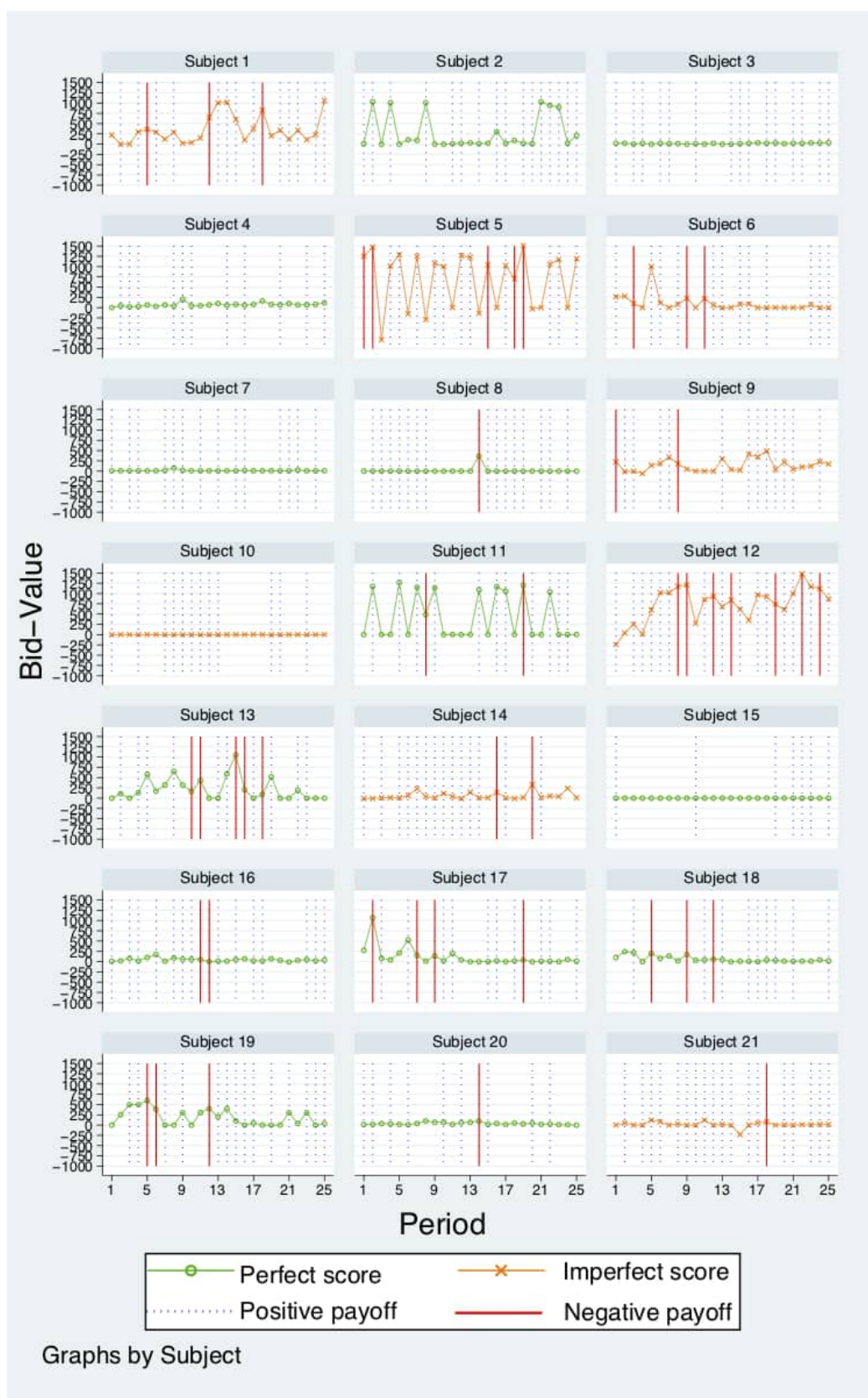


Figure 8: Time evolution of the gap between bid and value for unit 1 in VA2.

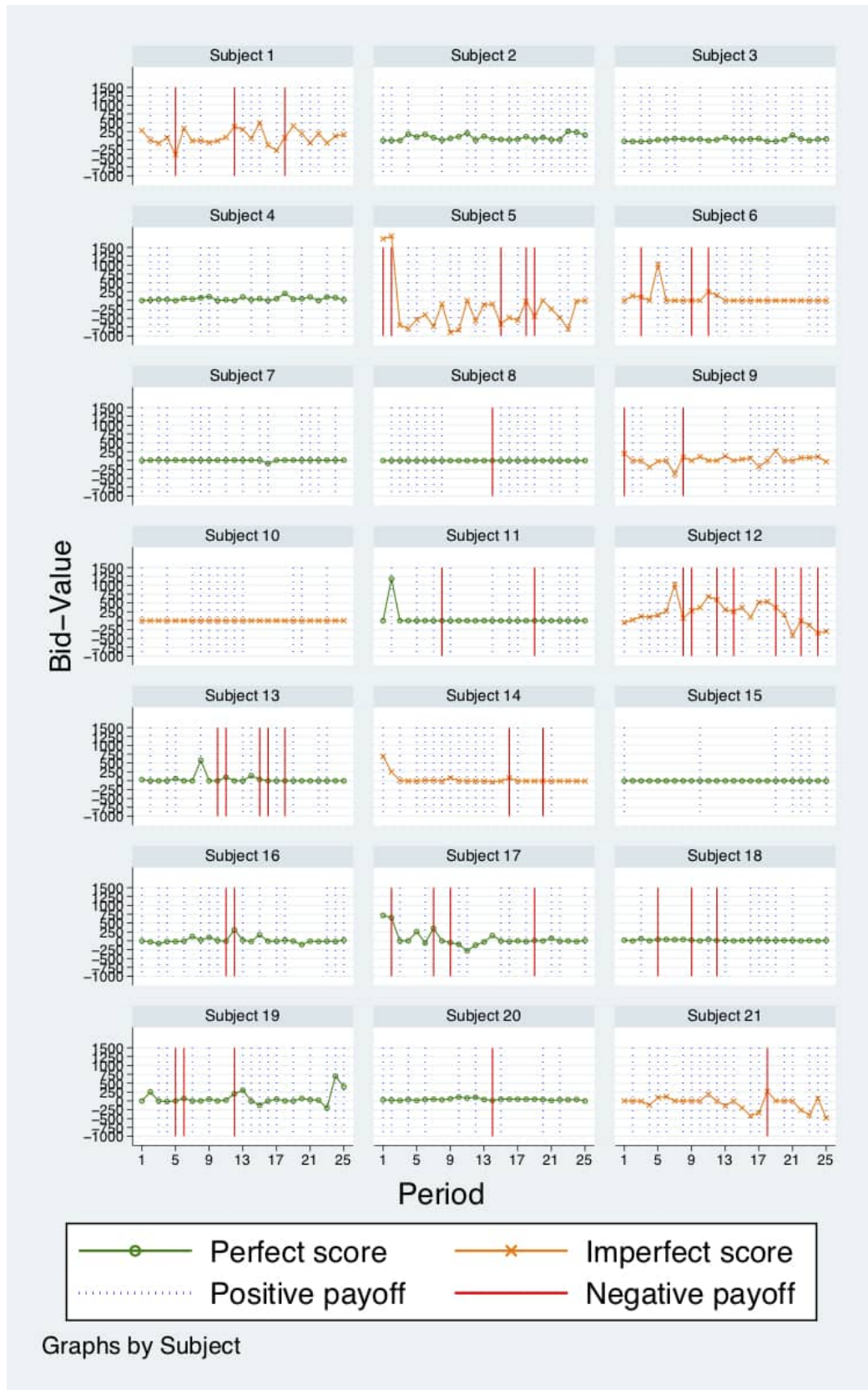


Figure 9: Time evolution of the gap between bid and value for unit 2 in VA2.

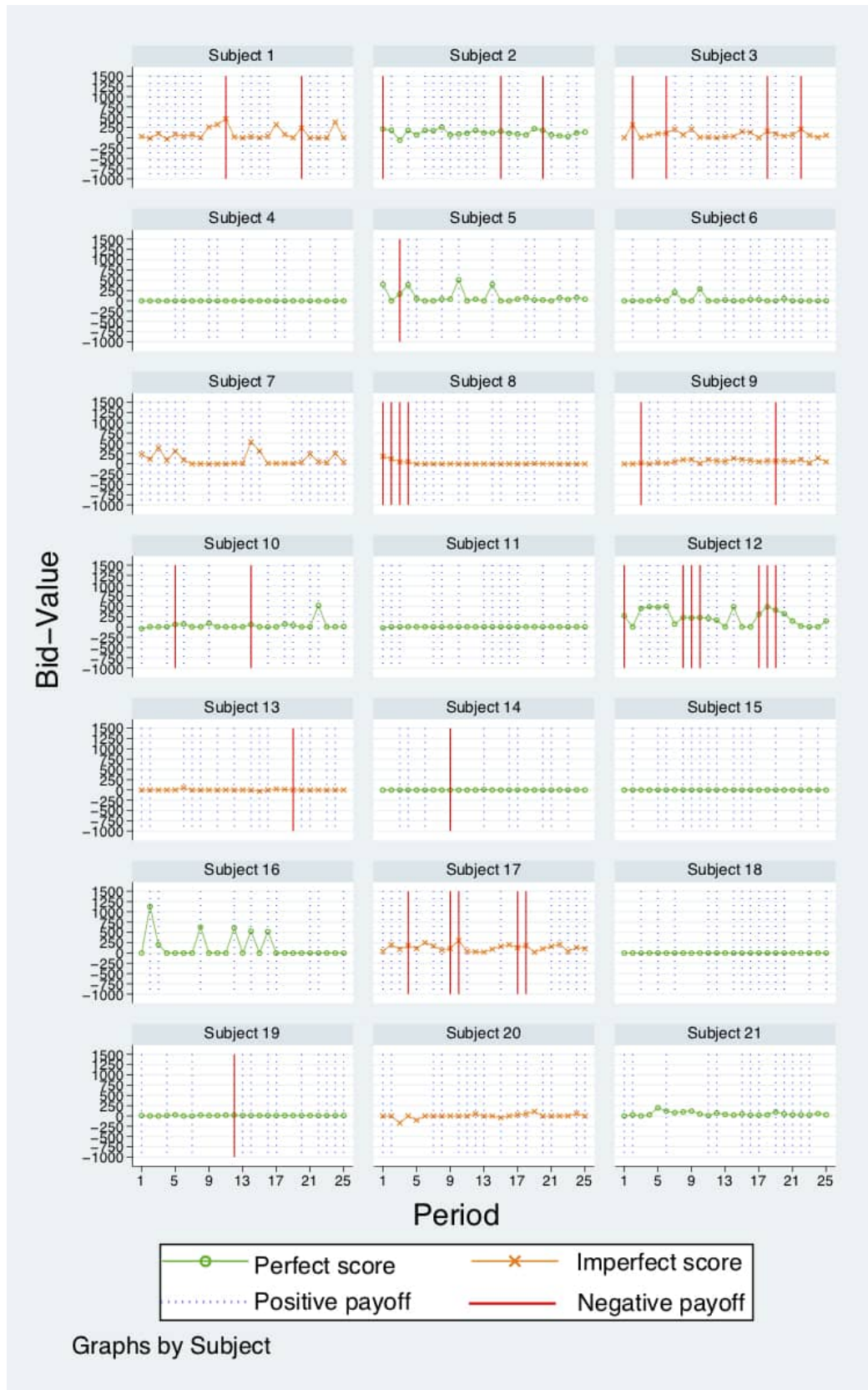


Figure 10: Time evolution of the gap between bid and value for unit 1 in VA3.

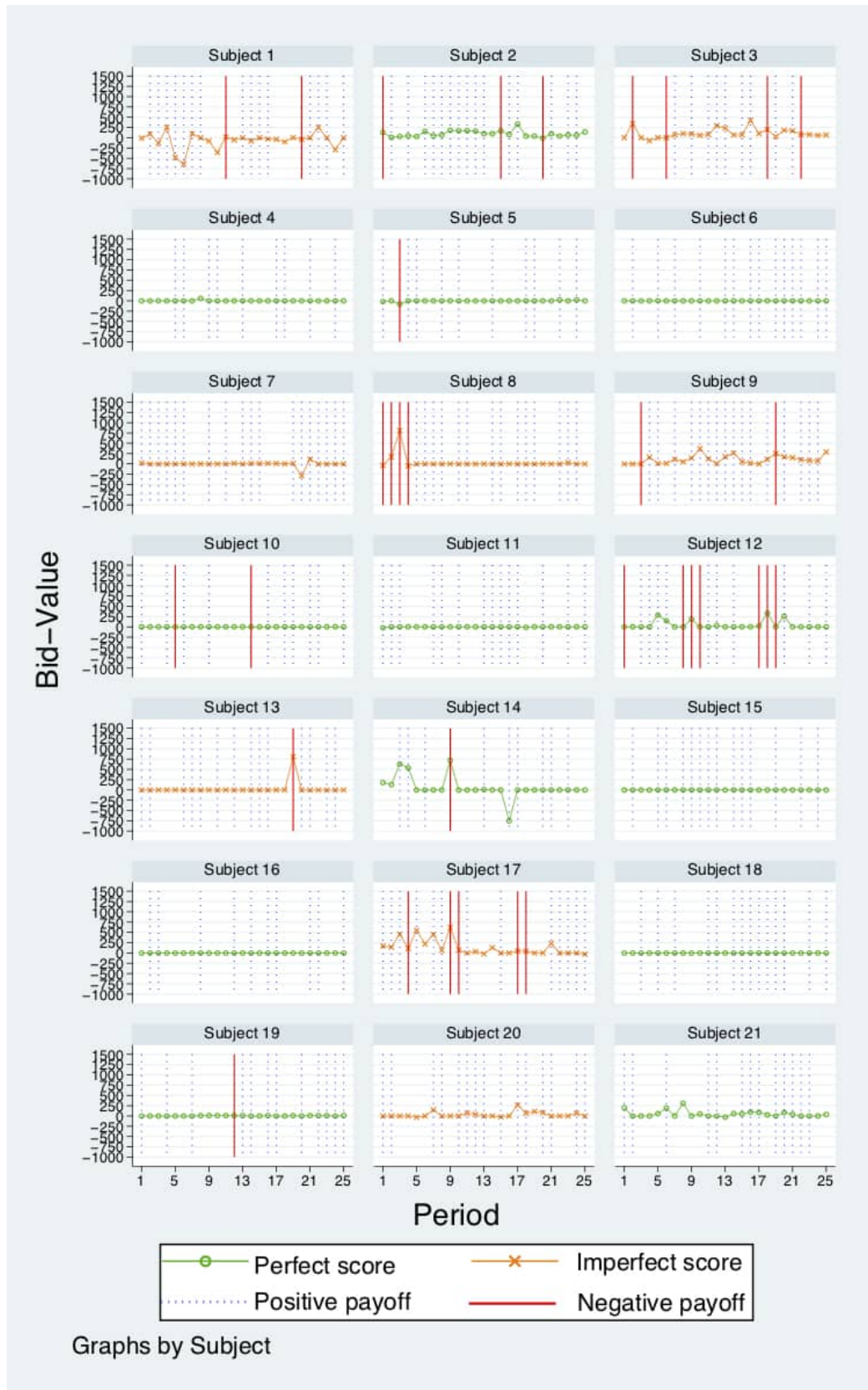


Figure 11: Time evolution of the gap between bid and value for unit 2 in VA3.

