Behavioral & Experimental Economics

Economic Theory and Experiments

Daeyoung Jeong

Pohang University of Science and Technology

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Introduction 이론만으로는 부족. 이론 위에 실험으로까지 증명되어야 함.

- The interaction of data and theory is the engine of progress in most scientific disciplines. Economics is no exception.

- On the one hand, we devote a large fraction of our economics education to models of consumer behavior and firm decision making, and to the interactions that determine market equilibrium.

- On the other hand, it is not always obvious how these theories are relevant to empirical research.

- Outside the academy, policymakers and business leaders often demand "basic facts" and simplified policy guidance with little or no concern for theoretical nuances.

Introduction

- How then do experimental or empirical economists negotiate between theory and “facts”?

- We present a classification of studies that captures the extent to which the experimental design and analysis is linked to economic theory (Card, et al. 2011).

주류경제학에서의 이론 : 수학을 활용한 모형화

Four Classes 실험연구 구분

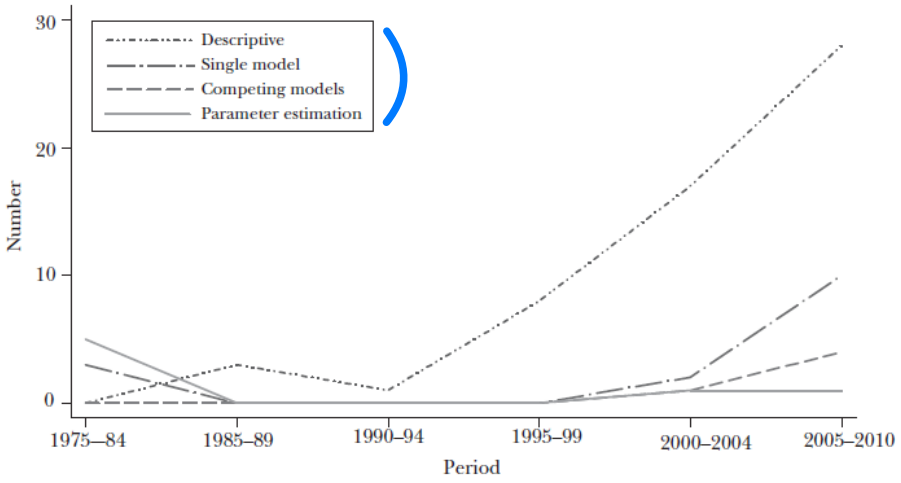
정치학에서 언어 → theory
수학 → formal theory

1. Descriptive studies (lack any formally specified model) 이론 거의 없는 경우 (수학적 분석 X)
2. Single Model studies (lay out a formal model and test one (or more) qualitative implications of the model) 하나의 모형 제시
3. Competing Models studies (lay out two or more alternative models with at least one contrasting qualitative implication and test between them on the basis of this implication)
4. Parameter Estimation studies (specify a complete data-generating process for (at least some subset of) the observed data and obtain estimates of structural parameters of the model)

이론연구 복잡성 ↑

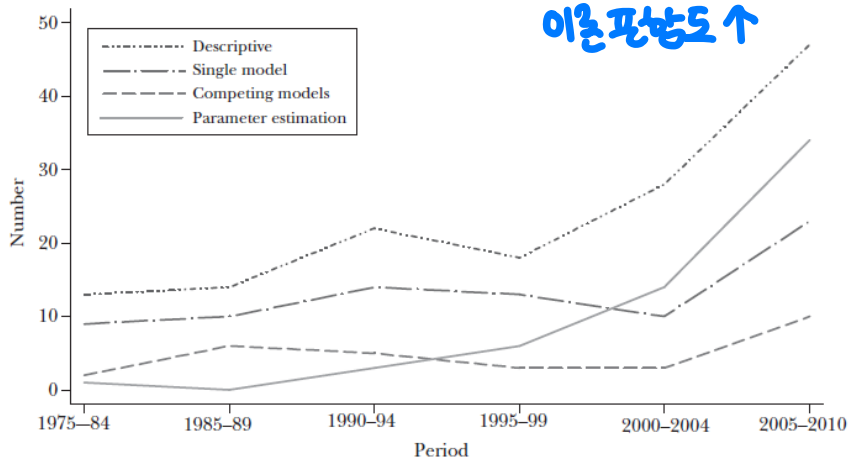
Field and Lab Experiments by Theoretical Contents 이론포함도가 얼마나 많은가

Field Experiments by Theoretical Content



Note: Figure 2 shows the numbers of field experiments in five top journals in four categories according to theoretical content for the initial decade of our sample period (1975–84), and for subsequent five-year periods and the six-year period 2005–2010. The five journals are the *American Economic Review*, *Econometrica*, the *Journal of Political Economy*, the *Quarterly Journal of Economics*, and the *Review of Economic Studies*.

Laboratory Experiments by Theoretical Content → 상대적으로 이론포함도 ↑



Note: Figure 3 shows the numbers of laboratory experiments in five top journals in four categories according to theoretical content for the initial decade of our sample period (1975–84), and for subsequent five-year periods and the six-year period 2005–2010. The five journals are the *American Economic Review*, *Econometrica*, the *Journal of Political Economy*, the *Quarterly Journal of Economics*, and the *Review of Economic Studies*.

In the last three decades, theory has played a more central role in the laboratory than in field experiments.

Economic Theory and Lab Experiment

- How can we combine work in economic theory and experimental economics?
- Can economic theory and experimental economics contribute to one another? If so, how can we shape their interaction to enhance these contributions?
- The perspectives and methods of combining the two are still developing.
- Let's discuss these shortly by considering a simple theory of bargaining.

Ultimatum bargaining 게임이론

- Consider the following highly stylized game of bargaining.

- There are two players, a proposer (P) and a responder (R). There is an M amount of money to be divided between P and R.

- P makes a proposal of the form $(m_P, m_R)$where $m_R = M - m_P$. R then either accepts, implementing the proposal, or rejects, in which case each player receives nothing.

