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Ernst Fehr
Jean-Robert Tyran

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Ernst Fehr
Institute for Empirical Research in Economics, University of Zurich and IZA, Bonn

Jean-Robert Tyran
Department of Economics, University of St. Gallen

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IZA

P.O. Box 7240
D-53072 Bonn
Germany

Tel.: +49-228-3894-0
Fax: +49-228-3894-210
Email: iza@iza.org

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ABSTRACT

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Money illusion means that people behave differently when the same objective situation is represented in nominal terms rather than in real terms. *This paper shows that seemingly innocuous differences in payoff representation cause pronounced differences in nominal price inertia indicating the behavioral importance of money illusio*n. In particular, if the payoff information is presented to subjects in nominal terms, price expectations and actual price choices after a fully anticipated negative nominal shock are much stickier than when payoff information is presented in real terms. *In addition we show that money illusion causes asymmetric effects of negative and positive nominal shocks.* While nominal inertia is quite substantial and long-lasting after a negative shock, it is rather small after a positive shock.

JEL Classification: C92, E32, E52

Keywords: Money illusion, nominal inertia, sticky prices, non-neutrality of money

Ernst Fehr
University of Zurich
Institute for Empirical Research in Economics
Blümlisalpstrasse 10
CH-8006 Zürich
Tel.: +41 1 634 3709
Fax: +41 1 634 4907
Email: efehr@iew.unizh.ch

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1. Introduction

Until recently, the notion of money illusion seemed to be thoroughly discredited in modern economics. Tobin (1972:3) described the negative attitude of most economic theorists towards money illusion as follows: "An economic theorist can, of course, commit no greater crime than to assume money illusion." As a consequence, for several decades money illusion was anathema to the profession. The index of the Handbook of Monetary Economics (Friedman and Hahn 1990), for example, does not even mention the term "money illusion". In principle, money illusion could provide an explanation for the inertia of nominal prices and wages and, thus, for the non-neutrality of money. The stickiness of *nominal* prices and wages seems to be an important phenomenon (see e.g. Akerlof, Dickens and Perry 1996, Bernanke and Carey 1996, Bewley 1998, Blinder 1990, Card and Hyslop 1998, Kahn 1997). It has puzzled economists for decades because it is quite difficult to explain in an equilibrium model with maximizing individuals. Instead of money illusion other factors like informational frictions (Lucas 1972), staggering of contracts (e.g., Fischer 1977, Taylor 1979), costs of price adjustment (Mankiw 1985) and near-rationality (Akerlof and Yellen 1985) have been invoked to explain nominal inertia.

In this paper we do not contest the potential relevance of these explanations. We do, however, argue that money illusion has prematurely been dismissed as a potential candidate for the explanation of sluggish nominal price adjustment. Our argument is based on rigorous experimental evidence from a price setting game that isolates money illusion from other potential determinants of nominal inertia. In particular, we show that after a fully anticipated *negative* nominal shock, long-lasting nominal inertia prevails, even if informational frictions, costs of price adjustment and staggering are absent. Our results indicate that the direct and indirect effects of money illusion are the major determinant of this long-lasting nominal inertia. We show, in addition, that money illusion causes much less nominal inertia after a fully anticipated *positive* nominal shock. Our results suggest that this asymmetric effect is caused by a particular form of money illusion that arises when some people take nominal payoffs as a proxy for real payoffs. After a negative money shock nominal payoffs decline because prices tend to decline while after a positive shock nominal payoffs increase because prices tend to rise. If these changes in nominal payoffs are taken as a proxy for changes in real payoffs there will be more reluctance to adjust prices to the new equilibrium after a negative shock.

Our experiments also allow us to judge the relative importance of the direct and indirect effects of money illusion on nominal inertia. The direct effects of money illusion are defined as those effects that are the direct result of individual optimization mistakes. The indirect effects of money illusion are defined as those effects that arise because some agents *expect* that others are prone to money illusion and, as a consequence, they behave differently. The distinction between the direct and the indirect effects of money illusion is important because many economists seem to believe that money illusion is not a widespread phenomenon at the individual level, i.e., that the direct effects of money illusion are small. The textbook example where all nominal prices and nominal incomes are doubled nicely illustrates this view. It is hard to believe that many people make an individual optimization mistake by choosing a different bundle of goods when prices and incomes are doubled. Our results clearly show, however, that it would be misleading to conclude that money illusion is largely irrelevant because the direct effects of money illusion are small. In our experiments the direct effects of money illusion on nominal inertia after the negative shock are also rather small but the total effects nevertheless are very large. The reason for this finding is that money illusion renders price expectations very sticky after the negative shock, which in turn induces agents to choose sticky prices. This result lends support to theories that stress that *small* amounts of individual-level irrationality can have large aggregate effects (Akerlof and Yellen 1985, Haltiwanger and Waldman 1985 and 1989, Russell and Thaler 1985). Taken together, the results of our experiments suggest that money illusion matters, i.e., money illusion should be considered as a serious candidate in the explanation of nominal inertia.

The rest of the paper is organized as follows: In section 2 we discuss the notion of money illusion and its potential aggregate implications in more detail. In section 3 we argue that experimental methods are appropriate for studying whether money illusion matters and we present our experimental design. In section 4 the experimental results of the design with the negative nominal shock are presented. Section 5 argues that the nature of money illusion in our experiment suggests that after a positive nominal shock there should be less nominal inertia. This conjecture is tested in a design with a positive nominal shock. In the final section we summarize and interpret our main results.

2. Money illusion at the individual and the aggregate level

2.1. Money illusion at the individual level

Leontief (1936) defined money illusion as a violation of the "homogeneity postulate". This postulate stipulates that demand and supply functions are homogeneous of degree zero in all nominal prices, i. e., they depend only on *relative* and not on absolute prices. Although other authors have used slightly different definitions, the intuition behind their definitions seems to be rather similar.[3] This intuition says that if the *real* incentive structure, i.e. the *objective* situation an individual faces, remains unchanged, the *real* decisions of an illusion-free individual do not change either. Two crucial assumptions underly this intuition: First, the objective function of the individual does not depend on nominal but only on real magnitudes. Second, people perceive that purely nominal changes do not affect their opportunity set. For example, people have to understand that an equi-proportionate change in all nominal magnitudes leaves the real constraints unaffected. Whether people are, in fact, able to pierce the veil of money, i.e., whether they understand that purely nominal changes leave their objective circumstances unchanged, is an empirical question. Irving Fisher (1928), for example, was convinced that ordinary people are, in general, prone to money illusion.