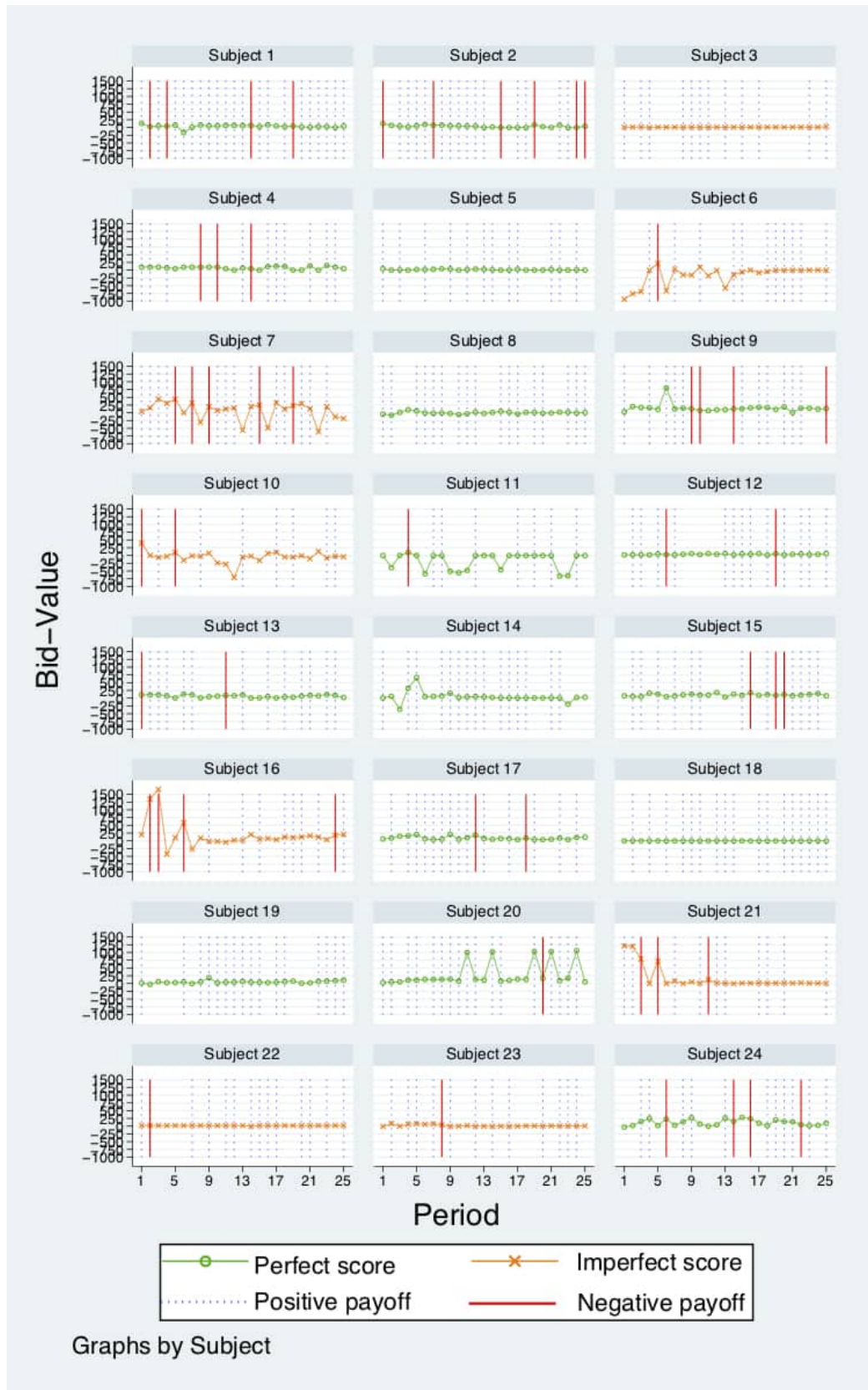


Figure 12: Time evolution of the gap between bid and value for unit 1 in VN1.

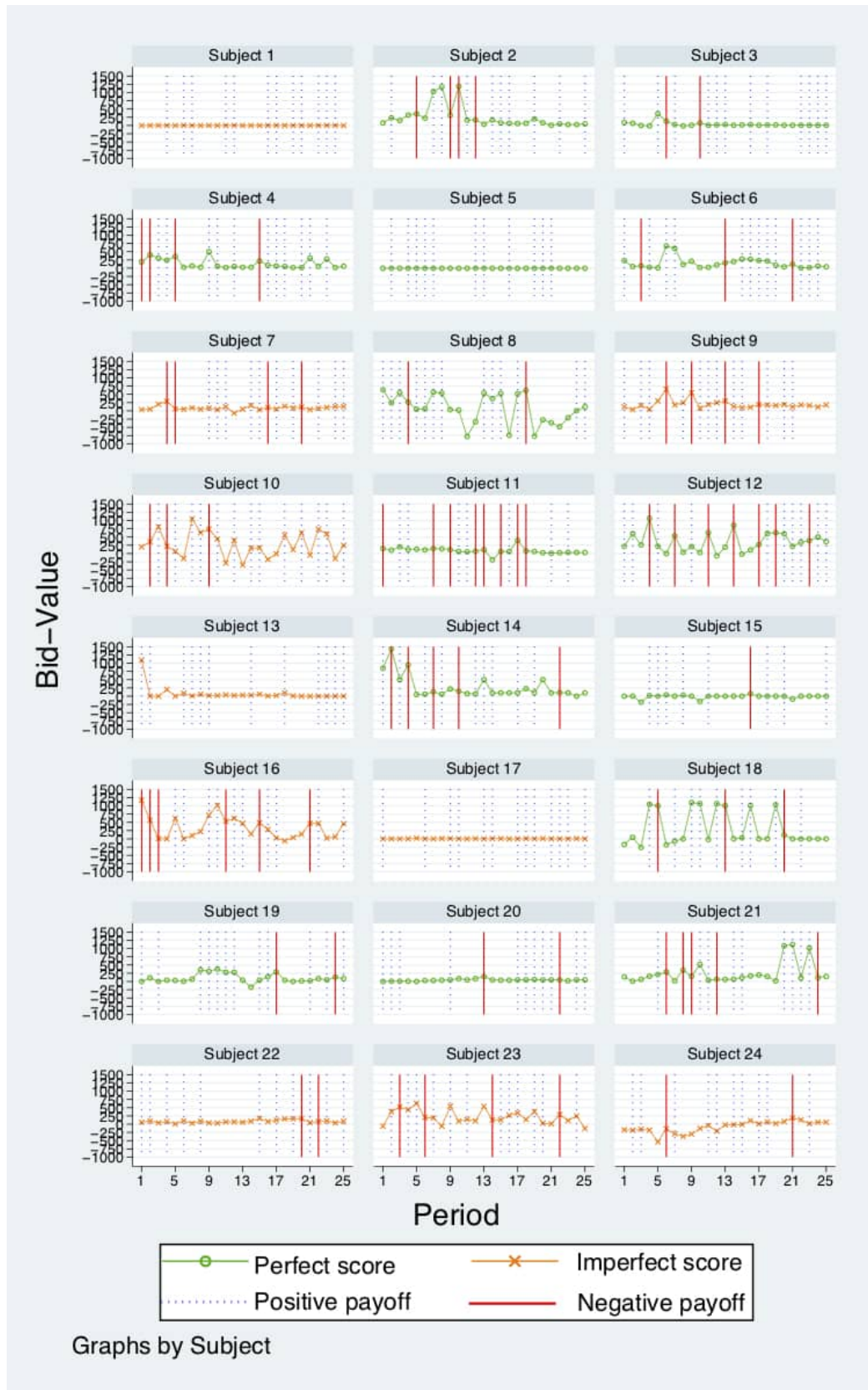


Figure 13: Time evolution of the gap between bid and value for unit 2 in VN1.

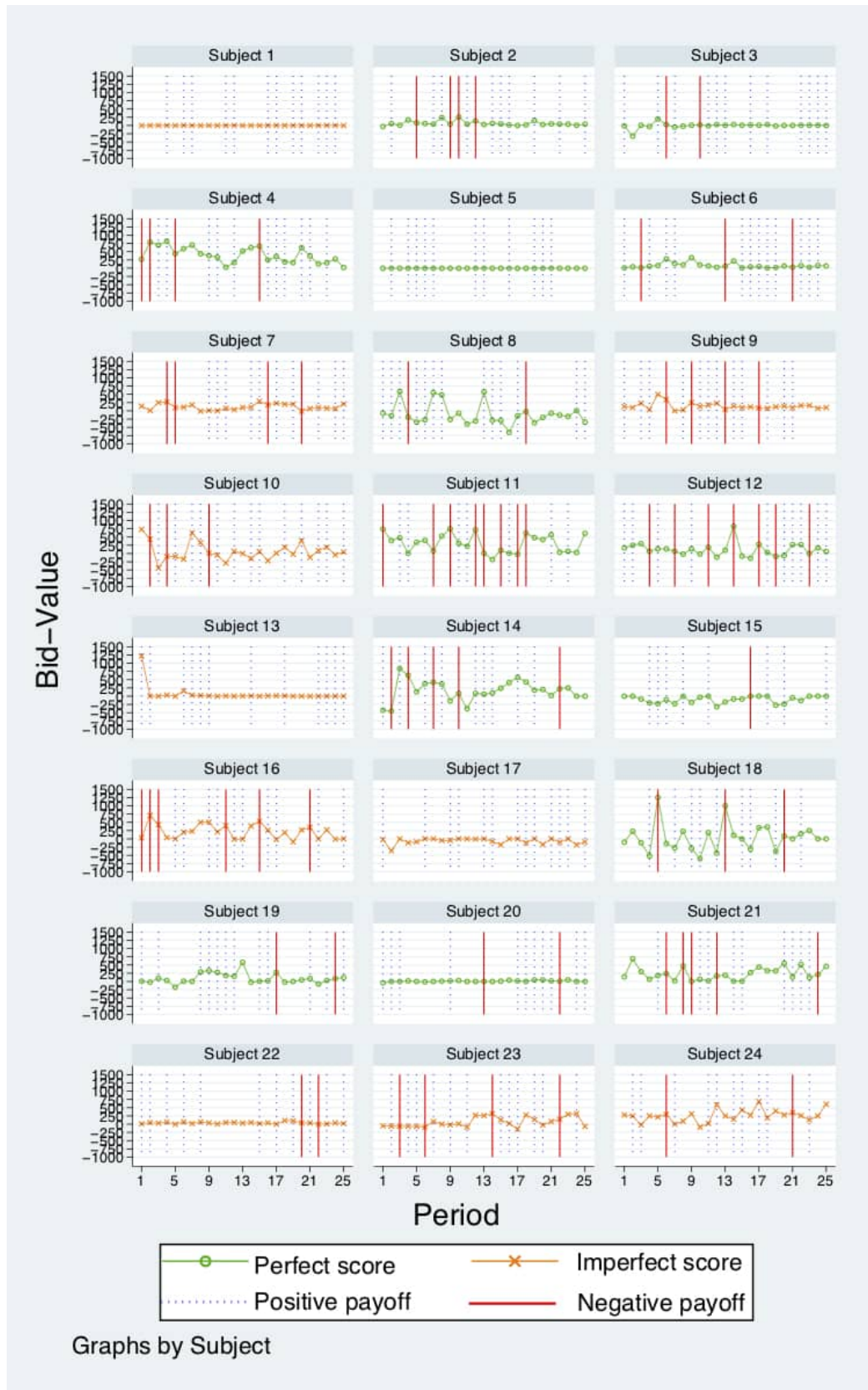


Figure 14: Time evolution of the gap between bid and value for unit 1 in VN2.

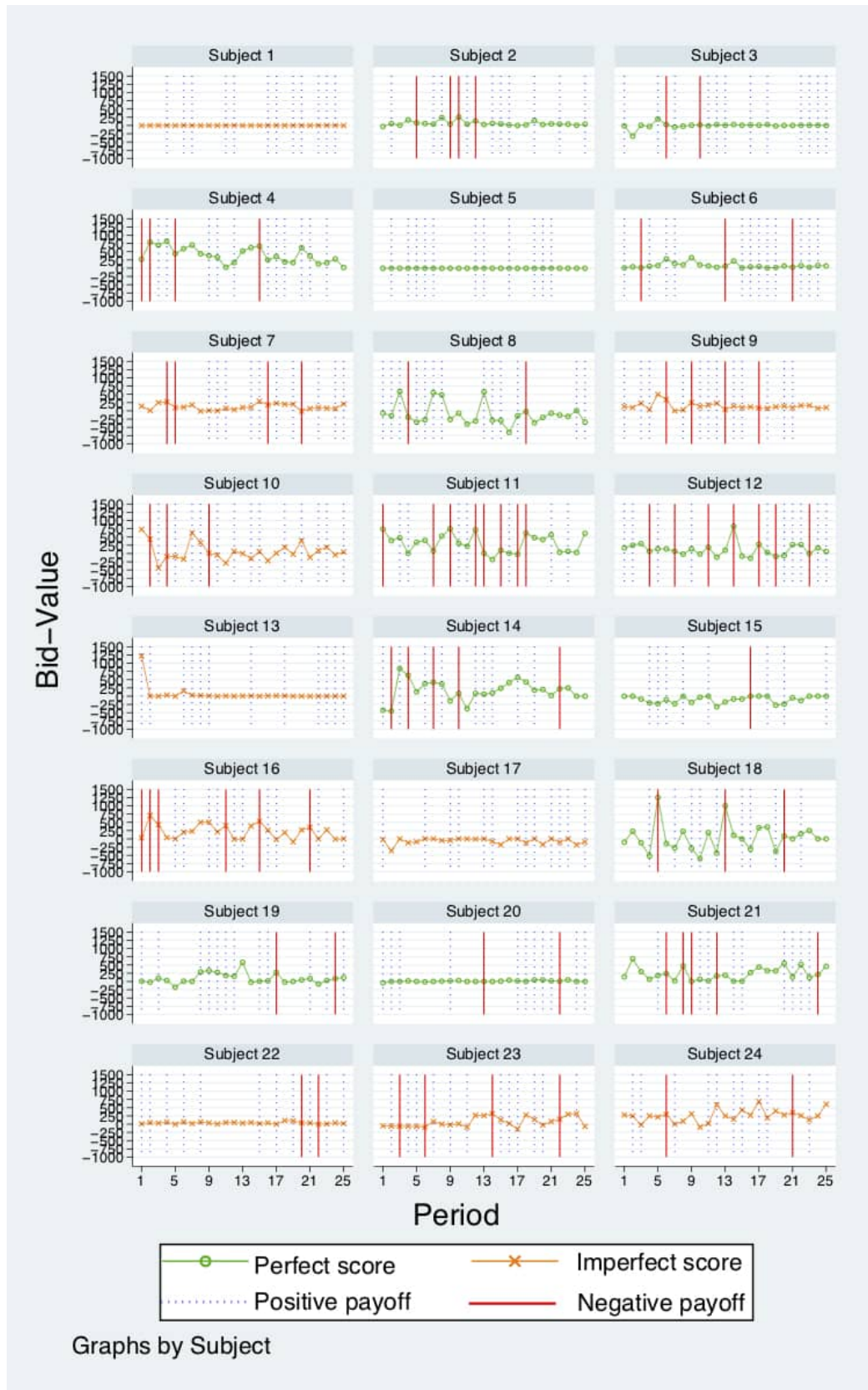


Figure 15: Time evolution of the gap between bid and value for unit 2 in VN2.