$0 \le m_P, m_R \le M$

$m_P + m_R = M$

P는 mp를 maximize 하고 싶음 → $m_R = \epsilon \approx 0$ 제안할것 (내시균형)

↳ 거절하면 0이므로 조금이라도 받아가기 위해 무조건 accept할것

↳ 협박이 가능해도 비슷하게 균형점을 이루기도함

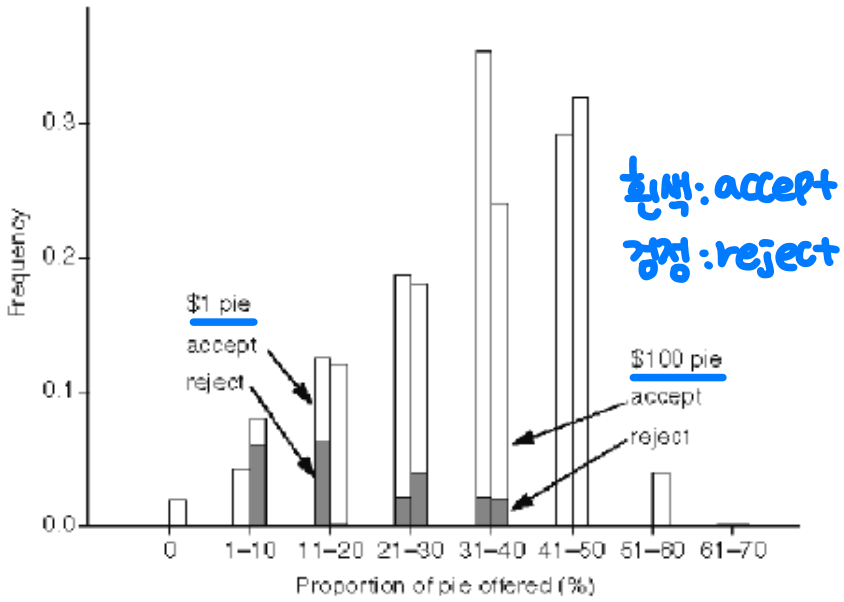
Ultimatum bargaining

- Standard game theory, using the concept of subgame-perfect Nash equilibrium (and the assumption of individual welfare maximization), predicts that P gives a negligible amount ε or nothing to R who accepts it.
  → 하지만 실제로는 이런경우 거의 안 나타남
- This ultimatum bargaining situation is a simple, two-player, perfect-information game in which subgame perfection is obviously compelling.

Experimental evidence

- Güth et al. (1982) and subsequent studies typically found that R rejects less than 20% of M frequently and P often offers between 30% and 50%.

- Figure from Hoffman, McCabe, and Smith (1996).



Some reactions

- A common initial reaction was to dismiss the laboratory environment as uninteresting (a question of *external validity*).

  - Why should we be interested in how experimental subjects play an artificial game for small amounts of money?

- Turning this question around, how *special* is the laboratory environment generating the experimental results? Missing relevant realism?

  - Do stakes matter? (Do our daily decisions always involve high stakes transactions?)
  - Do a non-student population behave differently?
  - Do cultures matter?

Ultimatum Games: Stakes Matter

- Andersen et al. (2011) conducted ultimatum bargaining experiments with a significant variation of stakes in rural India.
  - Varying from 20 rupees to 20,000 rupees (100 rupees represents a day's wage for the average villager)

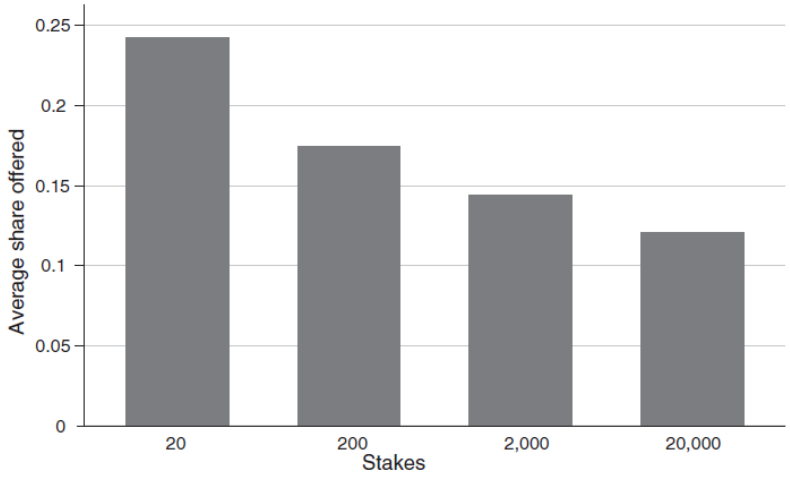


FIGURE 1. OFFER PROPORTION ACROSS STAKES

- Offer proportions are declining significantly in stakes; 비율로는 더 감소
- However, the actual amount offered increases as stakes increase. 절대적인 수치로는 증가

Ultimatum Games: Stakes Matter

FIGURE 4. REJECTION RATES FOR UNFAIR OFFERS

Notes: Figure reveals rejection rates by stakes for various levels of "unfair" offers. Stakes represents our four stakes treatments of 20, 200, 2,000, and 20,000 rupees to be bargained over in the ultimatum game. The top graph shows average rejection rates for offers made of less than or equal to 10 percent of the pie; the middle chart shows rejection rates for offers made between 10 percent and 20 percent (including 20 percent) of the pie. The bottom figure shows rejection rates for offers made between 20 percent and 30 percent (including 30 percent) of the pie. N denotes the number of observations for each bar.

- Rejection rates decrease as the cost of rejection increases.
- The "demand curve" for punishing unfair offers is downward sloping.