More recently Shafir, Tversky and Diamond (1997) provided interesting questionnaire evidence indicating that frequently one or both preconditions for the absence of money illusion are violated. Their results suggest that the preferences of many people as well as their perceptions of the constraints are affected by nominal values. Moreover, the answers of many people do not only indicate that they themselves suffer from money illusion but that they also expect other people's behavior to be affected by money illusion.

Since the absence of money illusion means that an individual's preferences, perceptions and, hence, choices of real magnitudes are not affected by purely nominal changes, it is natural to view money illusion as a framing or representation effect. From this viewpoint an individual exhibits money illusion, if his or her decisions depend on whether the same environment is represented in nominal or real terms. There is a large body of experimental research that shows that alternative representations of the same situation may well lead to systematically different responses (Selten and Berg 1970, Tversky and Kahneman 1981). Representation effects seem to arise because people tend to adopt the particular frame that is presented and evaluate the options within this frame. Because some options loom larger in one representation than in another, alternative framings of the same options may provoke different choices.

It is important to note that the nominal representation of an economic situation is probably the natural representation for most people. This is so because most economic transactions in people's lives involve the use of money and, hence, are framed in nominal terms. Therefore, it is likely that people often perceive and think about economic problems in nominal terms which may induce money illusion. A rather basic form of money illusion occurs, e. g., when people take

[3] For the different definitions of money illusion see Howitt (1989). Patinkin (1949), e. g., used a definition that also takes into account the potential effect of people's *real* wealth on their supply and demand behavior.

nominal values or changes in nominal values as a proxy for real values or changes in real values, respectively. Note that this rule of thumb makes perfect sense in an environment with a given aggregate price level. However, this rule is inappropriate in situations where the aggregate price level is changing. Therefore, the application of this rule in an environment with changing aggregate prices constitutes a form of money illusion.

2.2. Money illusion at the aggregate level

In the past, economists frequently invoked the assumption of money illusion to account for the short-run non-neutrality of money.[4] However, since the success of the rational expectations revolution economists have been extremely reluctant to invoke money illusion to explain the short-run non-neutrality of money. While New Classical macroeconomists focus on informational frictions to account for short-run non-neutrality (Lucas 1972), New Keynesians mainly focus on costs of price adjustment or staggering (see e. g. Mankiw and Romer 1991).[5] In the absence of menu costs, staggering, and informational frictions, the models of New Keynesian and New Classical economists rule out that purely monetary changes have real effects. A common feature of these models is that they *exclusively* focus on the equilibrium states of their economies. In general, they remain silent on how economic agents move from one equilibrium to the other. In models that exclusively focus on equilibrium the assumption of the absence of money illusion is very intuitive because it is difficult to imagine that an illusion could persist in equilibrium. However, there is a strong *a priori* argument that money illusion is likely to affect the *adjustment process* of an economy after a fully anticipated monetary shock. This argument is based on the simple fact that in an interactive situation the failure of some agents to fully adjust to the nominal shock will, in general, provide incentives for other agents to not fully adjust to the shock, either. Thus, there may be a snowball effect that causes less than full adjustment for a prolonged period of time.

This can be illustrated in the context of a monopolistically competitive economy as analyzed in, for example, Akerlof and Yellen (1985) or Blanchard and Kiyotaki (1987). To keep the argument simple we focus solely on the firms' behavior. The reduced form real profit function for firms in these models can be written as

[4] Irving Fisher's explanation of business cycles, for example, is based on lenders' money illusion during an upswing. Fisher believed that lenders are willing to supply more in the face of a rise in nominal interest rates although real interest rates decline or remain unchanged due to inflation.

[5] The near-rationality approach of Akerlof and Yellen (1985) can, in principle, be subsumed under the menu-cost approach by stipulating "cognitive" menu costs of maximizing behavior.

(1) $$\pi_i = \pi_i(P_i/\bar{P}, M/\bar{P}).$$

where π_i is firm *i's* real profit, P_i is the nominal price set by firm *i*, $\bar{P}$ is the aggregate price level and M denotes the supply of money.[6] In these models $M/\bar{P}$ is proportional to real aggregate demand. For simplicity, we assume identical firms, the absence of menu costs and informational frictions, and a unique and symmetric equilibrium $P_i^* = P_j^*$, for all *i*, *j*. In this equilibrium each firm maximizes real profits by setting $P_i^* = \bar{P}^*$. Since (1) is homogeneous of degree zero in P_i, $\bar{P}$ and M, a change in M to λM ($\lambda \neq 1$) leads to post-shock equilibrium values of λP_i^* and $\lambda \bar{P}^*$.

Suppose now that there is one group of agents who suffers from money illusion and does, therefore, not fully adjust their nominal prices to λP_i^*. Suppose further that there is a second group of agents that anticipates the behavior of the first group. The second group, therefore, anticipates a change in real aggregate demand $M/\bar{P}$ such that their members, in general, have an incentive to choose a price that differs from λP_i^*, too. Whether the interaction between these groups causes *aggregate* nominal inertia depends in an important way on the strategic environment, i. e., whether agents' actions are strategic complements or strategic substitutes. Haltiwanger and Waldman (1989) have shown that in the presence of strategic complementarity between agents' decisions the existence of a *small* group of non-rational subjects can have *large* effects on the process of adjustment to equilibrium. In the above mentioned model of monopolistic competition strategic complementarity means that firm *i's* profit maximizing nominal price P_i' is *positively* related to the aggregate price level $\bar{P}$. This means that firms which believe that, because of money illusion, the prices of other agents are kept close to the pre-shock equilibrium have a rational reason to choose a nominal price that is also close to the pre-shock equilibrium.