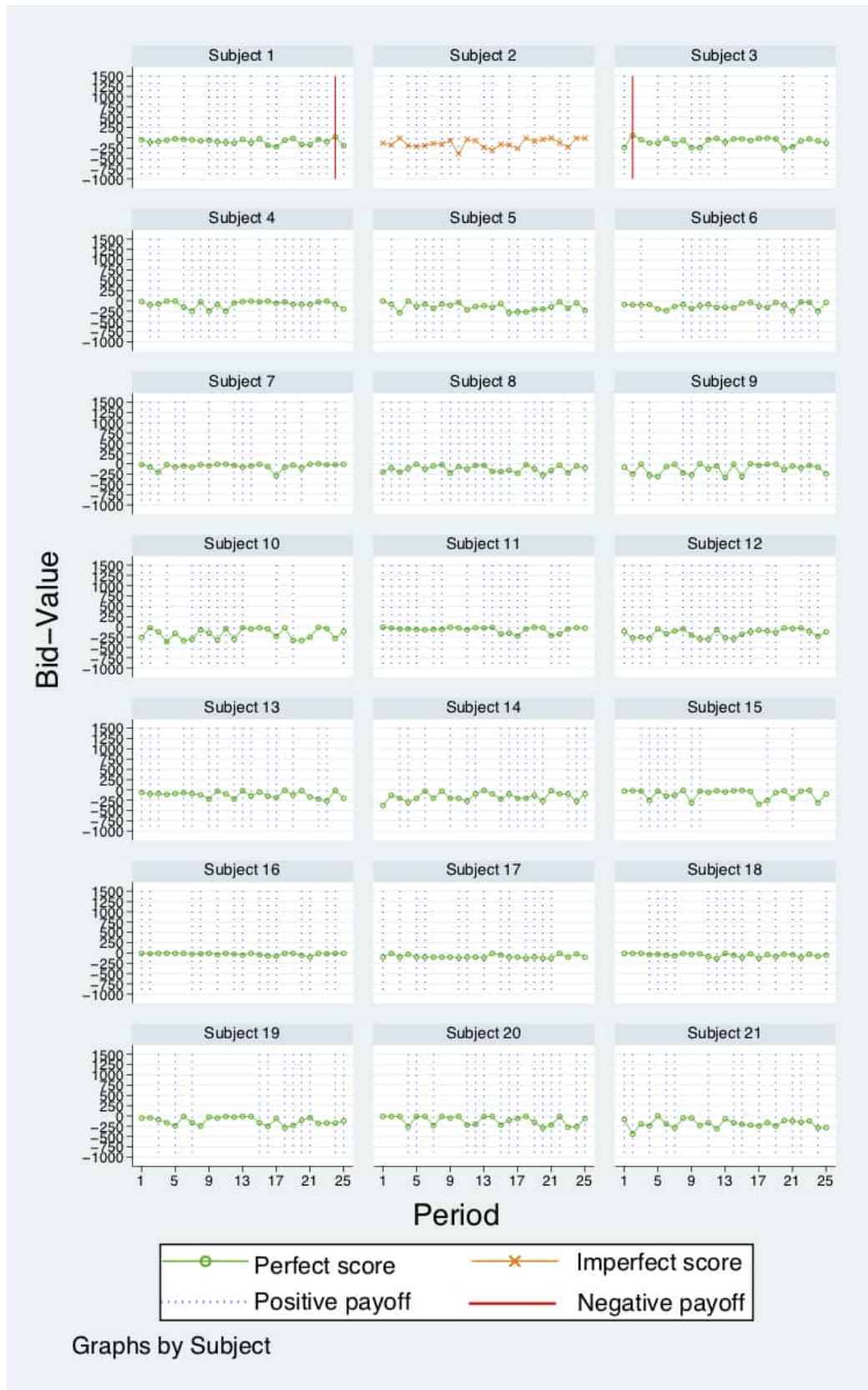


Figure 16: Time evolution of the gap between bid and value for unit 1 in PA1.

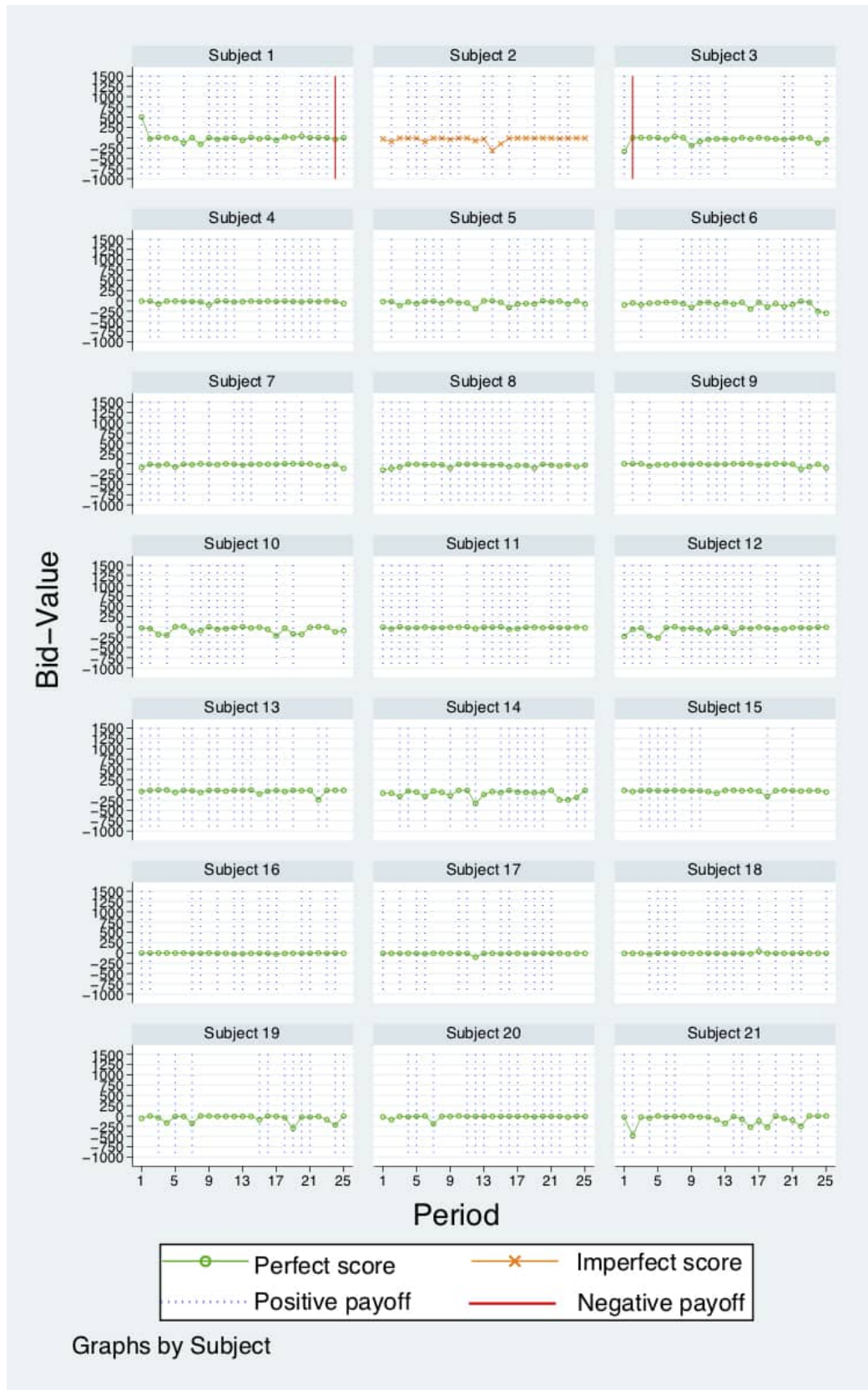


Figure 17: Time evolution of the gap between bid and value for unit 2 in PA1.

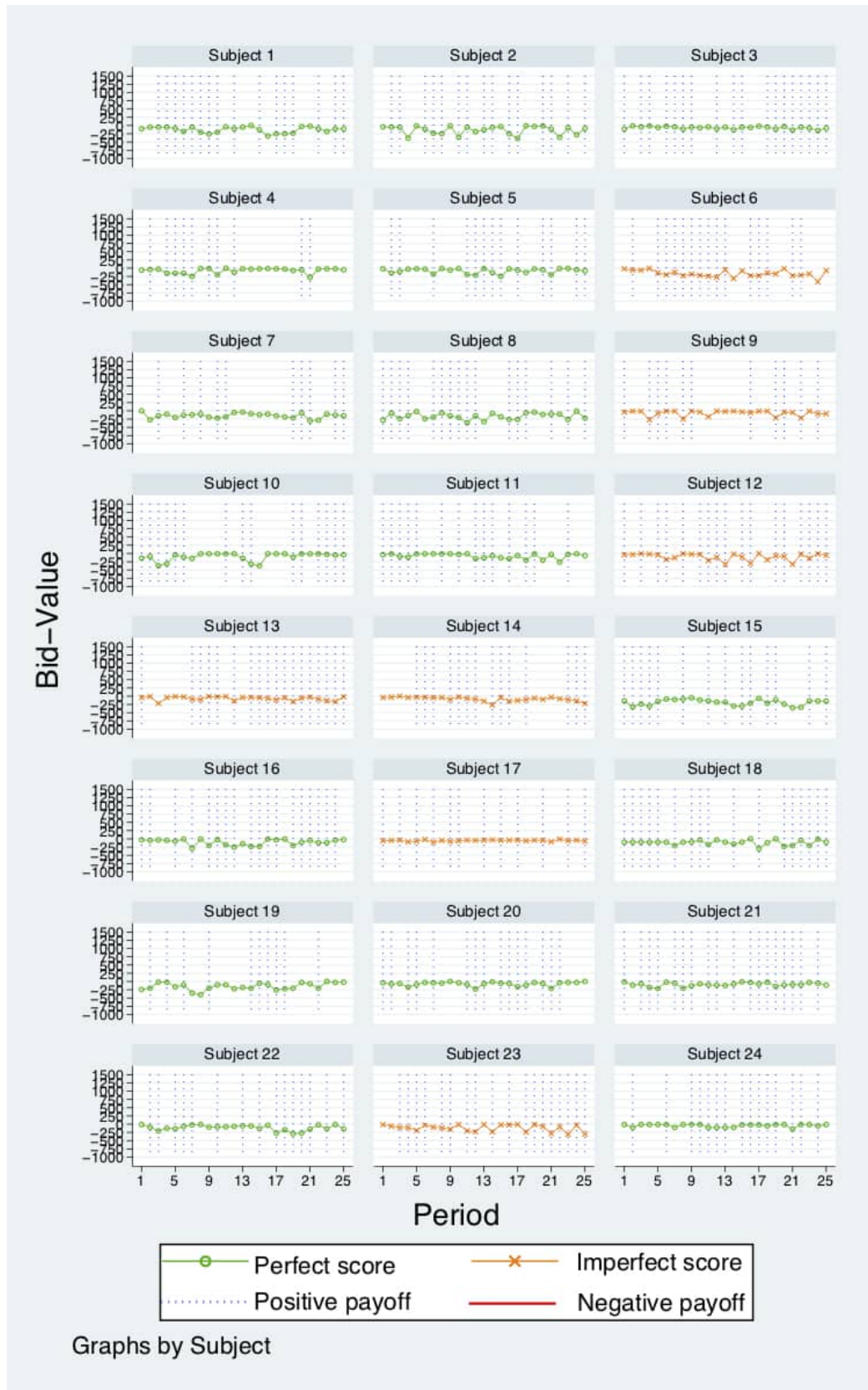


Figure 18: Time evolution of the gap between bid and value for unit 1 in PA2.

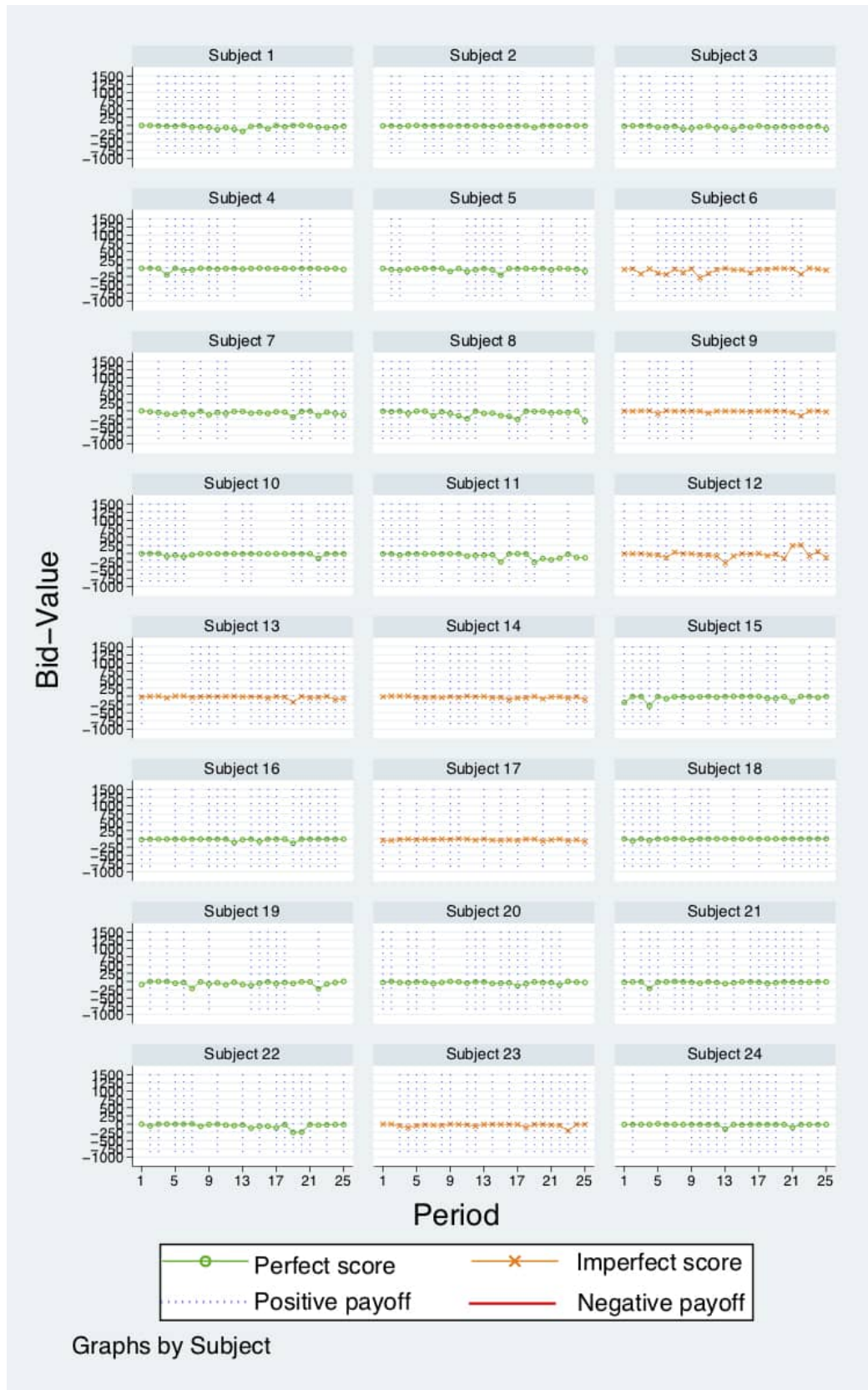


Figure 19: Time evolution of the gap between bid and value for unit 2 in PA2.