20000일때 reject을 매우작음
offer수학적 reject비율 ↓

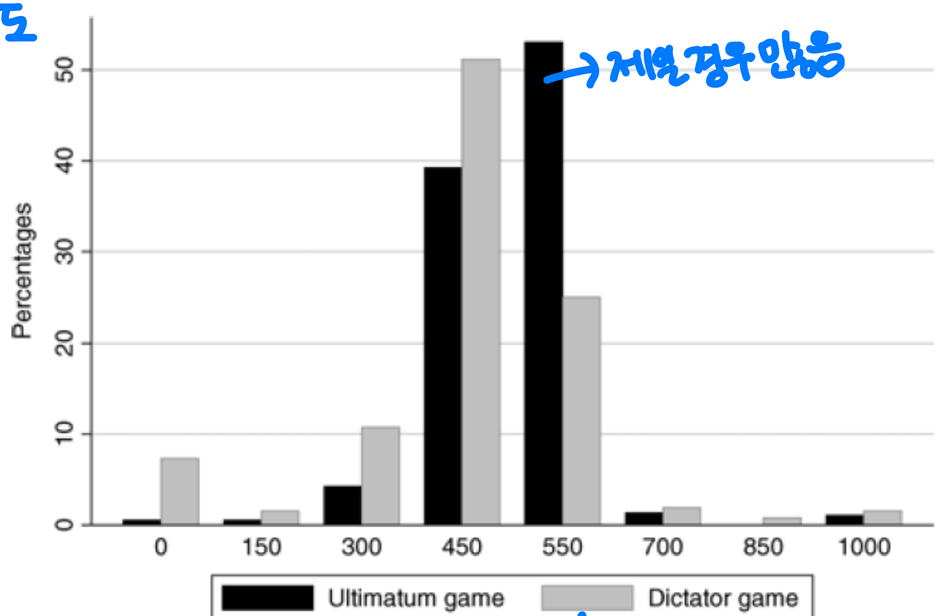
Ultimatum Games: Broder Subject Pool

나이/성별 별로 분석 가능

- Bellemare et al. (2008) conducted the ultimatum bargaining experiment in a large representative sample of subjects from the Dutch population.

- The stakes are low (1000 CP = 10 euros).

빈도



→ 제일 경우 많음

offer

↳ offer 후 바로 끝 (accept/reject 없음)
조금 더 이기적으로 행동.

상대에게 줌 ↗ offer 받은거를

Offers	Acceptance rates
0	0.05
150	0.15
300	0.32
450	0.93
550	0.91
700	0.68
850	0.58
1000	0.55

↱ 꽁꽁이 / 미안함 / 눈치 / 잘못 인식 / 꼰대 심리
↱ 사람들이 엄청 rational한 건 아님

↳ 다 주었는데
0.45는 reject

Ultimatum Games: Cultures

- Henrich (2000) conducted the ultimatum bargaining experiment with Machiguenga people in Peruvian Amazon and compared subjects' behavior across different countries.

TABLE 1—SUMMARY OF CROSS-CULTURAL ULTIMATUM GAME DATA AND STATISTICAL TESTS

Data factors	Los Angeles	Machiguenga	Yogyakarta[b] (high-stakes)	Yogyakarta[b]	Tucson[c]	Pittsburgh[a]	Tokyo[a]	Jerusalem[a]
Number of pairs	15	21	37	94	24	27	29	30
Stake size	$160	$160	$80–120	$10–15	$10	$10	$10	$10
Mean	0.48	0.26	0.44	0.44	0.44	0.45	0.45	0.36
Mode	0.50	0.15	0.50	0.40	0.50	0.50	0.50	0.50
Standard deviation	0.065	0.14	0.11	0.17	0.072	0.096	0.21	0.16
Rejection frequency	0	0.048	0.081	0.19	0.083	0.22	0.24	0.33
Rej < 20 percent	0/0	1/10 = 0.1	0/0	9/15 = 0.6	—	0/1	2/4 = 0.5	5/7 = 0.71
EST p (LA)[d]	—	0.0000	0.081	0.0000	—	0.089	0.030	0.010
EST p (Mach)[d]	0.0000	—	0.0000	0.0000	—	0.0000	00032	0.0011
MW p (Mach)[e]	2.64E-5	—	1.22E-5	3.64E-5	—	3.06E-5	0.002	0.049
EST p (Pitt)[d]	0.09	0.0000	0.99	0.023	—	—	0.24	0.16

Ultimatum Games: Cultures

- Henrich et al. (2005) conducted the ultimatum bargaining experiments from 15 different small-scale societies.

막대그래프가 평균 offer

바로 바로 옆 마을에서도 공통점이 보이지 않음

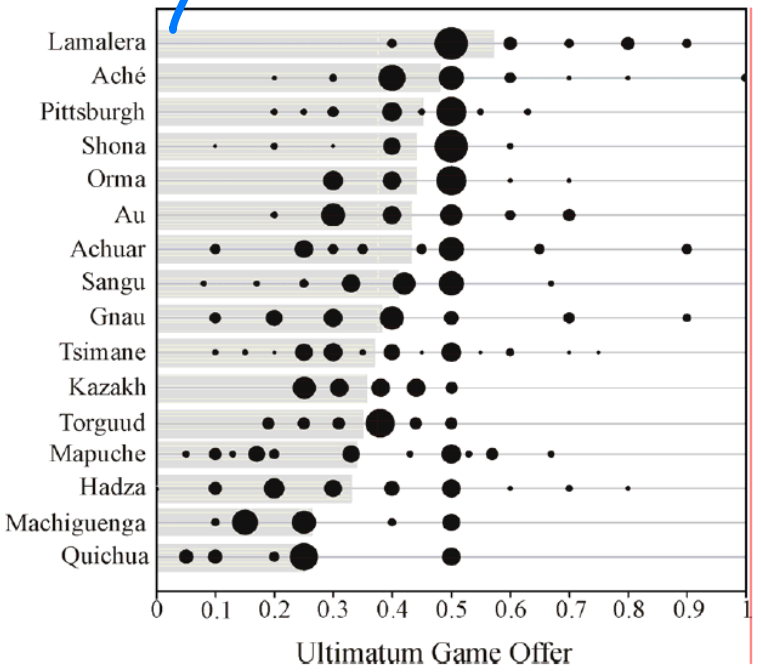


Figure 2. A Bubble Plot showing the distribution of Ultimatum Game offers for each group. The size of the bubble at each location along each row represents the proportion of the sample that made a particular offer. The right edge of the lightly shaded horizontal gray bar is the mean offer for that group. Looking across the Machiguenga row, for example, the mode is 0.15, the secondary mode is 0.25, and the mean is 0.26.

Some reactions

- The conflict between theory and experiment in the ultimatum game is robust with such variations as
  - for larger payoffs (Andersen et al. 2011);
  - in different countries and cultures (Roth et al., 1991; Henrich et al., 2001);
  - with a broader subject pool (Bellemare et al., 2008).
- The mounting evidence suggests that the standard theory of bargaining leaves some aspects of behavior unexplained (a question of *internal validity*).

Missing element?

- A common view is that subjects' behavior is shaped primarily by moral and ethical considerations such as fairness or reciprocity.
  공정함 호혜
- Do such moral and ethical considerations matter beyond a particular bargaining situation of ultimatum game?