Thus, under strategic complementarity rational firms have an incentive to partly *imitate* the behavior of the non-rational firms which gives the latter a *disproportionately large impact on the aggregate price level*. In contrast, in the presence of strategic substitutability, i. e., if P_i' is negatively related to $\bar{P}$, rational firms have an incentive to partly *compensate* the behavior of the non-rational ones so that the latter have a *disproportionately small impact* on the aggregate outcome. The results of Haltiwanger and Waldman (1989) thus suggest that, given strategic complementarity, the existence of a small group of subjects that suffer from money illusion may generate substantial nominal inertia. However, while this is a plausible theoretical argument,

[6] Equation (1) already incorporates (*i*) the maximizing behavior of all households, (*ii*) the cost minimizing behavior of all firms for given output and wages levels, (*iii*) the equilibrium real wage, and (*iv*) the equilibrium relation between real aggregate demand and real money balances. In Akerlof and Yellen (1985) the real wage is given by the Solow condition because firms are efficiency wage setters. In Blanchard and Kiyotaki (1987) households are wage setters so that firms take real wages as given when choosing nominal prices and output.

there is, to our knowledge, no empirical evidence for the claim that a small amount of money illusion may generate substantial nominal inertia.[7]

3. An experimental approach to money illusion

One way to rigorously examine whether money illusion matters, is to look for a natural experiment in which an *exogenous* and *fully anticipated* monetary shock occurs. The shock has to be exogenous because if the central bank responds to real events in the economy there can be a co-movement between money and output that has nothing to do with the real effects of money. The shock has to be fully anticipated because nobody doubts that nominal inertia and real effects occur in the presence of non-anticipated shocks. These effects should not be confounded with money illusion.

Of course, in order to unambiguously identify whether the shock is fully anticipated the researcher needs to know *individual information sets* before the shock. Moreover, to judge whether the anticipated shock causes a disequilibrium and nominal inertia the researcher has to know the equilibrium values of nominal prices *before* and *after* the shock. By comparing the pre- and post shock equilibrium values of nominal prices with actual prices the researcher can identify (*i*) to what extent actual prices are anchored at the pre-shock equilibrium and (*ii*) how long it takes for actual prices to adjust to the new equilibrium. Furthermore, to examine whether money illusion causes nominal inertia the researcher should identify two similar natural experiments. In one experiment the "world" should be framed in nominal terms while in the other experiment it should be framed in real terms.

In our view, it seems extremely difficult, if not impossible, to meet the above requirements with field data. In fact, the exogeneity of monetary policy and the causality between money and output is a matter of considerable debate (e.g., Romer and Romer 1989, 1994; Hoover and Perez 1994; Coleman 1996). Whether monetary shocks are anticipated or not is usually controversial, too. Belongia (1996) for example, shows that the measurement of unanticipated money shocks may be quite sensitive to the choice of monetary aggregates. Moreover, full

[7] Since strategic complementarity is important for our argument in favor of the aggregate relevance of (beliefs about) money illusion one would like to know to what extent it does prevail in naturally occurring economies. In fact, several papers suggest that strategic complementarity may well be an important feature of real economies. It arises frequently in imperfectly competitive labor and product markets. Strategic complementarity is an inherent feature of models of monopolistic price competition (Ball and Romer 1987), it can arise from the nature of preferences and technologies (Bryant 1983) or in environments in which heterogeneous agents search for transaction partners (Diamond 1982). Oh and Waldman (1990, 1994), Cooper and Haltiwanger (1993) and Blinder, Canetti, Lebow and Rudd (1998) provide evidence in favor of the relevance of strategic complementarity in real economies.

knowledge of the pre- and post-shock equilibrium values of nominal prices is clearly beyond the information content of presently available field data. Finally, as already mentioned in the introduction, almost all business transactions are shrouded in nominal money, i. e., it is very difficult to find real world examples of a real frame.

In an appropriate laboratory setting, however, the above mentioned data requirements can be met. The techniques of experimental economics allow the implementation of exogenous and fully anticipated nominal shocks and the experimenter can exert full control over pre- and post-shock equilibrium values of nominal prices. In addition, the experimenter controls the framing of the situation, e.g., whether subjects receive the payoff information in nominal or in real terms. Finally, experimental methods also provide the opportunity to observe subjects' behavior in interactive and non-interactive settings that are otherwise structurally identical. These enhanced control opportunities suggest that laboratory experiments provide valuable information regarding the impact of money illusion on nominal inertia, which may complement and help to interpret the results of studies based on field data.[8]

The use of experimental methods also distinguishes our examination from the study of Shafir et al. (1997). While these authors asked subjects hypothetical questions we directly observe subjects' *behavior* in our experiments. In our view the study of Shafir et al. neatly shows that questionnaires can be a very useful instrument to examine the nature of money illusion at the individual level. It is, however, also clear that it is impossible to examine aggregate effects of individual interactions and adjustment processes with this method. For our purposes the most important advantage of experimental methods, relative to questionnaires, is that we can directly observe the *evolution of individual and aggregate behavior* after a nominal shock. This means, e. g., that we can directly study the impact of the nominal frame, i. e., of money illusion, on the evolution of price sluggishness after the shock.

3.1. General description of the experimental design

To study the impact of money illusion we designed an *n*-player pricing game with strategic complementarity. The pricing game was divided into a pre-shock and a post-shock phase. All *n* players had to determine their nominal prices in each period of the game. They were

[8] For field evidence related to the question of money illusion see e.g. Abbott and Ashenfelter (1976) and Niemi and Lloyd (1981). Abbott and Ashenfelter estimate a system of commodity demand and labor supply functions and find evidence that the system does not satisfy the homogeneity restriction. Niemi and Lloyd report the result that the inflation rate has an independent impact on female labor supply.

free to change their nominal prices in each period at no cost. The players interacted anonymously via computer terminals. Each treatment condition had $2T$ periods. During the first T periods of a session the money supply was given by M_0. Then we implemented a *fully anticipated* monetary shock by reducing the money supply to M_1. This shock and the fact that the post-shock phase again lasted T periods was common knowledge.

Our major interest concerns subjects' pricing behavior in the post-shock phase. The pre-shock phase serves the purpose to make subjects acquainted with the computer terminal and the decision environment. In addition, and more importantly, the pre-shock phase allows us to see whether subjects reach equilibrium in the pre-shock phase. After all, one can only argue that money illusion is a disequilibrating force if equilibrium has in fact been reached before the shock.