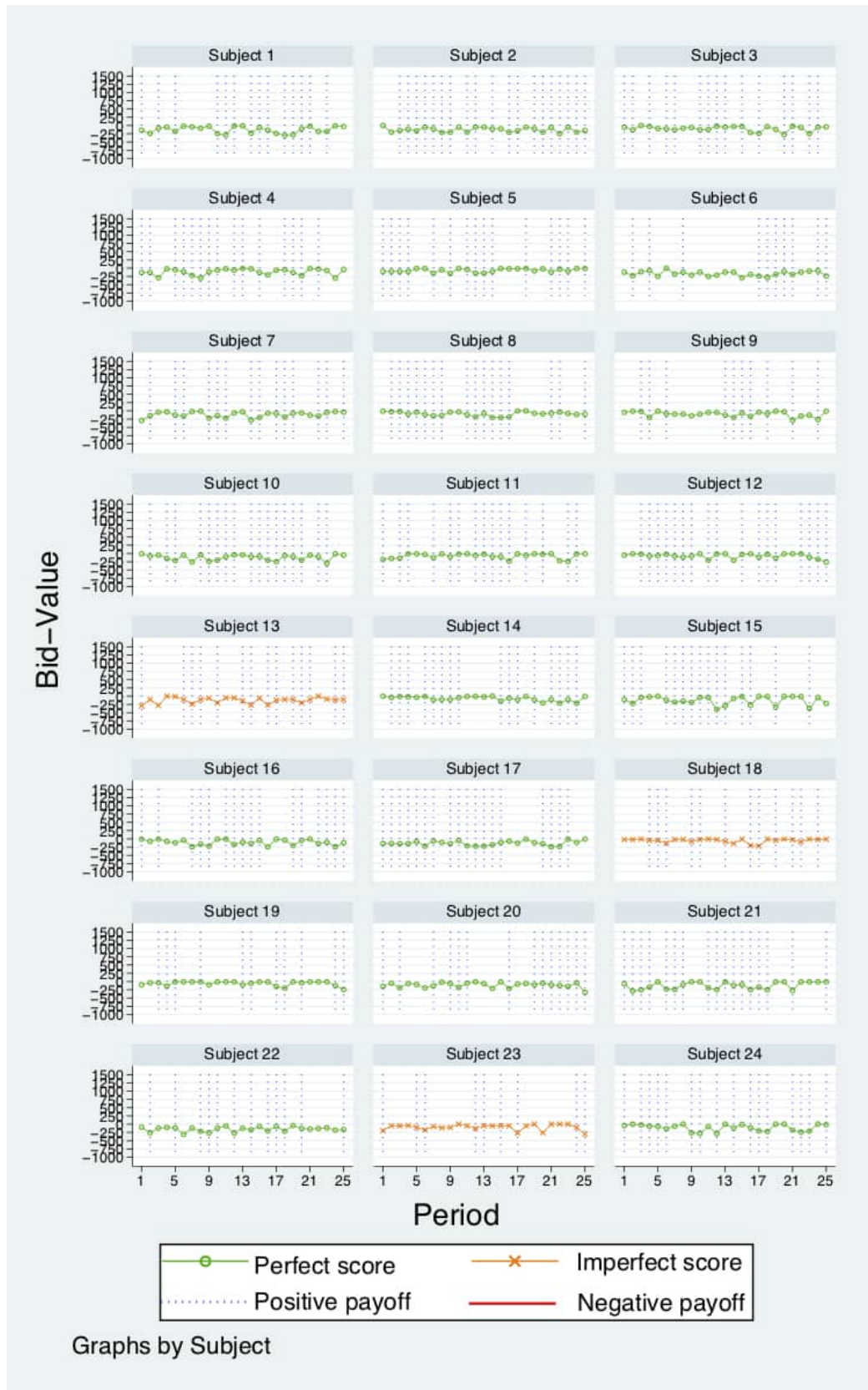


Figure 20: Time evolution of the gap between bid and value for unit 1 in PA3.

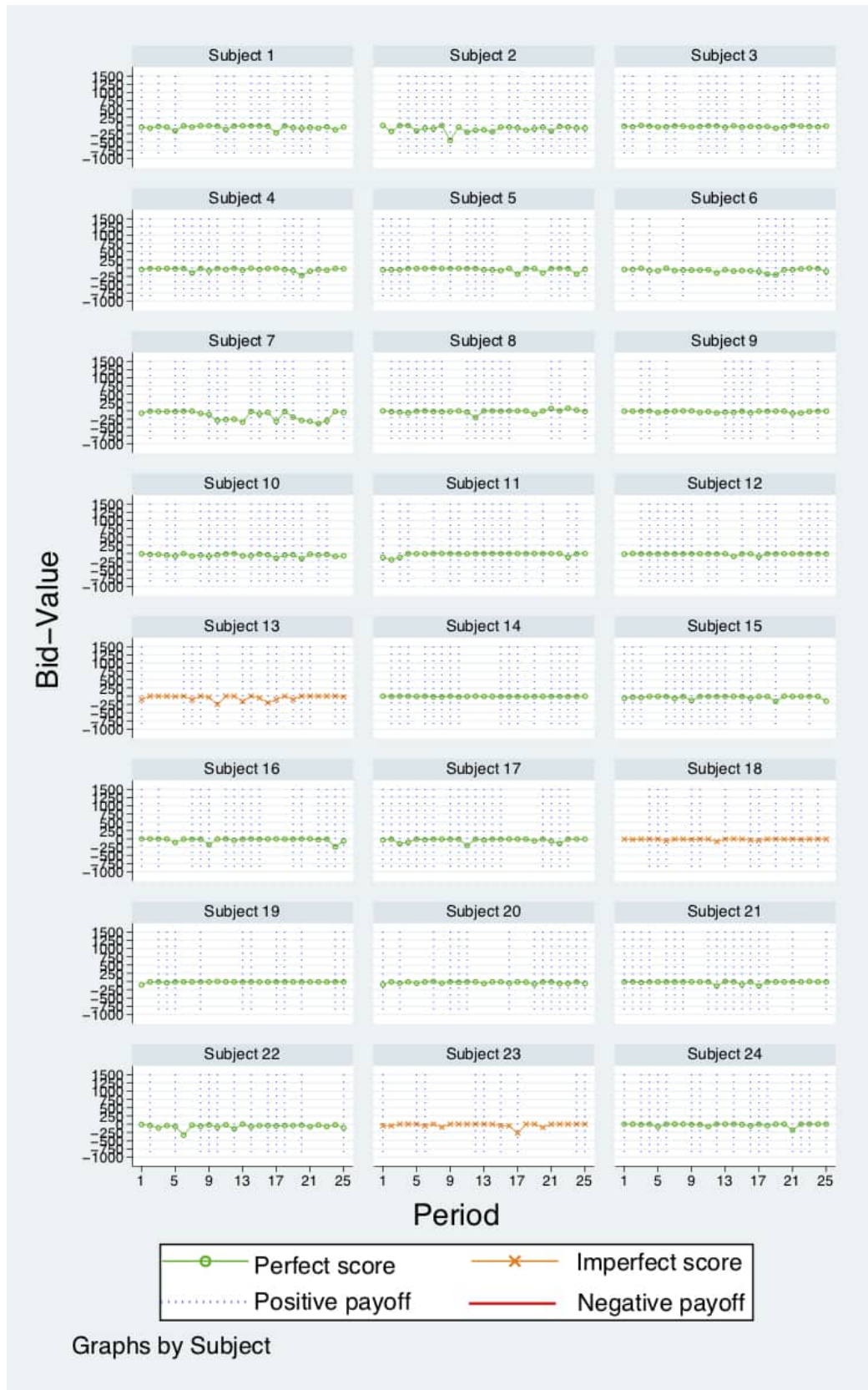


Figure 21: Time evolution of the gap between bid and value for unit 2 in PA3.

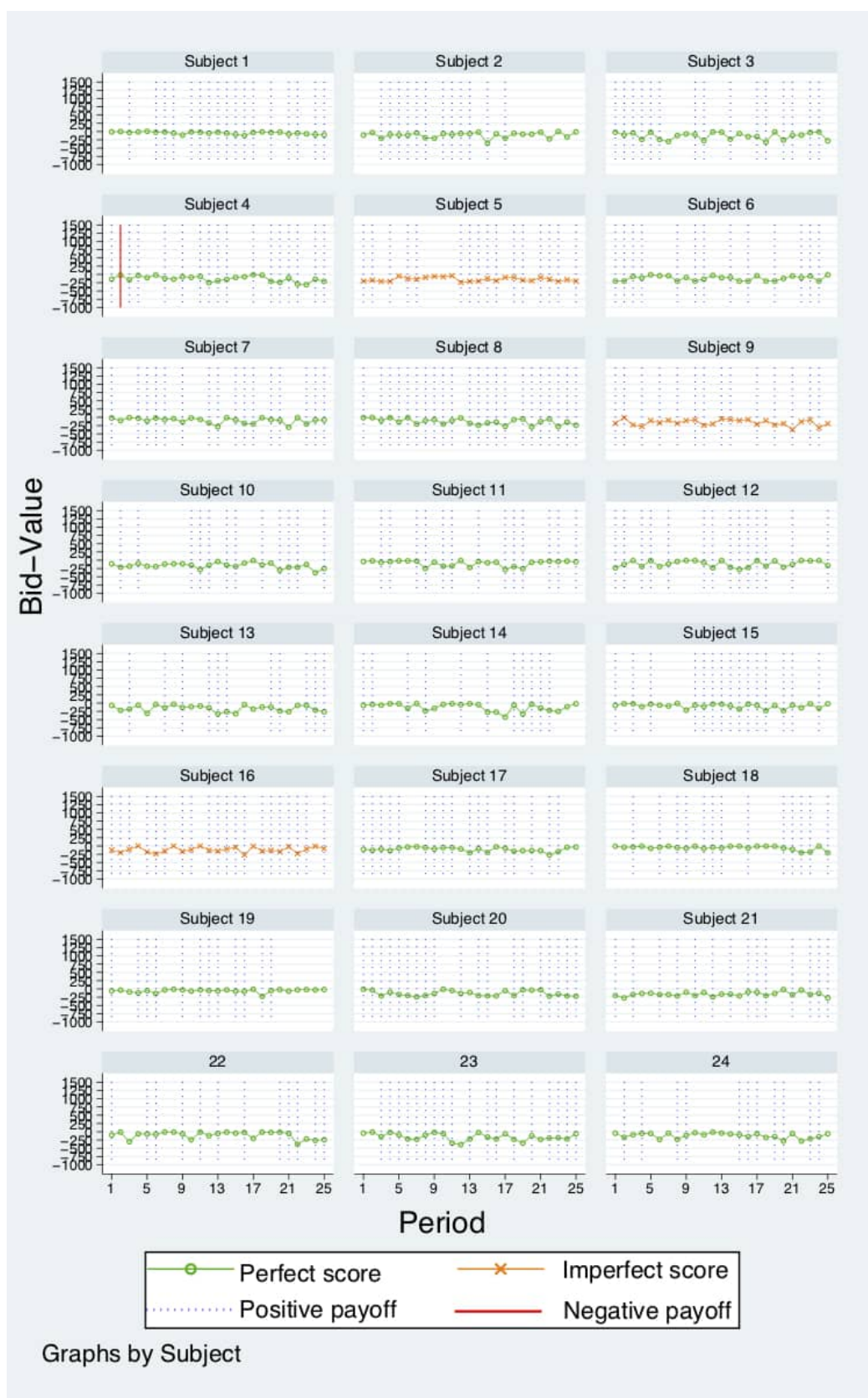


Figure 22: Time evolution of the gap between bid and value for unit 1 in PN1.

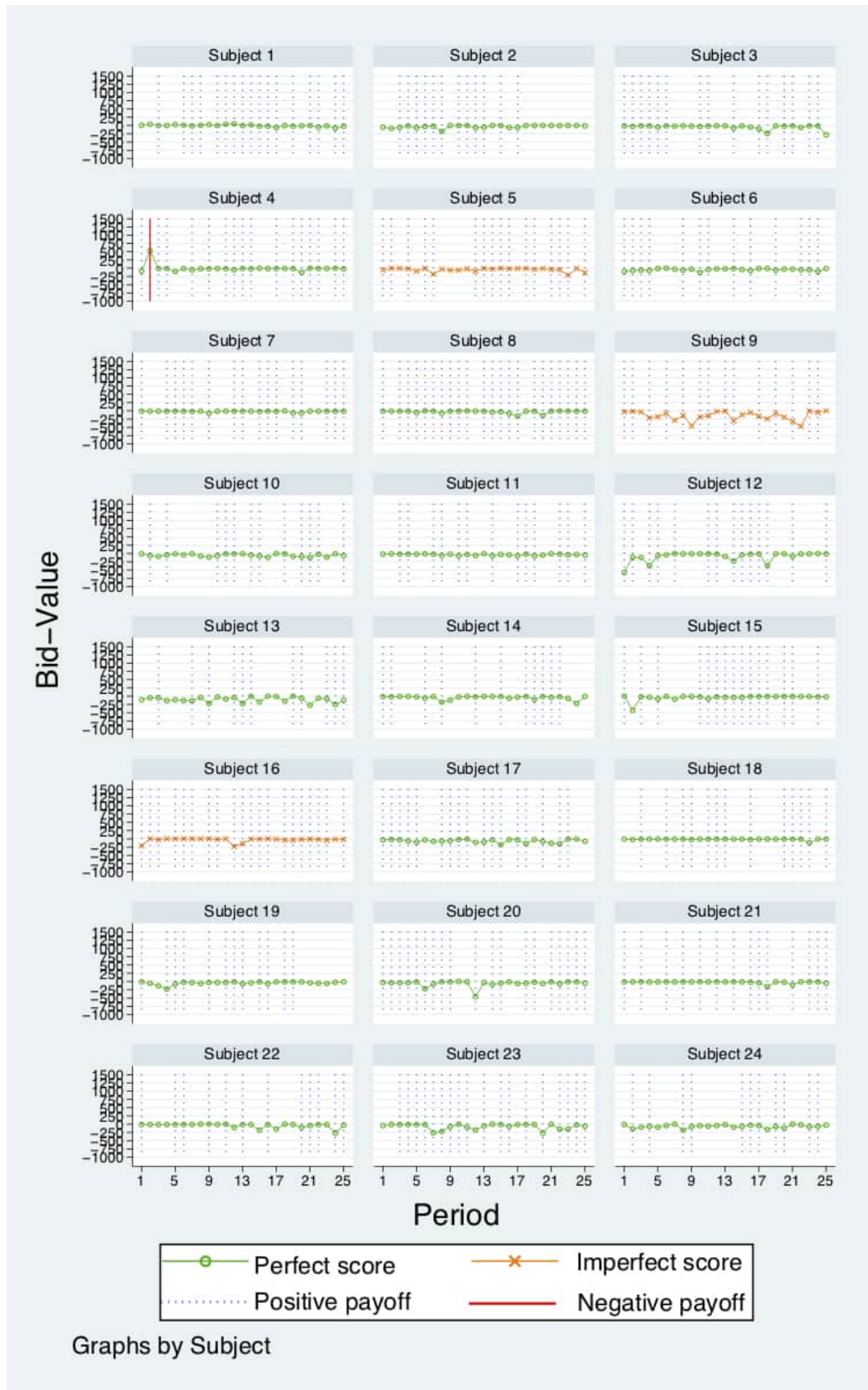


Figure 23: Time evolution of the gap between bid and value for unit 2 in PN1.