Gift Exchange Game 내가 많이 주면 많이 받을 수 있을까

- The gift exchange game was introduced by Fehr, Kirchsteiger and Reidl (1993) to test the presence of intrinsic reciprocity in labor market settings.
    - They design an experiment to mimic an employment relationship in which a wage offer is binding but effort is discretionary.
- They intends to test the fair wage-effort or efficiency wage hypothesis (Akerlof 1982; Akerlof and Yellen 1990).
    - Fairness-oriented workers may be willing to exert more efforts ('gift' given by workers) in response to a wage increase ('gift' given by firms).

Gift Exchange Game

- They set up a two-stage game to create a competitive labor market.
  - There are more workers than firms; → 회사의 가격경쟁 x (처음부터 많음이 주려고)
  - The first stage is a one-sided oral auction with employers as bidders (which last for several minutes). → 임금 협상하고 아니면 끝
  - At this stage, employers make wage offers in a competitive market manner (every worker could accept every offer).
  - If one worker accepted an offered wage *p*, a binding contract would be accepted and the first stage be finished for both the worker and employer.
  - In the second stage, workers choose effort and this choice is only revealed to the paired employer.

Payoffs and Predictions

- Firms choose wages from the interval [26, 126] (can only choose multiples of five) and earnings are given by (126 – wage) multiplied by effort put by workers.
- Workers earn (wage – 26 – cost of effort).

e(126-w) = firm π
w ∝ e 인가?

m(e)

TABLE I

$m(e)$-SCHEDULE

effort cost

e	0 1	0.2	0 3	0.4	0 5	0 6	0.7	0 8	0.9	1
$m(e)$	0	1	2	4	6	8	10	12	15	18

- Standard predictions:
  - Because effort is costly and workers cannot be punished for a low effort, workers choose the minimum level of effort, 0.1, regardless of a wage offer.
  - Anticipating this, employers offer the minimum wage, 30.
  - The sum of their payoffs under this prediction is 13.6.
  - ~~However, if effort is equal to one, the sum of payoffs is 82, which is more efficient~~.

Fair Wage-Effort Hypothesis

- Hypothesis: The effort level is increasing in the wage.

• There is a positive relation between effort and wage.

•The results indicate that fairness effectively prevented the wage from decreasing to the market-clearing level.

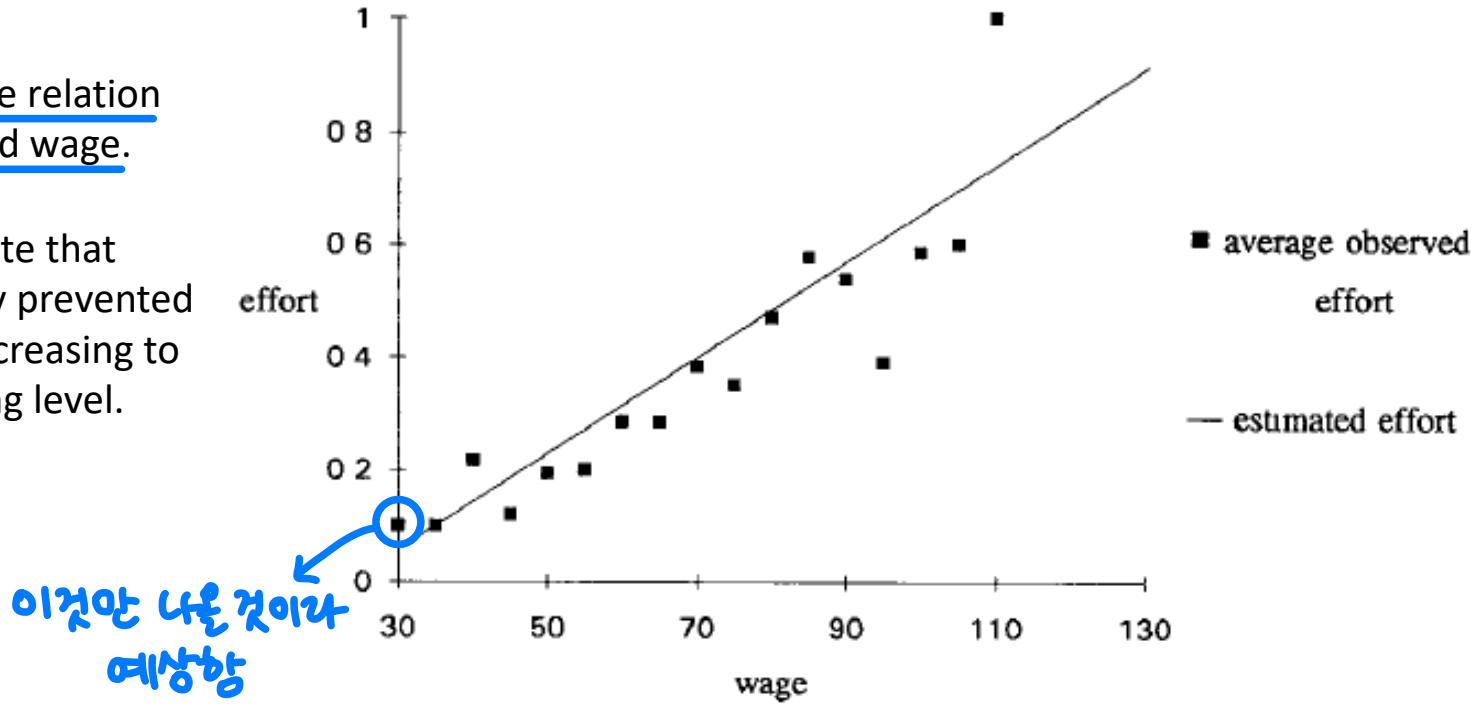


FIGURE I
The Wage-Effort Relation

Gift Exchange in Workplace Relations

- In the workplace, do workers provide more effort and due diligence if they feel they are treated better?

- Krueger and Mas (2004) examine the impact of a three-year period of labor unrest at a unionized Bridgestone-Firestone plant on the quality of the tires produced at the plant. social experiment → event를 보고 분석

- The workers went on strike (파업) in July 1994 and were replaced by replacement workers. ↘ replacement worker 고용

- The union workers were gradually reintegrated in the plant in May 1995 after the union, running out of funds, accepted the demands of the company.