The real payoff of subject i, π_i, is given by

(2) $$\pi_i = \pi_i(P_i, \bar{P}_{-i}, M) \qquad i = 1, \ldots, n$$

where P_i denotes *i's* nominal price, $\bar{P}_{-i}$ represents the average price of the *other* n-1 group members while M denotes a nominal shock variable (money supply). The nominal payoff of subject i is given by $\bar{P}_{-i}\,\pi_i$. In total, we have four treatment conditions and the payoff functions (2) are the same in all conditions. The four conditions differ along two dimensions (see Table 1). The *first* dimension concerns the framing of the situation, i. e., whether payoffs are represented in real or in nominal terms. In the real treatments, denoted by RC and RH, subjects received the payoff information in real terms while in the nominal treatments, denoted by NC and NH, payoffs were represented in nominal terms. Thus, to compute their real payoffs in the nominal treatments subjects had to divide their nominal payoffs $\bar{P}_{-i}\,\pi_i$ by $\bar{P}_{-i}$.

Insert Table 1 here

The *second* dimension concerns the fact whether our experimental subjects face n-1 pre-programmed computerized players or whether they face n-1 other human subjects. The crucial point here is that in the computerized condition, i. e., if one human subject faces n-1 pre-programmed computers, the subject is informed about the aggregate response rule of the computers in advance. The response rule of the computers is given by the best replies of the computers (based on the computers' payoff functions (2)). Therefore, there is no strategic uncertainty and, hence, no need to form expectations about the behavior of the other players in this condition. Moreover, since the computers play best replies their behavior rules out any money illusion or any other form of irrationality. In contrast, in the condition with human opponents each subject faces the task of forming expectations about the other players' price choices. This necessarily also involves a guess about the extent to which other players are affected by money illusion.

The condition with computerized players essentially boils down to an individual decision-making experiment in which human subjects can maximize their money earnings by playing optimally against the known aggregate best reply of the n-1 computerized players. Note that in the computerized condition the indirect effects of money illusion, which operate via the expectations that other players are affected by money illusion, can play no role because the computers play best reply. This condition, therefore, allows us to examine to what extent money illusion has direct effects on nominal inertia, i.e., to what extent it simply causes individual optimization mistakes. In the condition with human opponents the indirect effects of money illusion can, in addition, also play a role.

An important aspect of our design is that exactly the same payoff functions were implemented in all treatment conditions. Moreover, we also ensured that there is a unique equilibrium in each condition, and that the equilibrium price choices of all n players (human and computerized) are identical across all conditions. Therefore, the *only* difference between the real treatments RC and RH on the one hand and the nominal treatments NC and NH on the other hand is, that in the real treatments subjects received the payoff information in real terms while in the nominal treatments they received this information in nominal terms. The experimental design in Table 1 allows to isolate various potentially important determinants of nominal inertia. The treatments with a real payoff frame allow us, in particular, to isolate those determinants of nominal inertia that have nothing to do with money illusion.

In the RC money illusion is ruled out at the individual and, hence, also the aggregate level. Therefore, if we observe in the RC a slow adjustment of the nominal price chosen by the human subject after the shock, money illusion cannot be the source of this nominal inertia. Instead, other sources of individual irrationality must be responsible. Since the computers are programmed to play a best reply to the choice of the human subject, any deviation from equilibrium must be due to an optimization mistake of the subject.

In the NC, in contrast, money illusion can affect the behavior of individuals because as a part of the individual optimization problem human subjects have to correctly deflate nominal payoffs at the various (P_i, $\overline{P}_{-i}$)-combinations. Hence, by comparing the post-shock prices of human subjects in the RC and the NC we can observe whether there exists money illusion at the individual level. If, e.g., nominal inertia is more pronounced in the NC than in the RC we would have evidence in favor of individual-level money illusion.

In the RH, as in the RC, individual-level irrationality other than money illusion can play a role. However, in the RH the adjustment to the new post-shock equilibrium is not just an individual optimization problem of the human subjects. In the RH adjustment to the new equilibrium also involves the coordination of the expectations of all human subjects. Although there exists a unique equilibrium it cannot be taken for granted that subjects instantaneously succeed to act according to the new post-shock equilibrium. For example, if subjects play the equilibrium before the shock for several periods, it may well be the case that after the shock some subjects are anchored or believe that others are somehow anchored at the old equilibrium. As a consequence, adjustment to the post-shock equilibrium may not occur instantaneously. Since in the RC subjects face no coordination problem, we can isolate the amount of nominal inertia that is due to the coordination problem by comparing the adjustment process in the RC and the RH. In case that we find no individual irrationality in the RC the nominal inertia observed in the RH can be fully attributed to the coordination problem present in the RH.

In the NH subjects face the same coordination problem as in the RH. We are, however, particularly interested in the impact of adding the nominal frame to this coordination problem, i. e., in a comparison of the NH and the RH. This comparison allows us to isolate the *total* effects of money illusion in an environment where subjects face a coordination problem. The total effects of money illusion in this environment consist of the direct effects of individual-level money illusion as exhibited in the NC plus the indirect "multiplier" effects of individual-level illusion. These "multiplier" effects may arise because in our setting with human opponents subjects with money illusion can also affect the expectations and thus the behavior of the subjects without money illusion.

3.2. General properties of the payoff functions

Before we proceed to the specific numerical parameters of our experiment, it is useful to provide a general description of the payoff functions (2). They have the following properties:

(*i*) They are homogeneous of degree zero in P_i, $\overline{P}_{-i}$,-and M.

(*ii*) The best reply is (weakly) increasing in $\overline{P}_{-i}$.

In addition, our functional specification[9] of (2) implies that the equilibrium

(*iii*) is unique for every M,

(*iv*) is the only Pareto efficient point in payoff space, and

[9] The functional form is presented in Appendix A.

(v) can be found by iterated elimination of weakly dominated strategies.

Note that the real payoff π_i does not depend on the average price $\bar{P}$ of all group members but on $\bar{P}_{-i}$. This feature makes it particularly easy to play a best reply for a given expectation about the other players' average price. If we made π_i dependent on $\bar{P}$, so that P_i affects $\bar{P}$, it would have been much more difficult for i to compute the best reply (see also below). It is also worthwhile to point out that the nominal payoff for each subject i is given by $\bar{P}_{-i}\,\pi_i$ and not by $\bar{P}\,\pi_i$. This makes the computation of the real payoffs from a given nominal payoff much easier because the deflator is independent of one's own price choice.