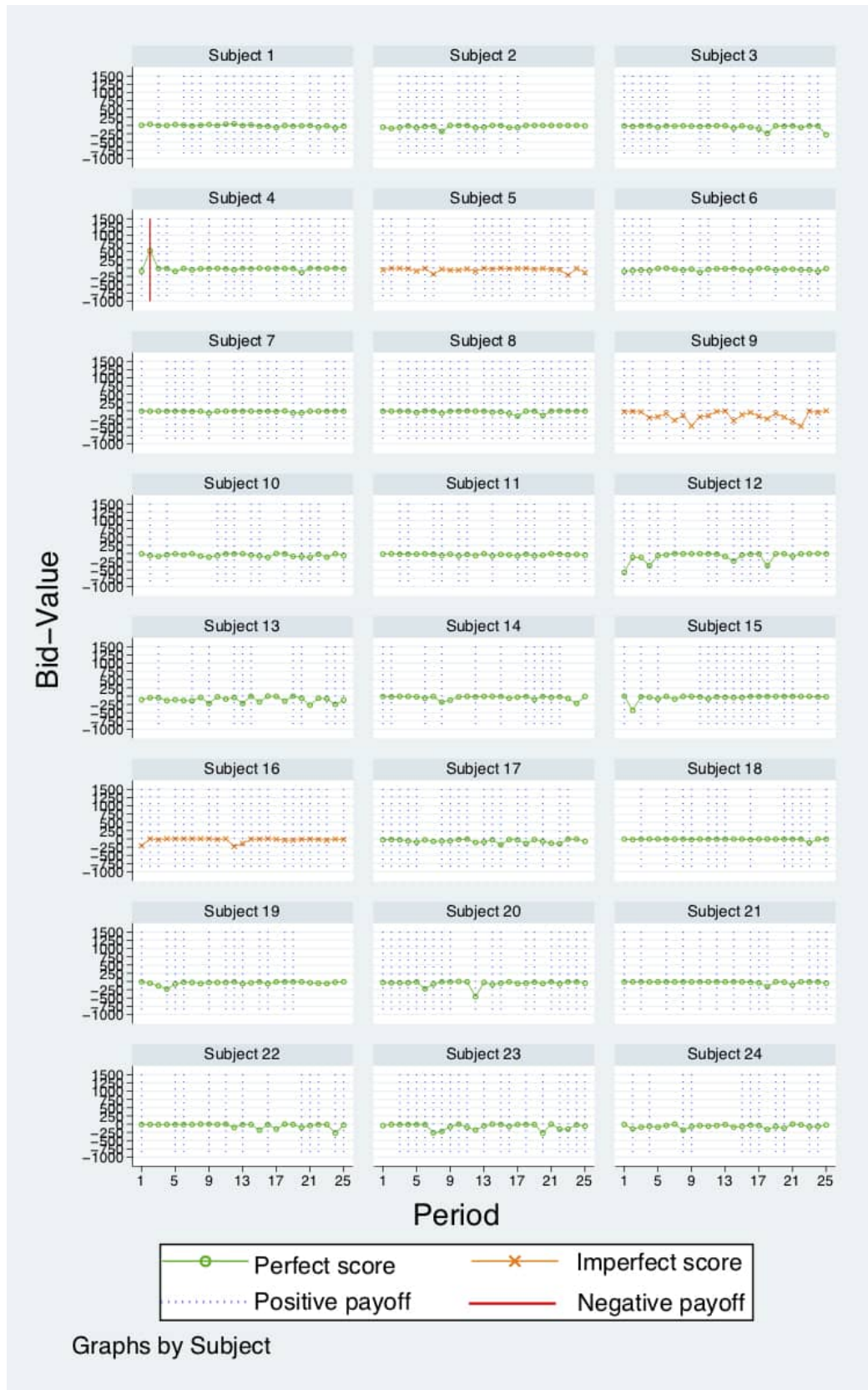


Figure 24: Time evolution of the gap between bid and value for unit 1 in PN2.

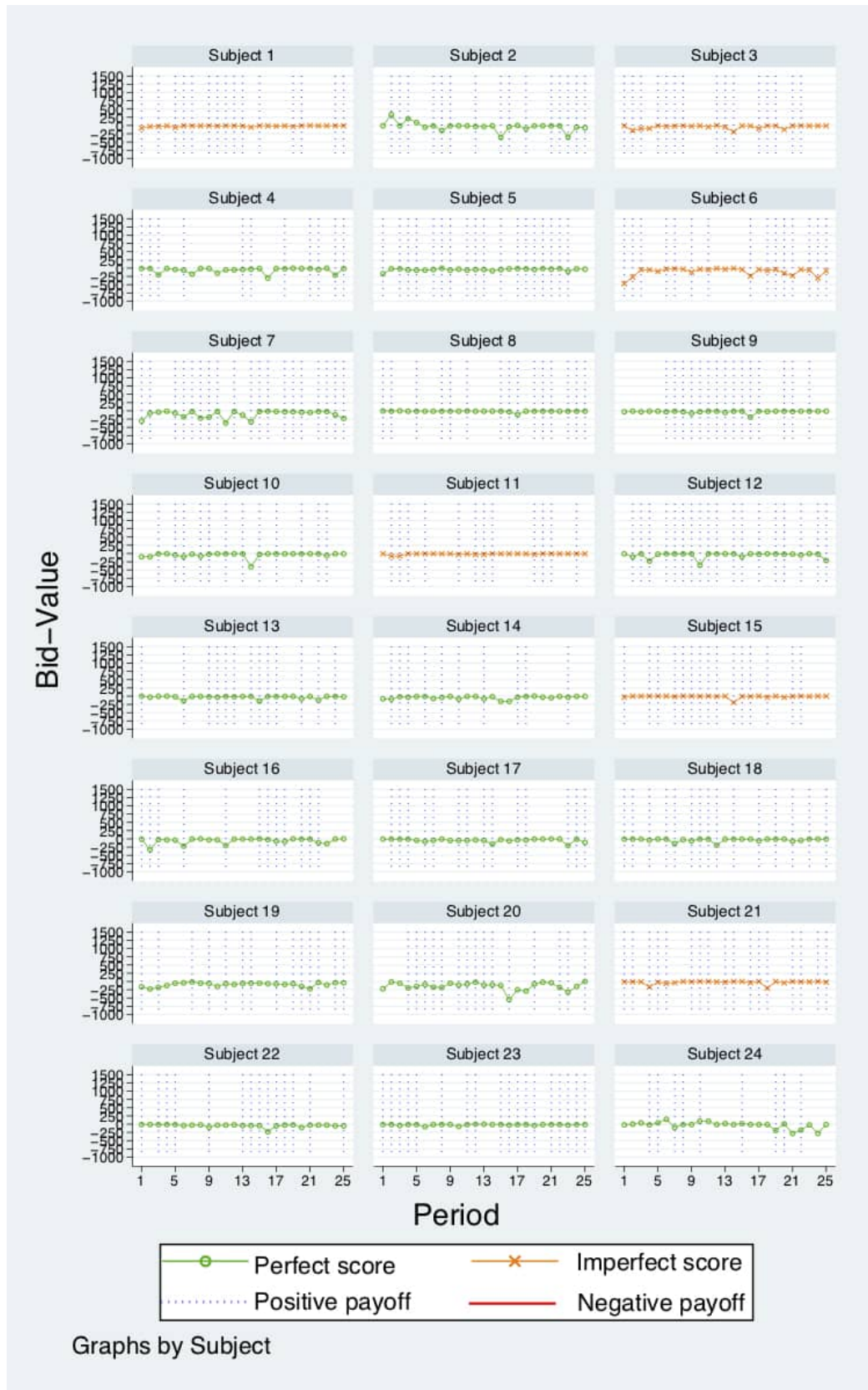


Figure 25: Time evolution of the gap between bid and value for unit 2 in PN2.

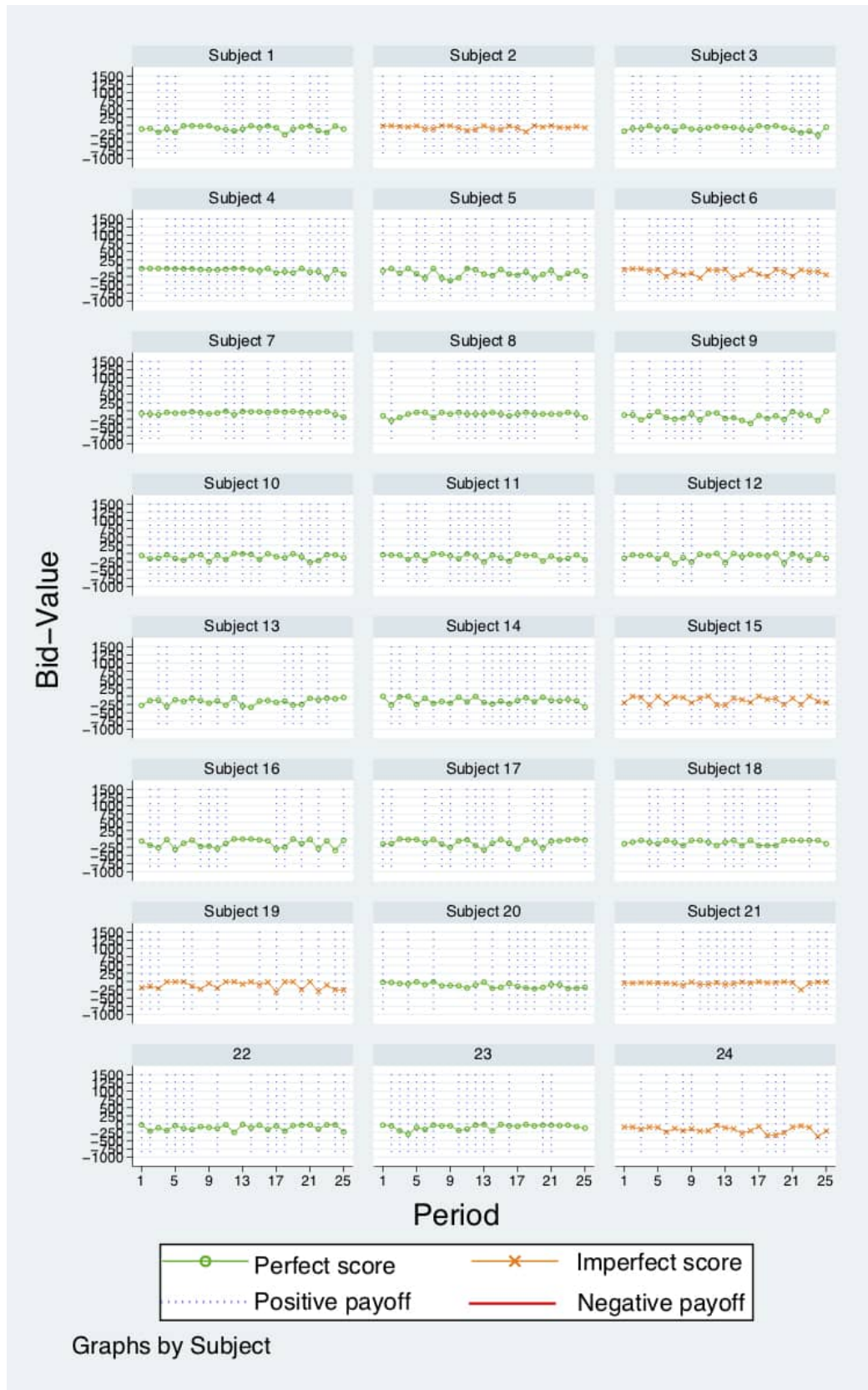


Figure 26: Time evolution of the gap between bid and value for unit 1 in PN3.