- An agreement (노사간의 협의) was not reached until December 1996. → 이후로도 replacement worker 남아있음

Background

- In 1988, the Japanese tire manufacturer Bridgestone purchased Firestone, making Bridgestone/Firestone the largest tire manufacturer in the world.
- In 1994, the company entered the negotiation with the United Rubber Worker and demanded
  - 8-hour shift → 12-hour shift;
  - Pay of new hires reduced to 30 percent, etc.
- The workers (particularly, in Decatur plant) went on strike in July 1994 and Bridgestone immediately began to hire temporary replacement workers (converted permanent by January 1995).

Background

- The union workers were gradually reintegrated in the plant in May 1995 after the union, running out of funds, accepted the demands of the company.
- An agreement was not reached until December 1996.
- In August 2000, Firestone and Ford jointly announced the recall of 14.4 million of tires. One of every 400 tires produced in the Decatur plant in 1995 was returned under warranty because of a default by 2000.

Background

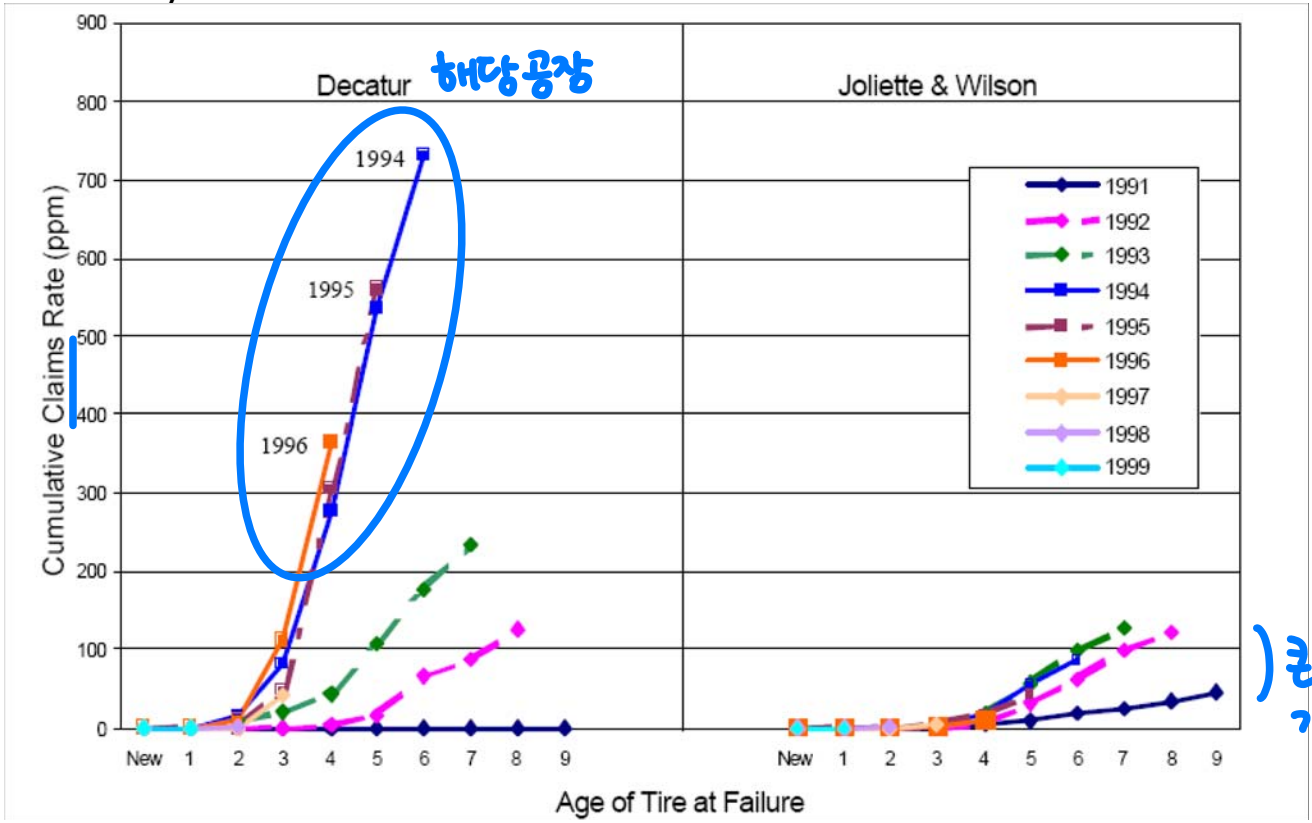
JANUARY 1991–MARCH 2000

Plant	Number of ATX and Wilderness Tires	Percentage of Total	Claims per Million ATX Tires Produced	Notes
Aiken, S.C.	1,442,115	6.9	NA	Plant began operation in 1999
Decatur, Ill.	6,408,584	30.5	356.0	Strike from July 1994 to December 1996; 1,048 replacement workers
Joliette, Que.	5,638,302	26.9	58.9	Strike from August 1995 to February 1996; no replacement workers
La Vergne, Tenn.	455,157	2.2	NA	No strike
Oklahoma City, Okla.	530,515	2.5	44.1	Strike from July 1994 to December 1996
Wilson, N.C.	6,503,642	31.0	142.0	Nonunion; no strike
Total	20,978,315	100.0		

SOURCE.—Production is derived from a Safety Forum spreadsheet. Claims per million are taken from a chart submitted by Firestone to the House Committee on Commerce; they pertain to property damage and personal injury claims for

Claims per million Firestone tires

- Do workers sabotage production at firm?
  - Examine claims per million tires produced in plants severely affected (Decatur) and compare them with plants not affected much by strike (Joliette and Wilson).