Properties (i) and (iii) above were implemented because our analysis focuses on the impact of money illusion on the adjustment process of an economy with a unique money-neutral equilibrium P_i^*, $i = 1, ..., n$. To see that properties (i) and (iv) imply neutrality, note that a change in M from M_0 to λM_0 leaves real payoffs unaffected if prices change to λP_i and $\lambda \bar{P}_{-i}$. Moreover, if P_i', $i = 1, ..., n$, is a best reply to $\bar{P}_{-i}$ at M_0, $\lambda P_i'$ also is a best reply to $\lambda \bar{P}_{-i}$, at λM_0. Thus, λP_i^* for all i is the post-shock equilibrium.

Property (ii) captures strategic complementarity and was implemented for the reasons given in section 2.2. In our pilot experiments we initially implemented a price-setting game with monopolistic competition. However, it turned out that subjects quickly realized that under monopolistic competition cooperative gains can be achieved by out-of-equilibrium behavior. Therefore, both in the nominal as well as in the real frame, subjects systematically tried to achieve real payoff gains through out-of-equilibrium behavior. Only towards the end of each phase these attempts vanished. Thus, in the pre- as well as in the post-shock phase of our pilot experiments adjustment towards equilibrium was strongly retarded by attempts to cooperate. To remove this confound with the other sources of nominal inertia we chose payoff functions that ensured that the equilibrium was the *unique* Pareto-efficient point in the whole payoff space (property (iv)).

Finally, property (v) means that there is a method for finding the equilibrium that works exactly in the same way in the real as well as in the nominal frame. Note that the framing of payoffs has no impact at all on whether a particular strategy is (weakly) dominated. In the real frame a (weakly) dominated strategy P_i has (weakly) smaller *real* payoff numbers at any level of $\bar{P}_{-i}$. In the nominal frame a (weakly) dominated strategy P_i has (weakly) smaller *nominal* payoff numbers at any level of $\bar{P}_{-i}$. Thus, to eliminate (weakly) dominated strategies in either frame, subjects only need to eliminate those strategies that have (weakly) smaller (real or nominal) payoff numbers at any given level of $\bar{P}_{-i}$. Since in the condition with human opponents the best reply function and, hence, the number of (weakly) dominated strategies is exactly the same under the real and the nominal frame, there is, in the absence of money illusion, no reason why adjustment should differ across the RH and the NH.

3.3. Experimental procedures and parameters

All major experimental parameters are summarized in Table 2. The experiment was conducted in a computerized laboratory with a group size of n = 4. The group composition did not change throughout the whole experiment, i.e., for $2T$ periods. In each group there were two types of subjects: Subjects of type x and subjects of type y. Payoff functions differed among the types. This difference implied that x-types had to choose a relatively low price in equilibrium while y-types had to choose a relatively high price (see Table 2 for details). There is no particular reason for our choice of the group size because there are no strong conjectures about the net effects of a different group size. On the one hand, a larger group size, e. g., enhances the chances that there are individuals with money illusion in a group. On the other hand, the relative impact of an individual on average prices becomes smaller. With regard to the heterogeneity of the players' payoff functions, the case of four different payoff functions would be the most realistic but also the most complicated case. Therefore, we went for an intermediate solution with only two types of players, i. e. two different payoff functions.[10]

Insert Table 2 here

In the pre-shock phase of each treatment the money supply was given by M_0 = 42 while in the post-shock phase it was given by $M_1 = M_0/3 = 14$. In the pre-shock equilibrium the average price over all n group members is given by $\overline{P}_0^*$ = 18 while in the post-shock equilibrium it is $\overline{P}_1^*$ = 6. In the treatments with human opponents both the pre- and the post-shock phase consists of T = 20 periods while in the treatments with computerized opponents T = 10. The reason for this difference was that we expected that adjustment would take longer in the presence of a coordination problem. For the purpose of comparing post-shock nominal inertia across treatments it is crucial that the required adjustment, i. e. the difference between *actual* nominal prices in the final pre-shock period and the new post-shock equilibrium price is roughly the same. To ensure comparable adjustment requirements across treatments we gave players more time to reach the equilibrium in the treatments with a coordination problem.

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[10] The payoff functions of the two types were the same up to a parallel shift. Except for P_k^* and $\overline{P}_k^*$ all parameters of the payoff function specified in Appendix A are the same for both types.

In each decision period subjects had to choose an integer $P_i \in \{1,2, \ldots, 30\}$. In addition, they had to provide an expectation about $\overline{P}_{-i}$ which we denote by $\overline{P}_{-i}^{e}$. Finally, subjects indicated their confidence about their expectation $\overline{P}_{-i}^{e}$ by choosing an integer from 1 to 6 where 1 indicated that the subject is "not at all confident" while 6 indicated that he or she is "absolutely confident".[11] This measure of confidence can be interpreted as an indicator of subjects' perceived uncertainty about the other players' choices. Note that this uncertainty is an inevitable component of the coordination problem that subjects face in the condition with human opponents. At the end of each period each subject was informed about the actual realization of $\overline{P}_{-i}$ and the actual real payoff π_i on a so-called "outcome screen" (see Figure B2 in Appendix B). In addition, the outcome screen provided information about the subject's past choices of P_i, past realizations of $\overline{P}_{-i}$ and past real payoffs π_i.

Subjects received the payoff information in matrix form. Appendix C contains the payoff matrices of *x*- and *y*-types for all treatment conditions. The payoff matrix shows the real and the nominal payoff, respectively, for each feasible integer combination of (P_i, $\overline{P}_{-i}$). To inform subjects about the payoffs of the other type, each subject also received the payoff matrix of the other type. This information condition was common knowledge. The presentation of payoffs in the form of a matrix made it particularly easy to find the best reply for any given $\overline{P}_{-i}$: The subject just had to look for the highest real or nominal payoff in the column associated with $\overline{P}_{-i}$.[12] In fact, one of the first things most subjects did, after we distributed the instructions, was to mark the best replies in the payoff tables.

In the treatments with computerized opponents, subjects received the same instructions and payoff tables as in the treatments with human opponents. In addition, subjects were informed that the decisions of the other 3 players in the group would be made by pre-programmed computers. Subjects received an information sheet that informed them about the $\overline{P}_{-i}$-response of the three computers to each price choice $P_i \in \{1,2, \ldots, 30\}$. 50 percent of the human subjects in these conditions were endowed with the payoff function of an *x*-player, the other 50 percent had the payoff function of a *y*-player.

At the end of the final pre-shock period the nominal shock was implemented in the following way: Subjects were publicly informed that *x*- and *y*-types received new payoff tables.