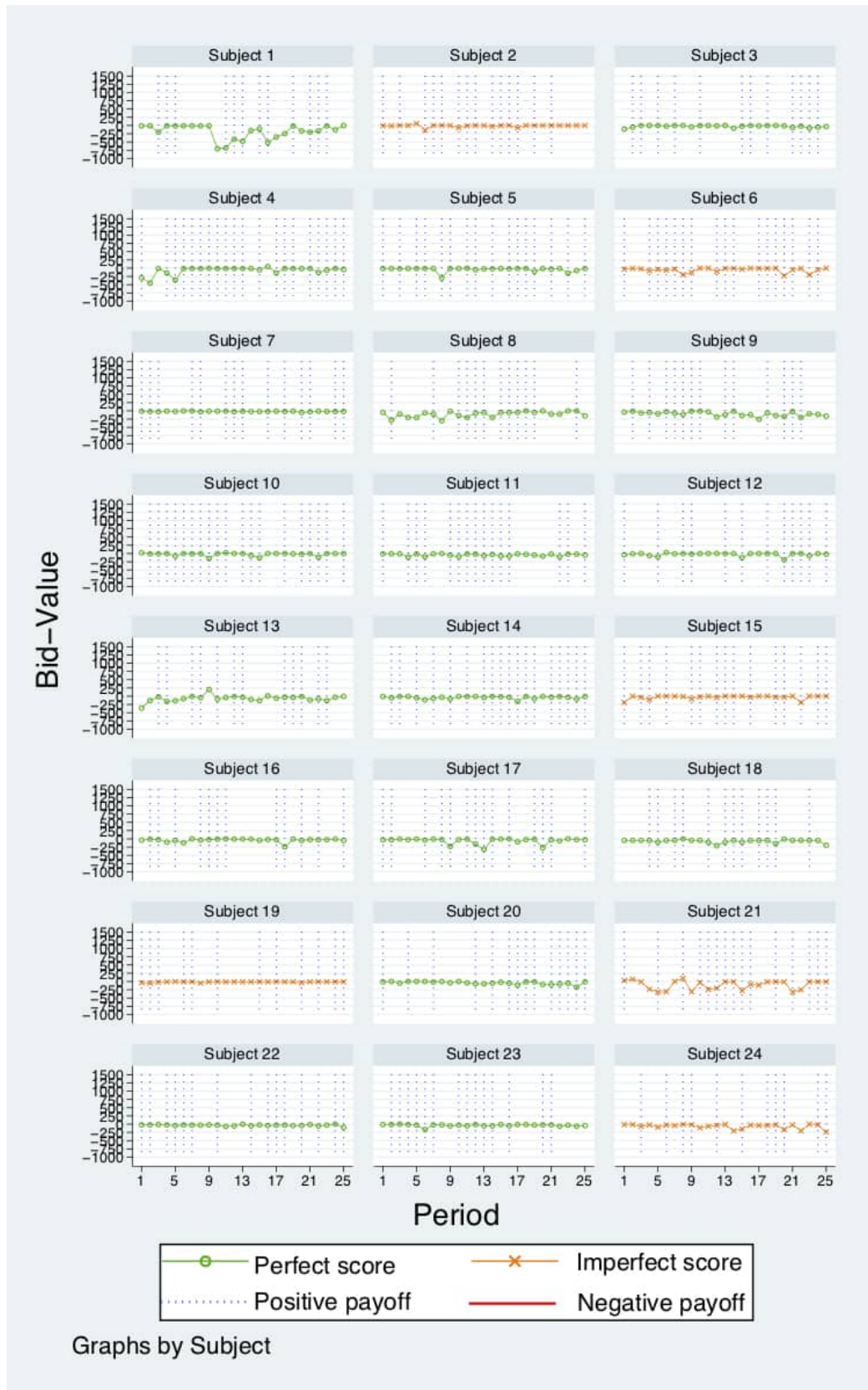


Figure 27: Time evolution of the gap between bid and value for unit 2 in PN3.

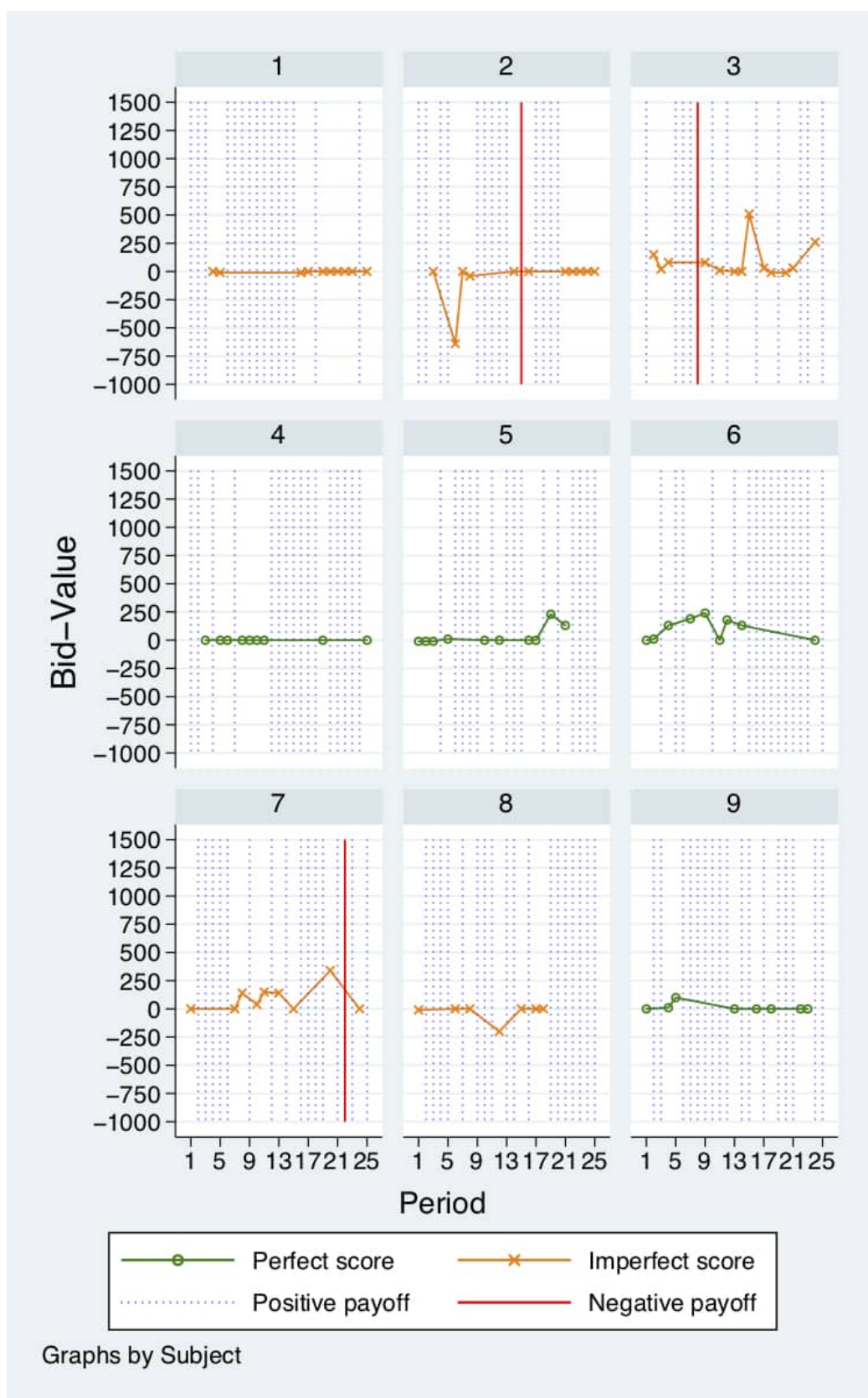


Figure 28: Time evolution of the gap between bid and value for unit 1 in AA1.

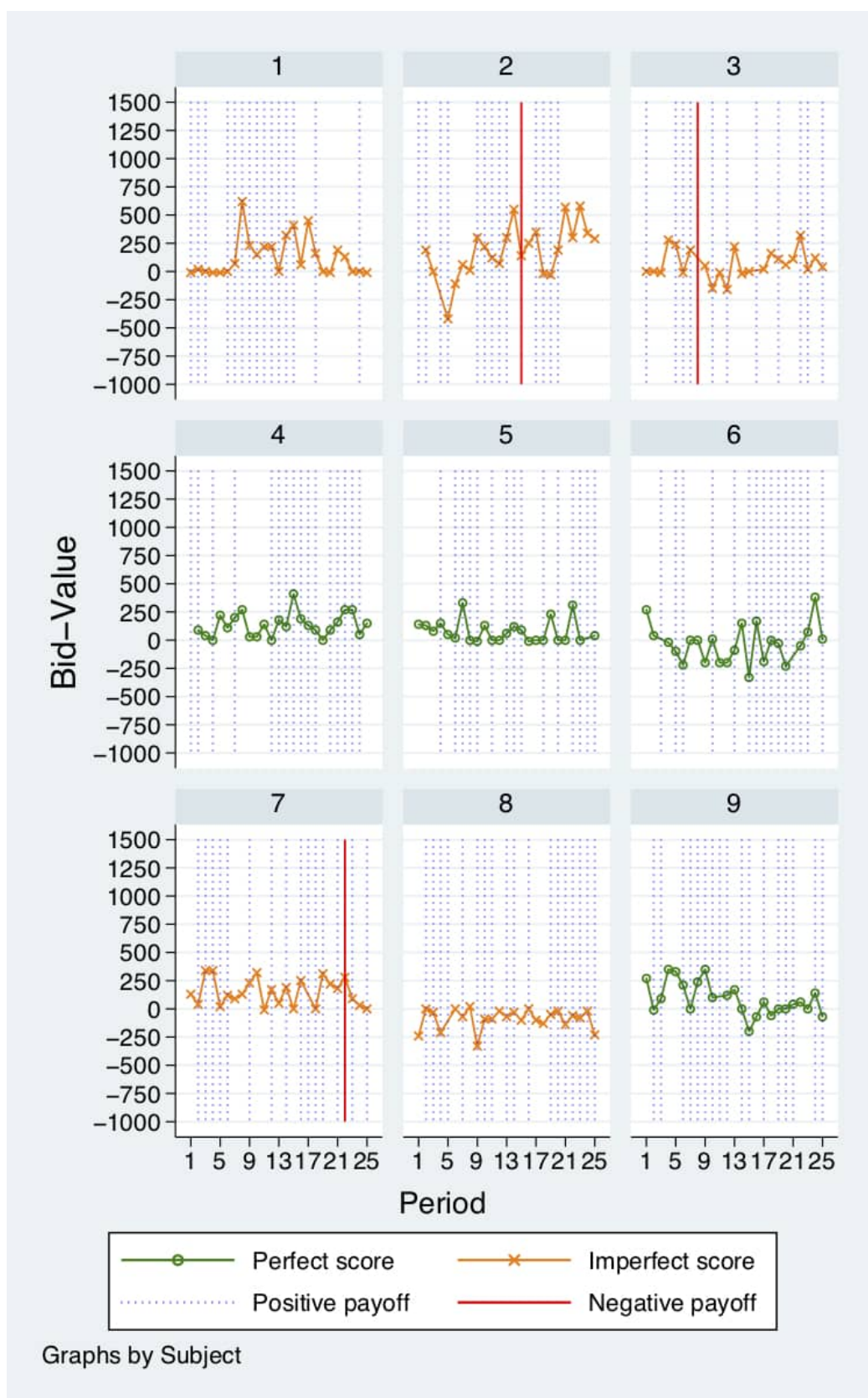


Figure 29: Time evolution of the gap between bid and value for unit 2 in AA1.



Figure 30: Time evolution of the gap between bid and value for unit 1 in AA2.

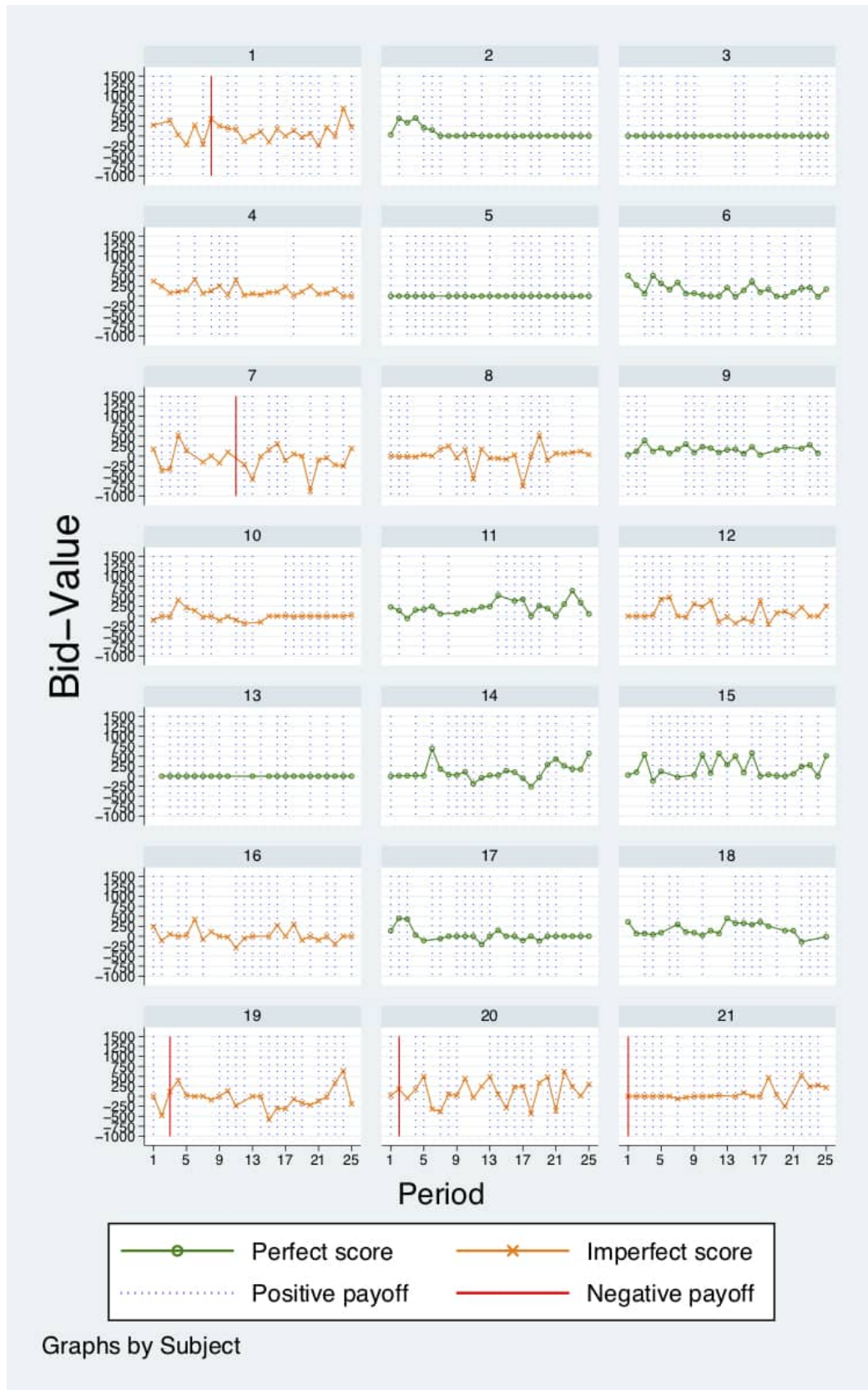


Figure 31: Time evolution of the gap between bid and value for unit 2 in AA2.