Accidents with Fatalities 인명 피해

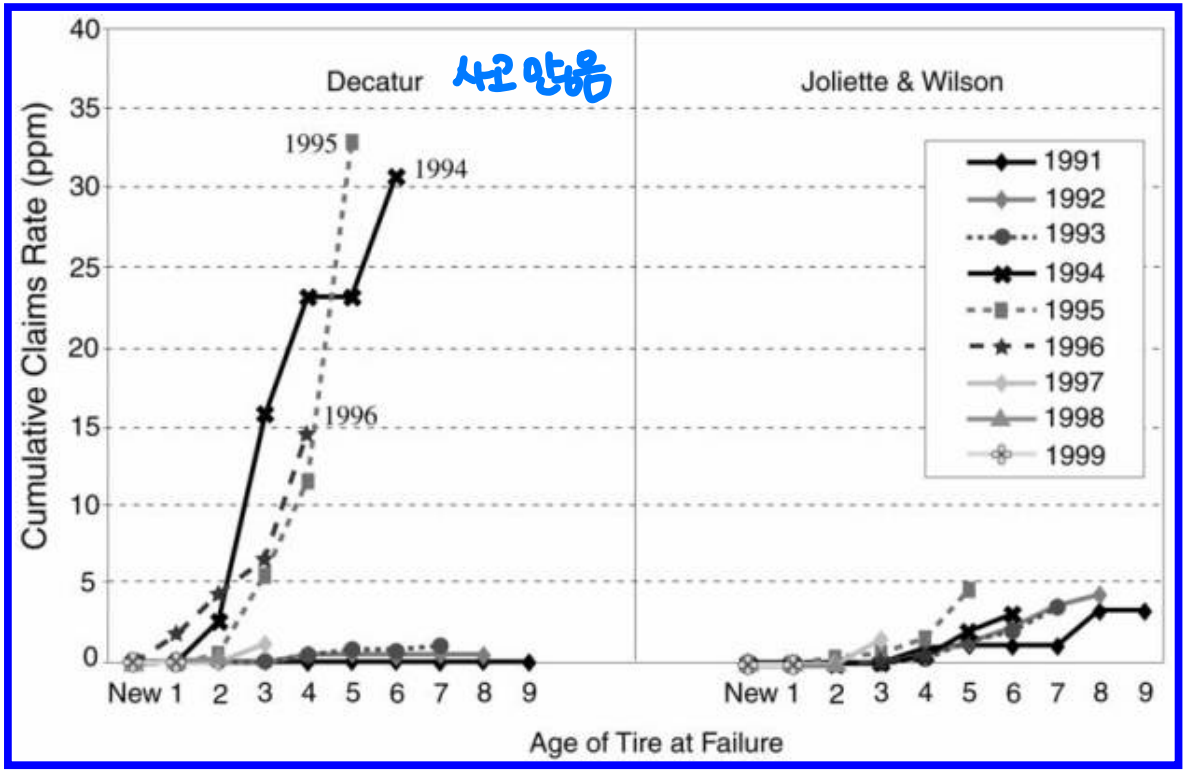


FIG. 4.—Number of accidents with fatalities per million Firestone P235/75R15 tires produced, by age of tire, production year, and plant (average of 10 imputed data sets). Source: Authors' calculations based on NHTSA and Safety Forum data. The sample includes ATX and Wilderness P235/75R15 tires. Accidents occurred between 1991 and 1999 and could have been reported at any time after 1991.

Possible explanations

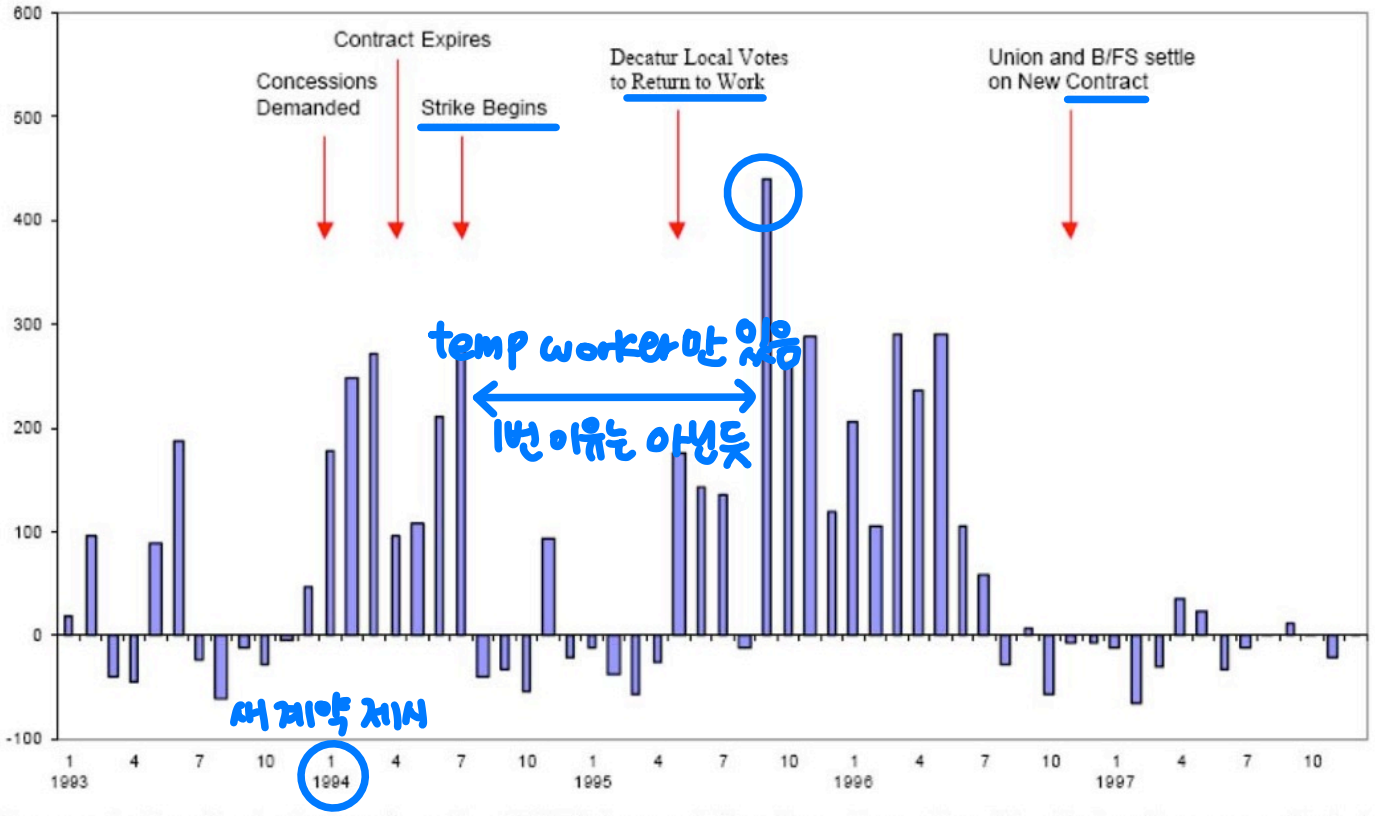
1. Lower quality of replacement workers?

   역샘이 잉 안했나?