[11] The detailed meaning attached to the numbers is: 1 = not at all confident; 2 = not much confidence; 3 = not quite confident; 4 = quite confident; 5 = very confident; 6 = absolutely confident.

[12] If a subject is uncertain about the true value of $\overline{P}_{-i}$ the calculation of the best reply requires, of course, to take into account the subjective distribution of $\overline{P}_{-i}$ and not only the expectation of $\overline{P}_{-i}$. However, for simplicity, in the following we will use the term "best reply" in the sense of a best reply to the expectation of $\overline{P}_{-i}$.

These tables are based on $M_1 = M_0/3$. Again each type received the payoff table for his own and the other type. Subjects kept the pre-shock tables and were encouraged to compare the pre- and post-shock tables. They were told that, except for payoff tables, everything else would remain unchanged. They were given enough time to study the new payoff tables and to choose P_i for the first post-shock period.[13] This procedure ensured that in the first post-shock period subjects faced an exogenous and fully anticipated negative nominal shock. At the beginning of this period it was also common knowledge that the experiment would last for another T periods.

Before we proceed to the experimental results, it needs to be emphasized that *in a given phase* the number of dominated price choices is identical across all treatments. It is, however, not identical between the pre- and the post-shock phase. Since the money supply is lower in the post-shock phase the number of dominated strategies is also lower in this phase. Note that the smaller number of dominated strategies in the post-shock phase is an inevitable result of the fact that the money supply is reduced *while the nominal strategy space and the nominal accounting unit is kept constant*.[14] Due to the differences in the number of dominated strategies a comparison of the adjustment speed across phases must take this difference into account. The higher number of dominated strategies in the pre-shock phase means, in particular, that the indirect effects of money illusion are likely to be smaller in this phase. This is so because, if a strategy is dominated, it is optimal to not play this strategy irrespective of the expectations about other players' behavior. Thus, expectations about other players' money illusion necessarily have less impact and, as a consequence, one would expect a quicker adjustment towards equilibrium in the pre-shock phase. Note also that the different number of dominated strategies across phases is not a problem for the main purpose of our research. We are not interested in comparing adjustment speed across phases but *across treatments in the post-shock phase.* For our purposes the crucial point is that in the post-shock phase the number of dominated strategies is identical across treatments because the only difference in the payoff tables concerns the framing of the payoffs.

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[13] Subjects were told that they had 10 minutes to study the new payoff tables and, in addition, 3 minutes to make a decision for the first post-shock period. Yet, almost all subjects made their decision well before the 13 minutes had elapsed. In the second post-shock period subjects were told that they should make a decision approximately within $2^{1/2}$ minutes, in the third post-shock period within 2 minutes, and so on, until the time limit reached 1 minute. However, most subjects were far from exhausting these time limits. If, occasionally, a subject used up the whole decision time the computer told her that she should now make a decision. Subjects could, however, violate the time limits without any sanction. The decreasing sequence of decision times was introduced because in the pilot experiments we noticed that subjects needed much less time after the first few periods.

[14] A change in the nominal price in the post-shock phase (i. e. at $M_0/3$) by one unit has the same real effects as a change in the nominal price by three units in the pre-shock phase (i. e. at M_0). This means that if a nominal price is strictly dominated in the post-shock phase there will, in general, be three nominal prices that are strictly dominated in the pre-shock phase.

While the framing of the payoffs is irrelevant from a purely game-theoretic viewpoint, it may well be relevant for subjects' expectations and behavior. If, for example, some subjects apply the rule of thumb to take (variations in) the nominal payoff as a proxy for (variations in) the real payoff, adjustment to equilibrium in the NH may be slower than in the RH. The reason is that after a negative shock adjustment requires a decrease in nominal prices. By definition, a decrease in nominal prices is associated with a decrease in nominal payoff numbers in the NH (see, e. g., payoff table C3b in appendix C). Therefore, subjects who apply the above rule of thumb mistakenly believe that real payoffs decrease with lower nominal prices. Thus, they prefer to stay at higher nominal prices, which may have a direct adjustment reducing effect. Moreover, if some subjects believe that others apply this rule of thumb, they have an incentive to slow down adjustment, too. In the RH, however, this rule of thumb cannot become effective because payoffs are represented in real terms. In the RH, it is, therefore, completely transparent that general price reductions are *not* associated with lower real payoffs (see, e.g., payoff table C4b in appendix C).

4. Results

In total, 130 subjects participated in the experiments described in Table 1.[15] 22 subjects participated in the real treatment with computerized opponents (RC) and 24 subjects in the nominal treatment with computerized opponents (NC). 11 groups of four human subjects participated in the nominal treatment with human opponents (NH) and 10 groups in the real treatment with human opponents (RH). Subjects were undergraduate students from different disciplines at the University of Zürich, Switzerland. They were paid a show-up fee of CHF 15 ($12) and their total earnings from the experiment were on average CHF 35 ($28) (including the show-up fee). On average, an experimental session lasted 90 minutes.

4.1. Nominal price adjustment as an individual optimization problem

In this section we address the question whether individual-level money illusion and other individual-level irrationality contribute to nominal inertia. Therefore, our discussion is constrained to the RC and the NC where adjustment to the post-shock equilibrium is a purely individual optimization problem. Our first main result is that in the RC *all* subjects instantaneously adjust to the new post-shock equilibrium, i. e., nominal inertia is completely

[15] In follow-up experiments with a positive money shock, described in detail in section five, another 96 subjects participated.

absent. Support for this claim is provided by column 1 of Table 3 and by Figure 1. Both the table and the figure show the pre- and post-shock path of the average price of all human subjects in the RC. What is remarkable here is that, except for a few periods, the average price is *exactly* equal to the equilibrium price of $\overline{P}_0^* = 18$ in the pre- and $\overline{P}_1^* = 6$ in the post-shock period. Moreover, it is not just the average that coincides with equilibrium. In most periods literally *all subjects* play the equilibrium. This result contrasts with what we observe in the nominal frame. In the NC there is a small amount of nominal inertia since some subjects do not fully adjust prices to the new post-shock equilibrium. This claim is supported by Table 3 (column 2) and Figure 1. Both the table and the figure show that the evolution of average prices is, in general, more volatile relative to the RC. This suggests that at least some subjects in the NC have problems in finding the optimal solution to their maximization problem. Moreover, while in the RC all subjects instantaneously adjust their prices *fully* to the post-shock equilibrium, in the NC only 80 percent of the subjects do so. The rest of the subjects choose prices above the equilibrium so that in the first post-shock period the average price is by 2.0 units too high. Throughout the whole post-shock phase the NC most of the time is close but never exactly in equilibrium which contrasts again with the RC where after the second post-shock period all subjects are exactly in equilibrium most of the time.