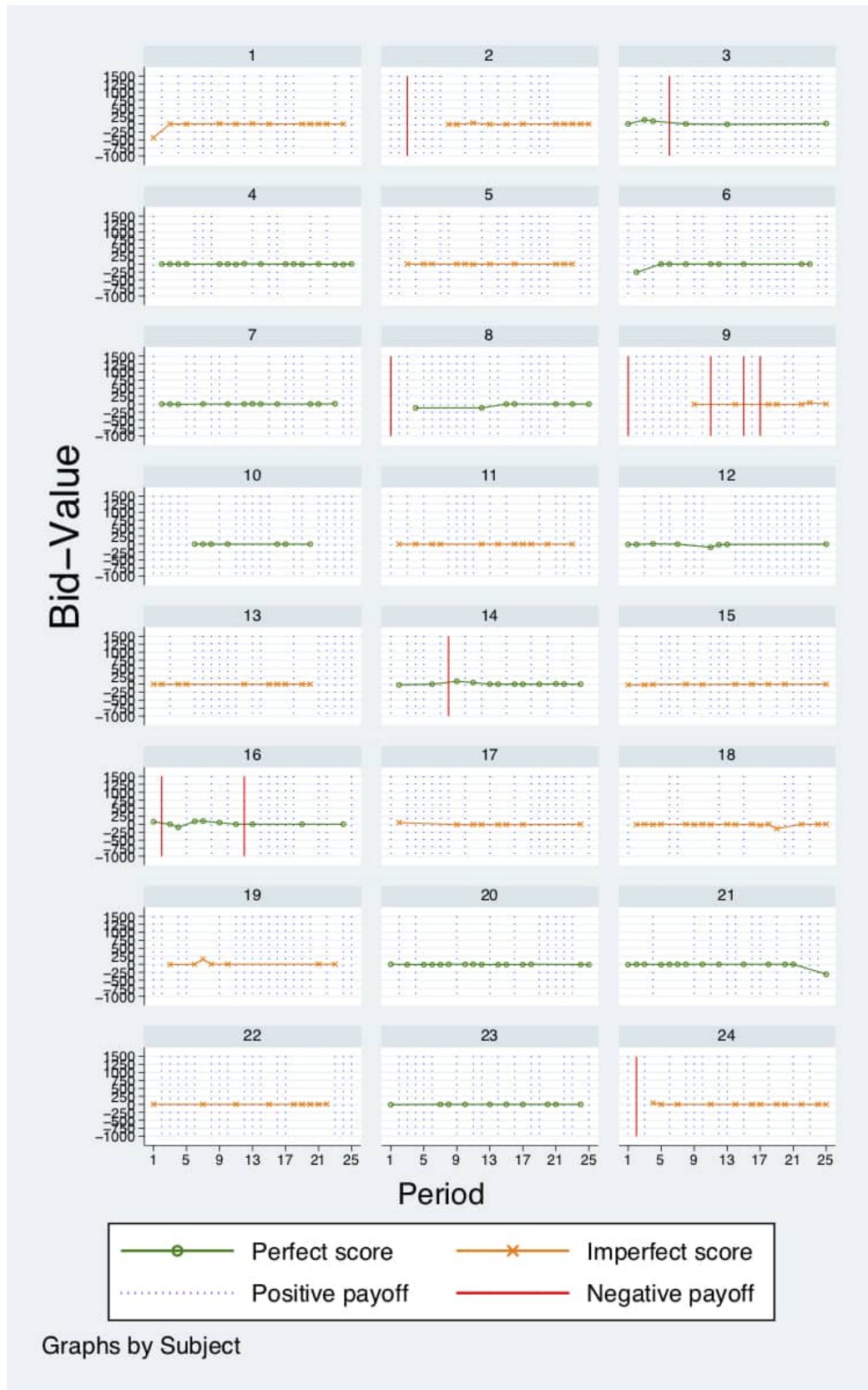


Figure 32: Time evolution of the gap between bid and value for unit 1 in AA3.

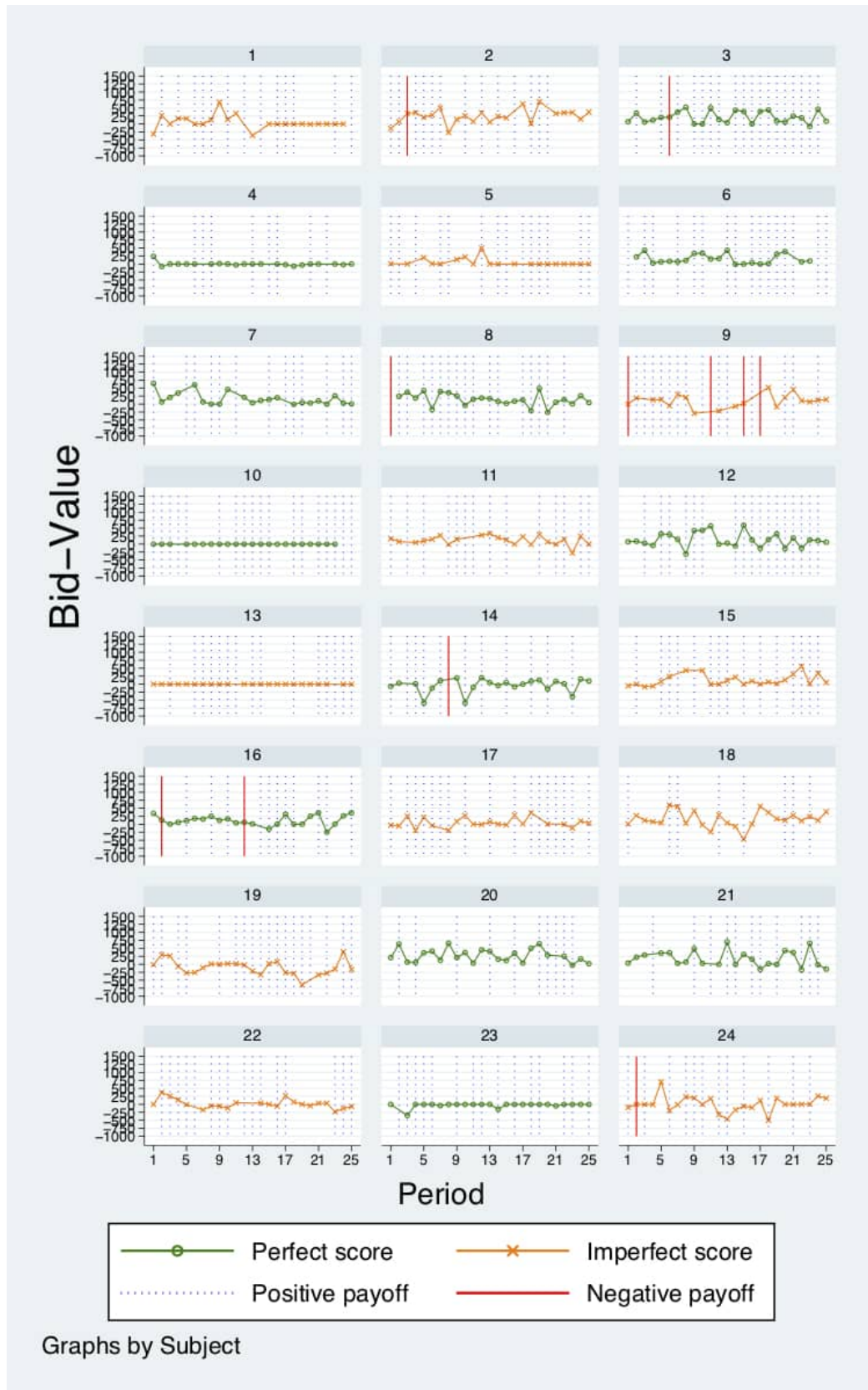


Figure 33: Time evolution of the gap between bid and value for unit 2 in AA3.

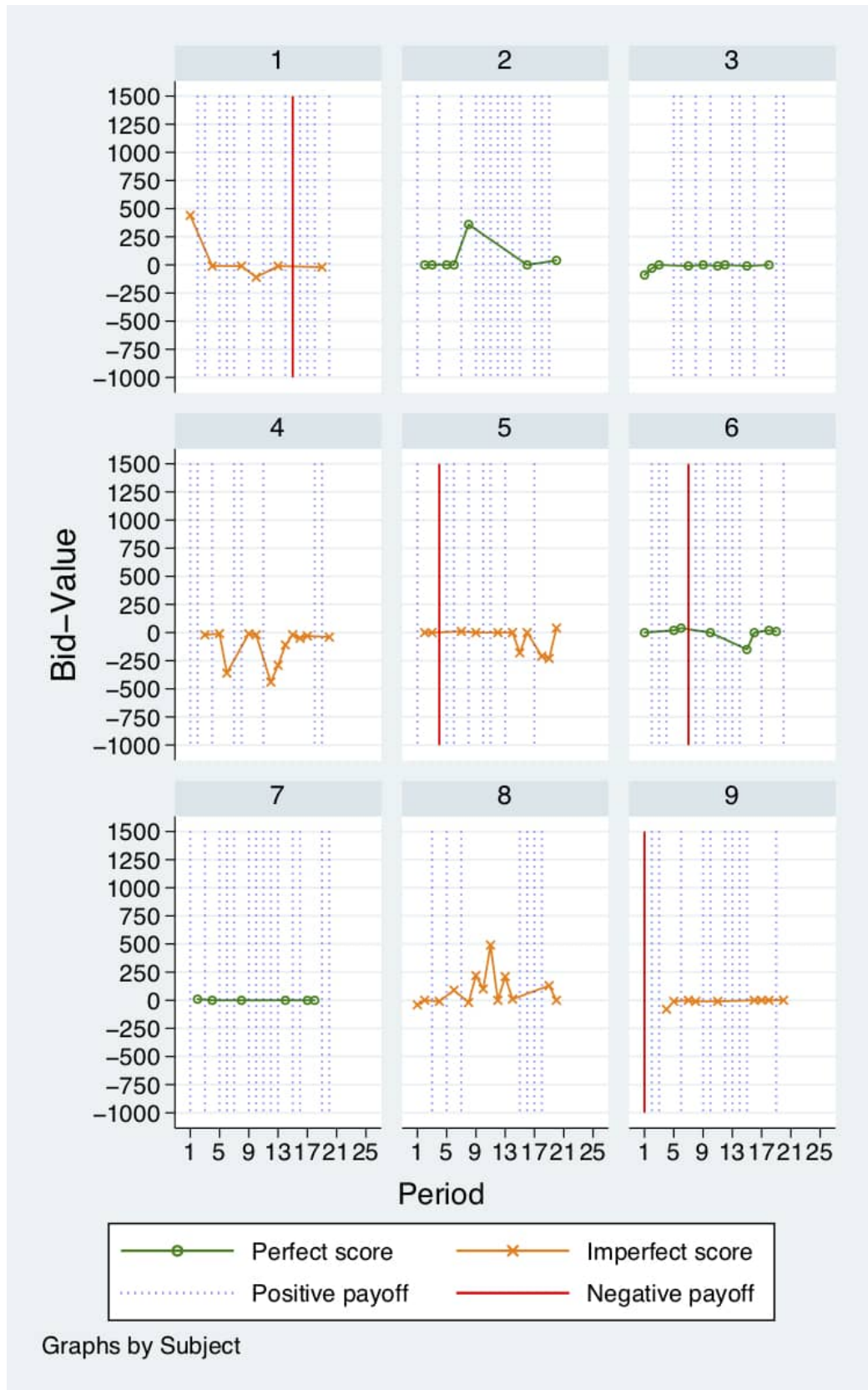


Figure 34: Time evolution of the gap between bid and value for unit 1 in AN1.

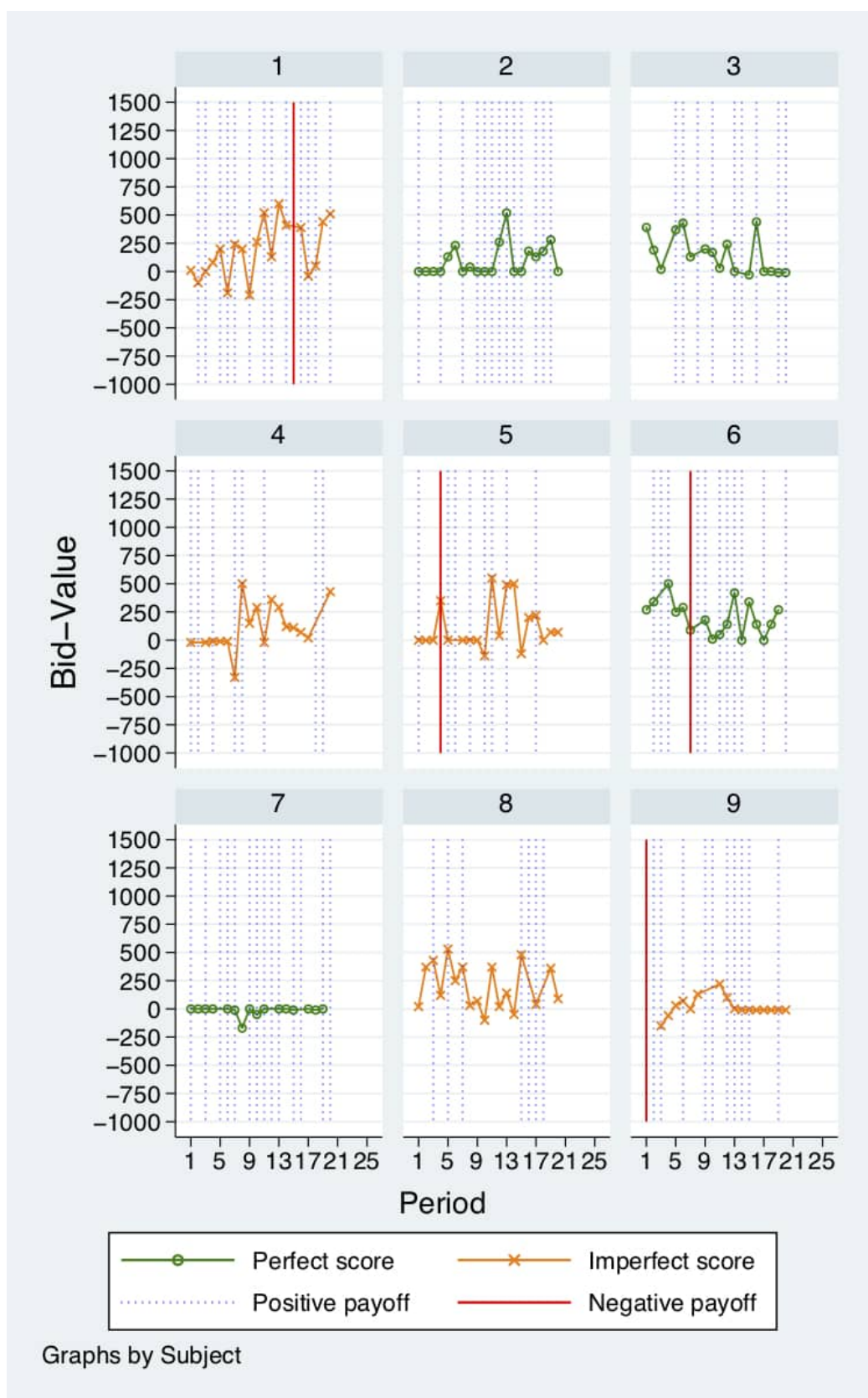


Figure 35: Time evolution of the gap between bid and value for unit 2 in AN1.