2. Boycotting and negative reciprocity by unionized workers?

Timing of the Claims

Figure 8: Difference in the Number of Complaints per million Tires Produced by Month: Decatur Plant minus Joliette and Wilson Plants.



↑ complain ↑

↓ " ↓

(더 연상이임)

Source: Authors' calculations based on NHTSA complaints data. Records with missing data are excluded.

Timing of Replacement Workers

- Through early 1995, when large numbers of replacement workers were building tires, the number of complaints remained relatively low.
- At the end of 1995 when replacement workers and returning strikers worked side by side, the complaints rate reached its highest level.

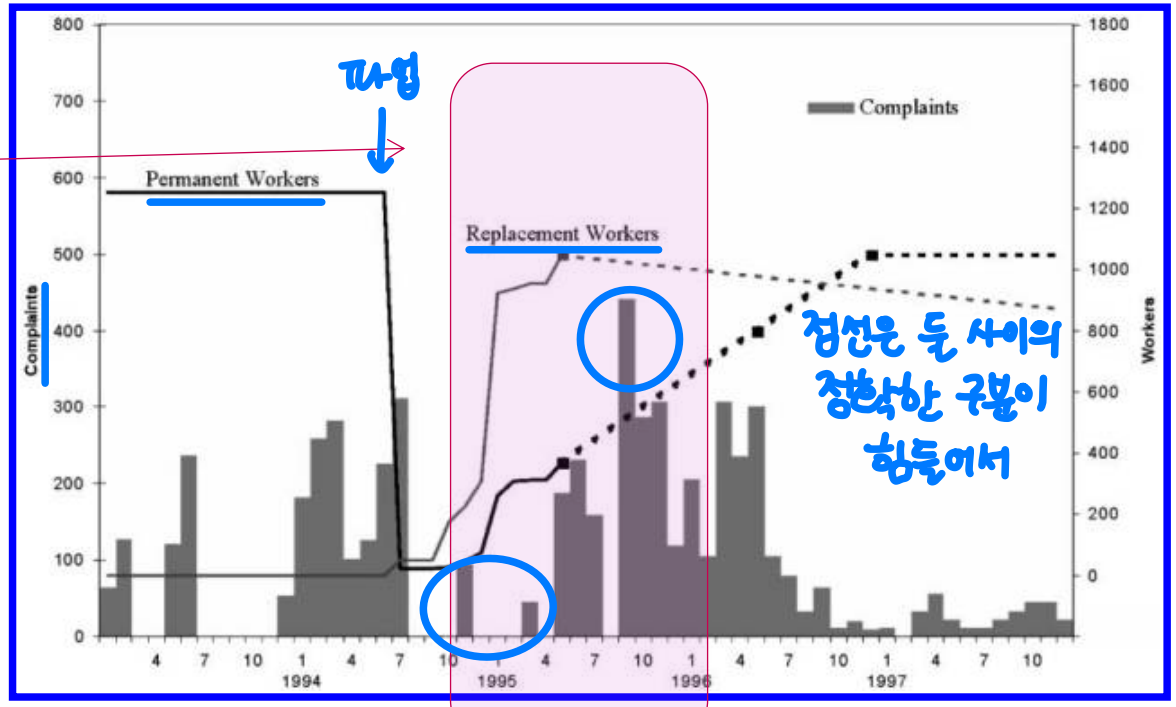


FIG. 7.—Number of permanent workers, replacement workers, and estimated complaints per million tires produced, by month (Decatur plant). Source: Authors' calculations based on NHTSA complaints data, estimated monthly production (see Krueger and Mas 2002, app.), press reports, and Firestone documents submitted to the House Committee on Commerce (U.S. House 2000). Dashed lines indicate estimates of employment; blocks indicate specific data points.

Interpretations

- Two time periods with high number of claims:
  - In the first half of 1994, around the time in which concessions were demanded and the old contract expired.
  - In the end of 1995, when large numbers of replacement workers and returning strikers worked side by side, the complaints rate reached its highest level.
- Through early 1995, when a large number of replacement workers were building tires, the number of complaints remained relatively low.
- Claims were back to normal after a new contract was reached.
- These results suggest the extreme importance of building/maintaining good relations between workers and employers (the form of reciprocity as gift exchange).

조건이 좋다 안좋다

↳ give & take 관계를 보수 있음

Missing element?

- Moral and ethical considerations such as fairness are indeed applied in a variety of economic settings.

- How helpful is this in constructing a more encompassing account of behavior?

  - Is the concept of fairness something that we can easily grasp and use in many situations?

  - Can we still rely on the basic premises of economic modelling-- people maximize their objectives (whatever they are) subject to some constraints-- or are such models of behavior simply on the wrong track?

Alternative Preference-Based Approach

- The literature of behavioural and experimental economics adopts the basic principle of utility maximization but relaxes the assumption of self-regarding preferences.

  - Outcome-based models such as the model of inequity aversion (Fehr and Schmidt 1999) 결과에 초점을 맞추어 행동

  - Intention-based models: psychological games (Rabin 1993)
    의도에 초점을 맞춤

Financial Incentives → 피실험자의 올적한평가를 위해

- One practical distinction between experimental economics and experimental psychology is the use of monetary incentives in economics experiments.

- The induced value theory by Vernon Smith (1976) provides a rationale on this practice.

- A main idea is that proper use of a reward medium allows an experimenter to induce pre-specified characteristics in experimental subjects, and the subjects' innate characteristics become largely irrelevant.

Induced Value Theory

- The induced value theory by Vernon Smith (1976) provides a rationale on this practice.
  - **Monotonicity**: Subjects must prefer more reward medium to less, and not become satiated. 보상을 더 많이 받으면 더 행복하도록 해야함 → 돈 (Stake의 문제)
  - **Salience**: The reward received by the subject depends on her action (and those of other subjects) as defined by institutional rules that the subject understands. 피실험자의 이해
  - **Dominance**: Changes in subjects' utility from the experiment come predominantly from the reward medium and other influences are negligible. 본인의 행동에 따른 보상이 다른 요소보다 더 많이 영향을 주어야함

- When the three conditions are satisfied, the experimenter achieves control over subjects' characteristics.

Example: Double-Auction Experiment

- Consider Smith (1962)'s market experiment.
- Each buyer i is endowed with a maximum willingness to pay V_i and each seller j is endowed with a reservation price U_j.
- Each buyer sets a bid price for the unit of the good, B_i, and each seller sets an ask price for the unit, A_j.
- All market participants can see the highest outstanding bid and the lowest outstanding ask.
- Buyers could raise the current best bid at any time, and sellers could undercut the current best ask at any time.