Insert Figure 1 here

Insert Table 3 here

These differences in post-shock adjustment also give rise to differences in the real income losses across RC and NC. Nominal inertia in the NC causes small but non-negligible real income losses in the post-shock phase. In contrast, in the RC there are no or only extremely small real incomes losses in the post-shock phase. To verify this claim we calculate by how much actual real income of player *i*, π_i, falls short of real income in equilibrium π^*. For this purpose we have computed $\varepsilon_{it} \equiv (\pi^* - \pi_{it})/\pi^*$ for all players in each period *t*. ε_{it} is a measure of the income loss relative to the equilibrium payoff as a percentage of the equilibrium payoff. Since the equilibrium is efficient it is also a measure of the efficiency loss. Columns 5 and 6 of Table 3 present the evolution of the average value of ε_{it} over all players in the RC and in the NC. The two columns indicate that after the shock the average efficiency loss is most of the time zero in the RC and always lower than in the NC.

Taken together the results of the treatments with computerized opponents indicate that there is a small amount of money illusion at the individual level but beyond that there is no individual irrationality. The small amount of individual-level money illusion is suggested by the small price differences between the NC and the RC after the shock. The absence of other forms of individual irrationality is suggested by the perfect adjustment to the shock and the generally high incidence of equilibrium play in the RC.

4.2. Nominal price adjustment as a coordination problem

The fact that in the RC the adjustment to the post-shock equilibrium is perfect makes the interpretation of the deviation of prices from the post-shock equilibrium in the RH particularly easy. It means that the whole deviation is due to the fact that subjects in the RH face a coordination problem. The major facts about price adjustment in the RH are displayed in Table 3 and Figure 1. Column 3 of Table 3 shows that in the first post-shock period average prices in the RH are 3.1 units above the average equilibrium price of $\overline{P}_1^* = 6$. This deviation quickly decreases to 1.4 units in period three and after period four the deviation is never larger than one unit. This pattern of average behavior is not an artifact of aggregation but is also revealed at the level of individual choices. In the final pre-shock period 93 percent of the subjects in the RH play *exactly* their equilibrium strategies. In the first post-shock period only 35 percent of the subjects play the new equilibrium and 23 percent of the subjects are only one or two price units above the equilibrium. The other 42 percent are more than two units above the equilibrium. Yet, after only three periods the distribution of individual price choices has moved much closer to the equilibrium. In period four 45 percent of all subjects play exactly the equilibrium, 48 percent are one or two units above and only 7 percent are more than two units above the equilibrium. This post-shock evolution of prices indicates that the coordination problem initially causes considerable nominal inertia but that after a few periods this effect is rather small because prices are again close to the equilibrium.

Our description of the pattern of nominal inertia in the RH is also supported by formal statistical tests. To check how long average group prices in the RH and the NH deviate significantly from the equilibrium we ran the following regression for the post-shock phase:

$$(3) \qquad \overline{P}_{it} - \overline{P}_1^* = \sum_{t=1}^{19} \alpha_t d_t + \sum_{t=1}^{20} \beta_t (1 - d_t)$$

where $\overline{P}_{it}$ denotes the average price of group i in period t. $d_t = 1$ if the price observation in period t comes from the RH. The coefficients α_t measure the deviation from equilibrium in the RH while the coefficients β_t measure the deviation in the NH.[16] The results of regression (3) are summarized in Table 4. The table shows that, at the five percent level, average prices in the RH deviate significantly from the equilibrium for two periods. Yet, from period three onwards, the hypothesis that average prices are in equilibrium can no longer be rejected.

Insert Table 4 here

To what extent is nominal inertia in the RH associated with real income losses? Column 7 of Table 3 indicates that in the first post-shock period the real income loss resulting from disequilibrium is quite considerable (52 percent). Yet, due to the relatively quick adjustment of nominal prices after this period the real income loss declines substantially and after the fifth post-shock period it is – except for period ten – always below ten percent. In the final periods the real income loss is always rather small which reflects the high incidence of equilibrium play.

The key difference between the RC and the RH is the presence of a coordination problem in the RH. If subjects perceive coordination as a difficult problem this should be reflected in subjects' confidence in $\overline{P}_{-i}^{e}$. In the first few pre-shock periods subjects' average confidence is at a level of 4 which means that they are, on average "quite confident". The high frequency of equilibrium play before the shock then causes a general increase in the confidence level. In the last five pre-shock periods subjects exhibit, on average, a confidence level between 5 and 5.5. This means that most subjects are "very confident" (= level 5) or even "absolutely confident" (= level 6) that they have correct expectations. The anticipated negative money shock causes, however, a considerable decrease in subjects' confidence. In the first post-shock period subjects on average confidence are "not quite confident" (level 3) and "quite confident" (level 4) that their expectations will be correct. It takes about eight periods until pre-shock confidence levels are again established. This indicates that the money shock indeed causes a coordination problem for the subjects.

Taken together, the evidence suggests that the introduction of a coordination problem in the real treatment causes initially a non-negligible amount of nominal inertia that is associated with considerable real effects. Yet, nominal inertia vanishes relatively quickly so that already after a few periods prices are quite close to the equilibrium.

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[16] To prevent linear dependence among the set of regressors we included no dummy variable for period 20 of the RH. We also ran a regression where we added a constant to (3) so that all deviations are measured relative to the small deviation in period 20 of the RH. The results of this regression are very similar.

4.3. Coordination in the presence of money illusion

Nominal inertia in the RH has nothing to do with money illusion but is caused by the problem to coordinate expectations and actions on the new equilibrium. From the comparison between the RC and the NC we already know that individual-level money illusion has a small positive effect on nominal inertia. In the NH a small amount of individual-level money illusion may, however, cause important indirect effects. These indirect effects can arise because the presence of individual-level money illusion is likely to affect subjects' expectations, which in turn affect their behavior. If money illusion indeed causes such indirect effects we should observe that the introduction of the nominal frame has a larger effect in the setting with human players than in the setting with computerized players. We should, in addition, also observe that in the setting with human players the nominal frame gives rise to an increase in the stickiness of subjects' price expectations.