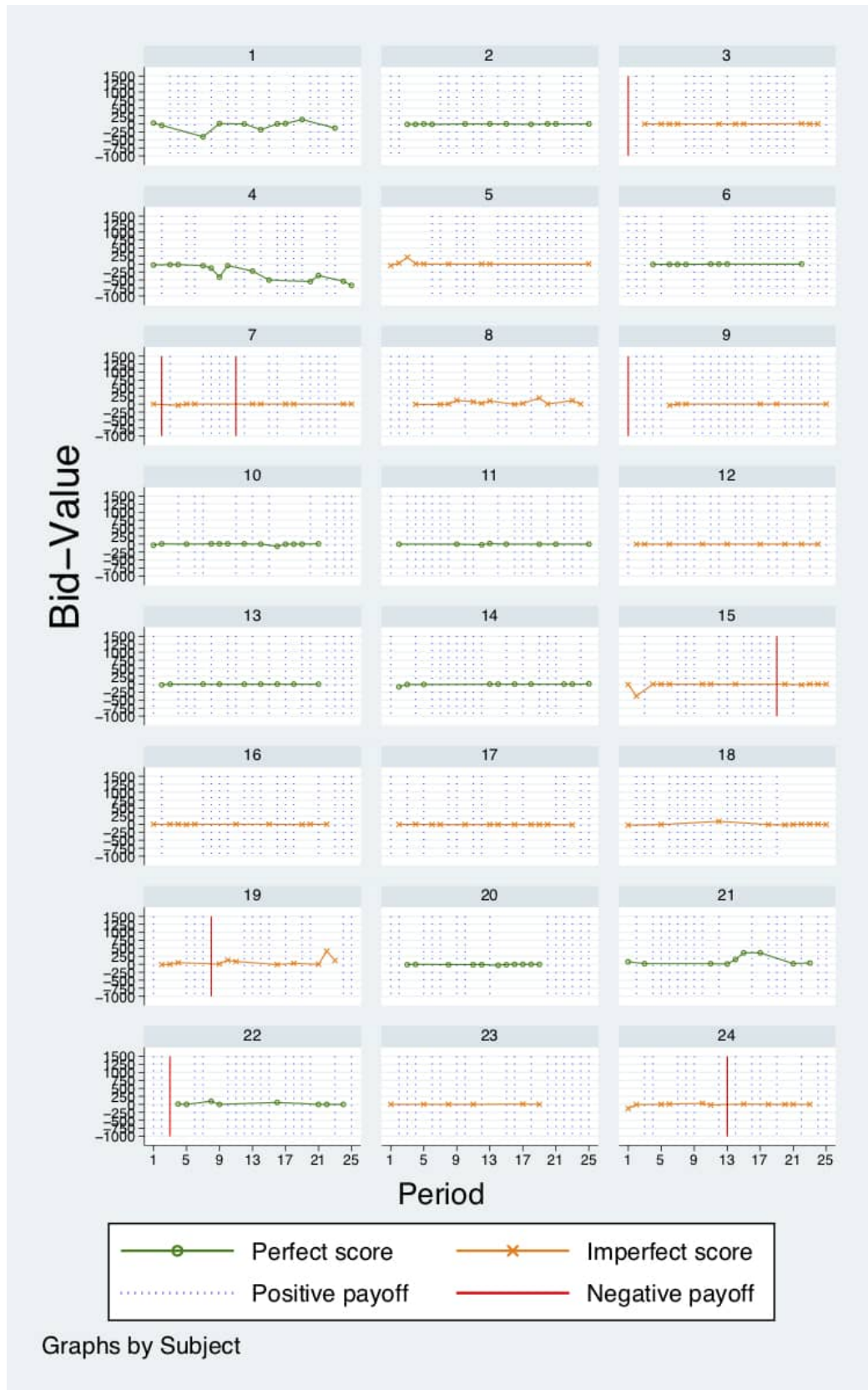


Figure 36: Time evolution of the gap between bid and value for unit 1 in AN2.

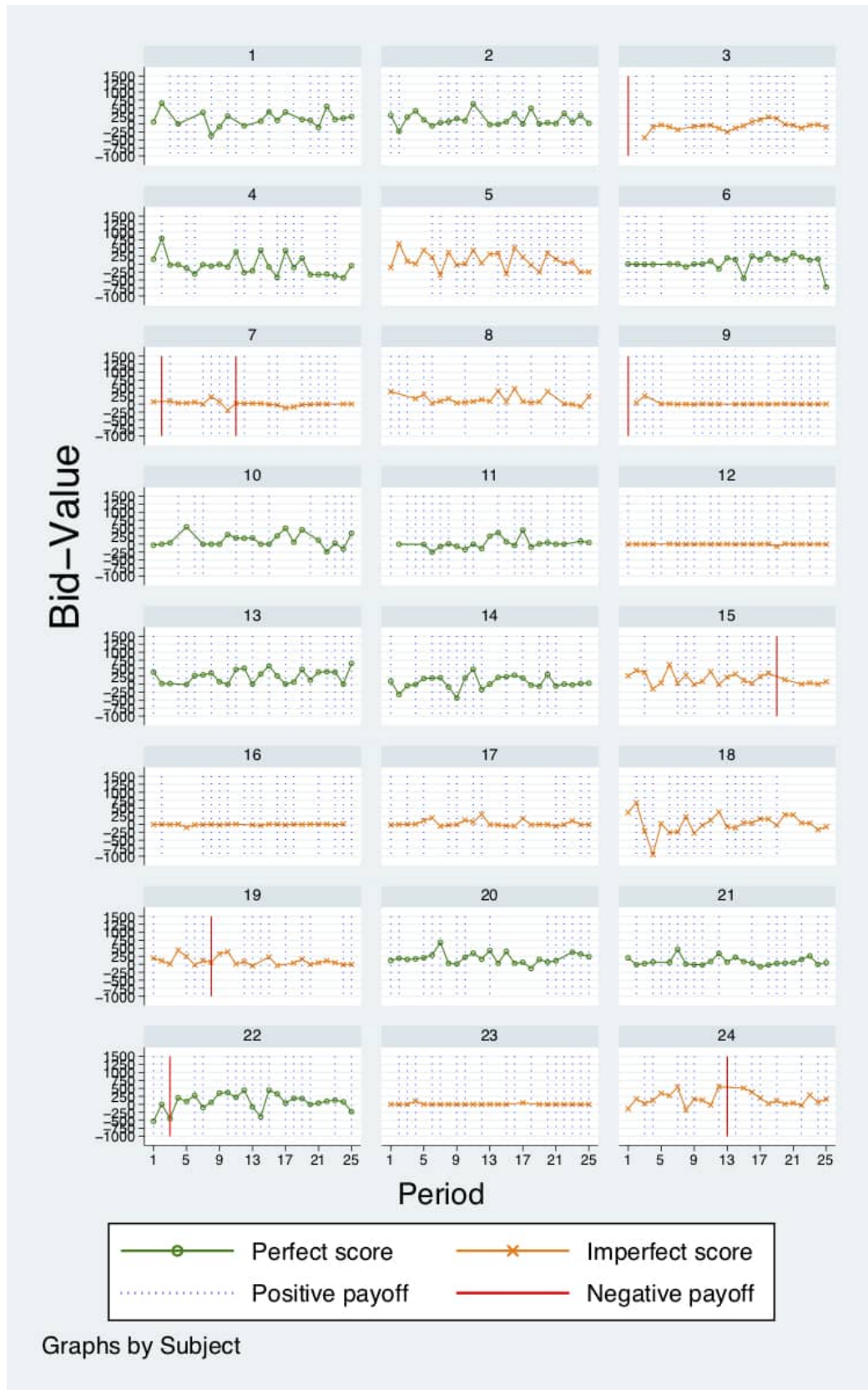


Figure 37: Time evolution of the gap between bid and value for unit 2 in AN2.

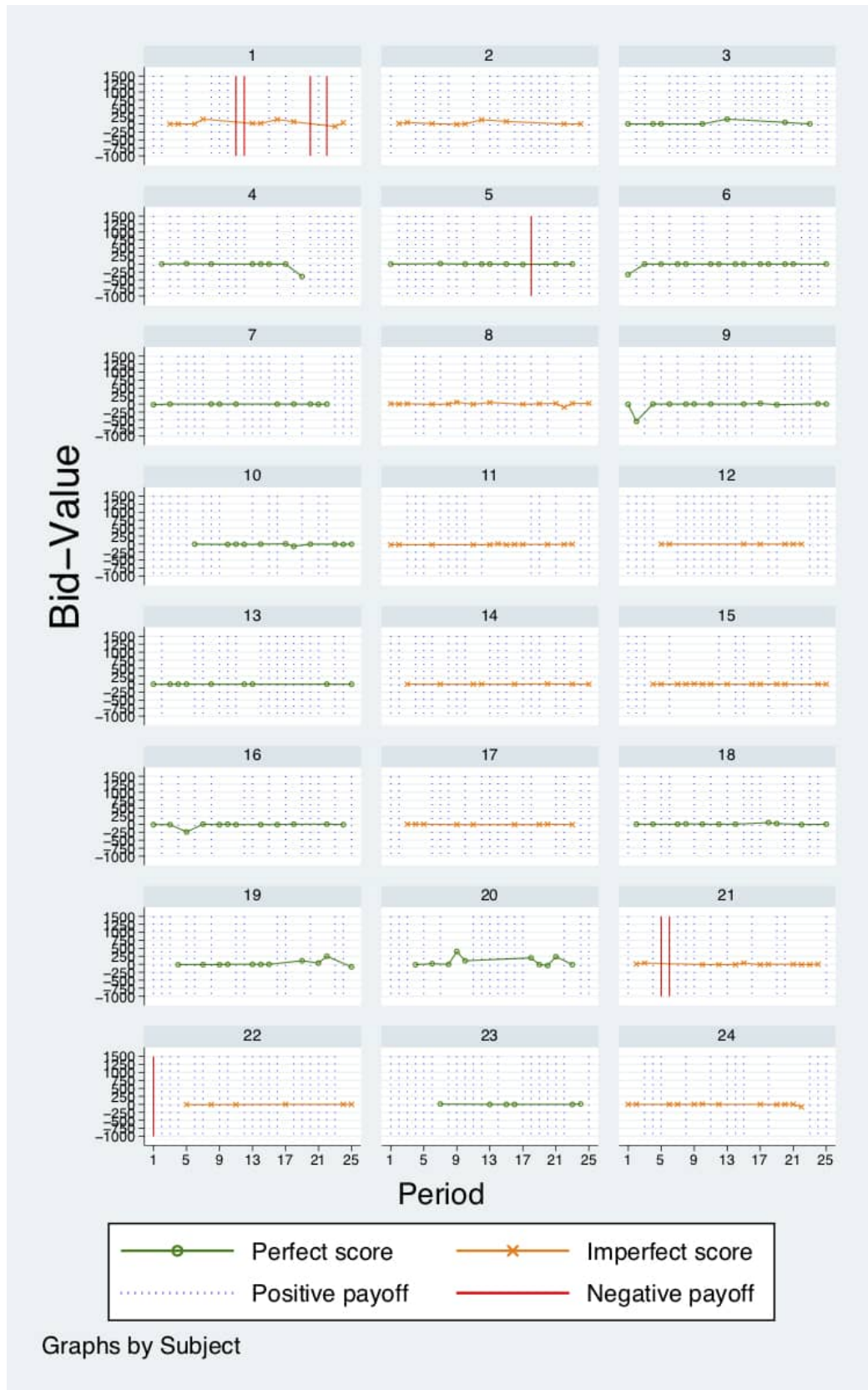


Figure 38: Time evolution of the gap between bid and value for unit 1 in AN3.

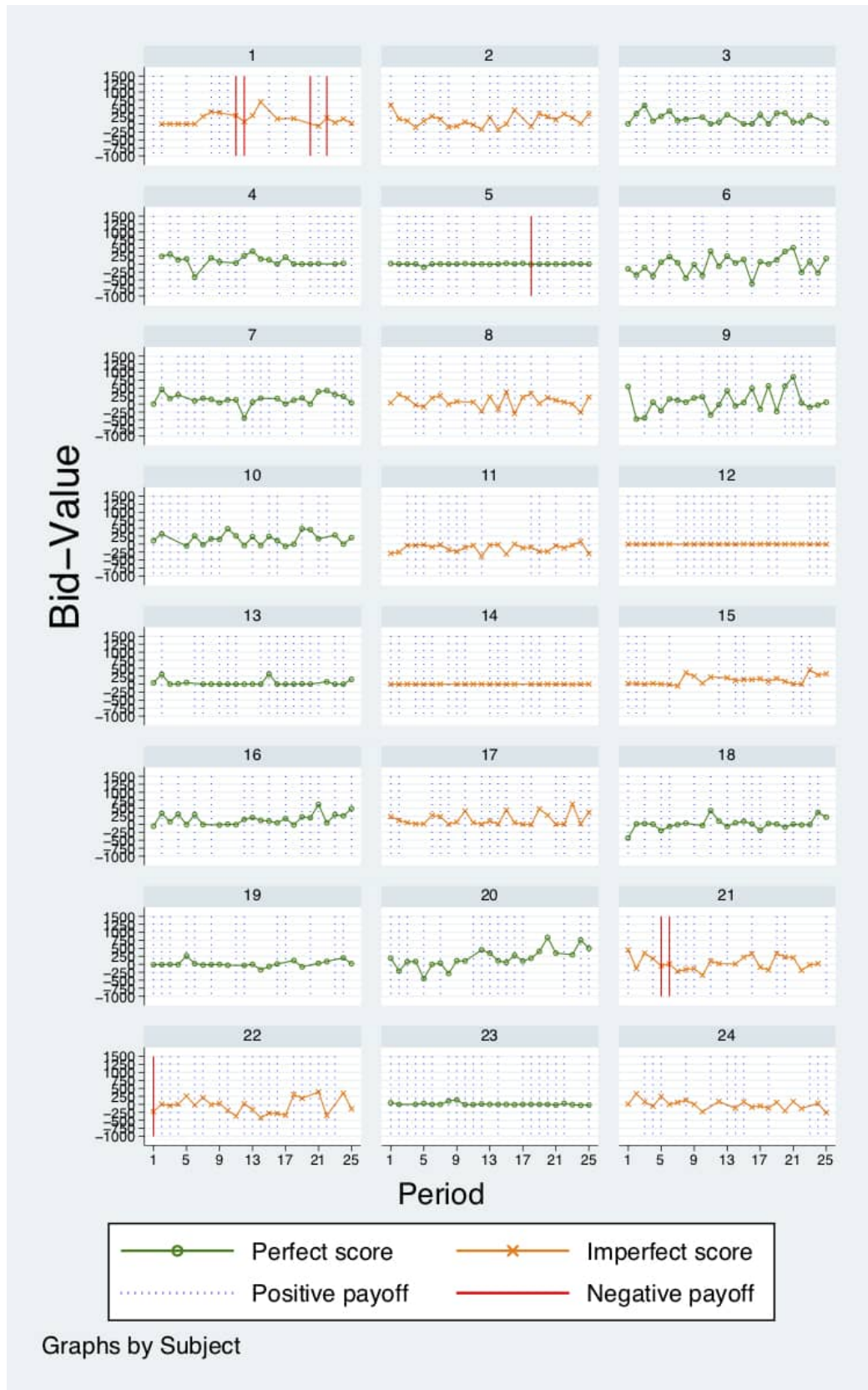


Figure 39: Time evolution of the gap between bid and value for unit 2 in AN3.

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