Example: Double-Auction Experiment

- A trade occurs when these processes meet, that is, when a buyer accepts a seller's ask $(p = A_j)$ or when a seller accepts a buyer's bid $(p = B_i)$.

- If a trade occurs, a buyer's payoff is $V_i - p$ and a seller's payoff is $p - U_j$. If not, the payoff for each is zero.

- If a trade occurs, a matched pair of buyer and seller is out of the market. And the remaining buyers and sellers continue this process until the end of the trading time.

Example: Double-Auction Experiment

- Would subjects behave accordingly as the experimenter hopes them to do?

- Under what conditions do we expect subjects to behave in such a manner?

Induced Value Theory

- To illustrate this, suppose we want to induce some specific smooth preferences represented by $U^B(x, p)$ for buyer and $U^S(y, p)$ for seller.
- Pick convenient objects such as numbered paper for buyer and seller:
  - x = (the number on red paper as a buyer's maximum willing to pay)
  - y = (the number on blue paper as a seller's reservation price)
- Explain to subjects that, from market trading at price p in the experiment,
  - the buyer's payment will be $\Delta m = U^B(x, p)$;
  - the seller's payment will be $\Delta m = U^S(y, p)$;

Induced Value Theory

- Then the buyer's induced preferences are

$$W^B(x,p) = V(m_0 + U^B(x,p), z_0 + \Delta z)$$

where (m_0, z_0) is the subject's unobservable initial endowment of money and everything else.

- Two utility functions $W^B(x,p)$ and $U^B(x,p)$ represent the same preferences if their marginal rate of substitution always coincide:

$$MRS^{W^B} = MRS^{U^B}$$

Induced Value Theory

- Two utility functions $W^B(x,p)$ and $U^B(x,p)$ represent the same preferences if their marginal rate of substitution always coincide:

$$MRS^{W^B} = \frac{\frac{\partial W^B(x,p)}{\partial x}}{\frac{\partial W^B(x,p)}{\partial p}} = \frac{\frac{\partial V}{\partial m}\frac{\partial U^B(x,p)}{\partial x} + \frac{\partial V}{\partial z}\frac{\partial z}{\partial x}}{\frac{\partial V}{\partial m}\frac{\partial U^B(x,p)}{\partial p} + \frac{\partial V}{\partial z}\frac{\partial z}{\partial p}}$$

이렇게해서 m_0 사라짐

MRS^{W^B}: P. 가 x에 대한 선호도

MRS^{U^B}

$W^B(x,p) = V(\underbrace{m_0 + U^B(x,p)}_{=m}, \underbrace{z_0 + \Delta z}_{=z})$ 사용

Induced Value Theory

- Two utility functions $W^B(x,p)$ and $U^B(x,p)$ represent the same preferences if their marginal rate of substitution always coincide:

$$MRS^{W^B} = \frac{\frac{\partial W^B(x,p)}{\partial x}}{\frac{\partial W^B(x,p)}{\partial p}} = \frac{\frac{\partial V}{\partial m}\frac{\partial U^B(x,p)}{\partial x} + \frac{\partial V}{\partial z}\frac{\partial z}{\partial x}}{\frac{\partial V}{\partial m}\frac{\partial U^B(x,p)}{\partial p} + \frac{\partial V}{\partial z}\frac{\partial z}{\partial p}} = 0$$

이 term 잘 인식해야 (미적분자가)

simple design 편리

$\frac{\partial V}{\partial m} > 0 \ (\neq 0)$ ← monotonicity

salience

Dominance makes it zero

$$= \frac{\frac{\partial U^B(x,p)}{\partial x}}{\frac{\partial U^B(x,p)}{\partial p}} = MRS^{U^B} = |-1| \quad (x-p = U^B(x,p))$$

Induced Value Theory

- Two utility functions $W^B(x,p)$ and $U^B(x,p)$ represent the same preferences if their marginal rate of substitution always coincide:

$$MRS^{W^B} = MRS^{U^B}$$

- Thus, the experimenter can freely choose any relationship between intrinsically worthless objects and the reward medium.

Miscellanea

- Deception 속이면 안됨 → 신뢰도를 낮출 수 있으므로
  - Deceiving participants is generally taboo among experimental economists (almost impossible to publish economic research with even minor deception).

  - The typical rationale for economists' reasons to argue against deception are illustrated by Davis and Holt (1993, pp.23-24):

> *The researcher should ... be careful to avoid deceiving participants. Most economists are very concerned about developing and maintaining a reputation among the student population for honesty in order to ensure that subject actions are motivated by the induced monetary rewards rather than by psychological reactions to suspected manipulation. Subjects may suspect deception if it is present. Moreover, even if subjects fail to detect deception within a session, it may jeopardize future experiments if the subjects ever find out that they were deceived and report this information to their friends.*

Miscellanea

- Between-subjects vs. within-subjects design
  - Designs that vary levels of a treatment variable only *across subjects* are called between-subjects designs; those varying levels of a treatment variable *within a subject* are called within-subjects designs.
  - The advantage of within-subjects design is that individual differences are controlled by letting each person serve as their own control. In general, a within-subject design is desirable if there is high behavioral variability across individuals.
  - However, the order of control/treatments in within-subjects design should be controlled.

Miscellanea

- Human subjects committee and ethics
  - In most countries, university researchers who work with human subjects are required to obtain clearance from campus human subjects committee.
  - Threat of moral, physical, or financial harm in economics experiments is usually nonexistent.
  - SNU Research Ethics Committee: http://snuethics.snu.ac.kr/
  - POSTECH: http://www.postech.ac.kr/research/research-ethic/bioethics/

Miscellanea

- Instructions
  - Instructions tell subjects what they need to know such as the set of available choices and the rules for determining earnings as a function of subjects' actions.
  - It is scientifically very useful to have a clear instructional script that enables precise replication.

- Contexts in experiments
  - An important design decision for any experiment pertains to the amount and richness of context to provide.
  - If economic theories do not depend on assumptions about social context, then the best approach is to try to hold this context constant as treatment variables are changed.
  - It is thus often recommended to strip away a lot of social context that is not an essential part of economic theories being tested.
  - Social context can sometimes be critically important. In such cases, researchers may better use field experiments involving people in their natural environments.

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