Figure 1 and Table 3 (columns 3 and 4) provide the relevant information regarding the impact of the nominal frame. They show that nominal prices are indeed much stickier in the NH compared to the RH. In the final pre-shock period the overwhelming majority of the subjects play *exactly* the equilibrium both in the RH (93 percent) and the NH (80 percent). Therefore, average prices are very close to the pre-shock equilibrium $\overline{P}_0^* = 18$. In the first post-shock period, however, only 11.5 percent of all subjects in the NH play exactly the equilibrium and 73 percent of the subjects are *three or more* price units above the equilibrium. In contrast, in the RH 35 percent play exactly the equilibrium and, in addition, 23 percent are only *two or less* price units above the new equilibrium. These treatment differences in individual adjustment behavior also give rise to large differences in the average price level. In the first post-shock period the average price in the NH is 7.1 units above the equilibrium while in the RH the deviation is only 3.1 units (see Table 3). It takes eight periods in the NH until the deviation of average prices from equilibrium decreases to 3.1 units. These large differences in price adjustment speed are also confirmed by formal statistical tests. Table 4 reveals that in the NH the hypothesis of equilibrium play can be rejected at the five percent level for the *first twelve* post-shock periods while in the RH it can only be rejected for two periods.

To what extent is nominal inertia in the NH associated with real income losses? Column 8 of Table 3 indicates that shortly before the shock subjects in the NH achieve almost full efficiency. The monetary shock leads, however, to a substantial real income loss. In the first period after the shock the average income loss is 65 percent and during the first ten post-shock periods the loss is never below 9.5 percent. Note also that throughout the whole post-shock period the income loss is in general much higher in the NH than in the RH which is a consequence of the much stickier prices in the NH. For example, in the first ten post-shock periods of the NH the aggregate real income loss is roughly twice as large as the loss in the RH.[17] Thus, the evidence clearly indicates two results: (i) In the setting with human players the introduction of a nominal frame has large and long-lasting effects on price stickiness. (ii) This increase in price stickiness is associated with a considerable increase in the real income loss caused by the anticipated money shock.

From Figure 1 and Table 3 we can also infer that the nominal frame causes much stickier prices when money illusion can have indirect effects, i. e., in the setting with human players. Throughout the first ten post-shock periods the adjustment difference in average prices between the NH and the RH is between 2 and 13 times larger than the adjustment difference between the NC and the RC. In the second post-shock period, e. g., the adjustment difference between the NH and the RH is 12.9 – 7.7 = 5.2 price units while the difference between the NC and the RC is only 7.4 – 7.0 = 0.4 units. Hence, in this period the impact of the nominal frame is 13 times larger in the setting with human players compared to the setting with computerized players. In the tenth post-shock period the adjustment difference is still 1.8 units in the setting with human players and only 0.5 units in the setting with computerized players. Thus, the implementation of the nominal frame has a much larger impact in the setting where money illusion can also have indirect effects.

If money illusion has indirect effects we should also observe that expectations are stickier in the NH compared to the RH. Figure 2 shows the evolution of the average price expectations over time in both treatments. The figure shows that in the last few pre-shock periods expectations are in equilibrium in both treatments. In the post-shock phase there are, however, striking differences. While expectations are very sticky in the NH they are far less sticky in the RH. Thus, there can be little doubt that the nominal frame causes a large increase in the stickiness of price expectations. The next question then is, to what extent this difference in expectations causes differences in subjects' price choices. Or put differently, to what extent did subjects play a best reply to their expectations. The vast majority of subjects in both treatments indeed played best replies to $\bar{P}_{-i}^{e}$. During the first ten post-shock periods, e.g., 84 percent of the subjects in the RH choose *exactly* the payoff-maximizing price in response to $\bar{P}_{-i}^{e}$ and the rest of the subjects chooses prices that were very close to the best reply. In the NH there are slightly fewer subjects (80 percent) who chose exact best replies during the first ten post-shock periods. Yet, as in the RH the deviations from the exact best reply where in general very small. The fact that most

[17] To be precise: In total, groups in the NH lose 26% of the potential payoff in the first ten post-shock periods. In the RH, the respective losses are slightly less than 14 percent.

subjects responded to $\bar{P}_{-i}^{e}$ with a payoff-maximizing price choice suggests that the greater stickiness of the expectations in the NH also caused a greater stickiness of actual prices in the NH.

5. Nominal Inertia after a positive money shock

5.1. The relevance of a positive money shock

Our results so far indicate that the direct effects of individual-level money illusion are relatively small. The introduction of the nominal frame in the setting with computerized players leads only to a small increase in nominal inertia. Nominal inertia is much more pronounced, however, when money illusion can also affect players' expectations and can, thus, also have indirect effects. In the NH subjects' expectations are much stickier and, as a consequence, prices are much stickier. This raises the question of why expectations are so sticky in the NH compared to the RH. We believe that the answer to this question can be found in the existence of subjects who take nominal payoffs as a proxy for real payoffs. Subjects who apply this rule of thumb mistakenly believe that if all players choose relatively high prices, all will reap high real payoffs because they all reap high nominal payoffs. They mistakenly believe that there are real gains from jointly setting high prices. Such subjects will, therefore, be reluctant to cut their nominal prices after the negative money shock in the NH. Moreover, if the presence of subjects who are reluctant to cut prices is anticipated by other subjects, others will be induced to cut their price insufficiently, also.

It is important to note that the above rule of thumb cannot become effective in the RH. In the RH the numbers in the payoff tables represent real payoffs which makes it completely transparent that at high nominal prices real payoffs are *not* generally higher. This means that the presence of subjects who take nominal payoffs as a proxy for real payoffs causes no reluctance to cut nominal prices after the negative shock in the RH. These differences between the NH and the RH in the reluctance to cut nominal prices also provide a rationale for the much stickier price expectations in the NH.

Yet, if the above explanation for the stickier expectations in the NH is correct, we should also observe that after a *positive* money shock prices and expectations adjust more quickly to the equilibrium than after a negative shock. This is so because after a positive shock adjustment towards equilibrium means adjustment towards higher prices and, hence, higher nominal payoffs. Note, however, that while we should observe a quicker adjustment to equilibrium after a positive shock in the NH, the adjustment speed in the RH should not differ across positive and negative shocks. The reason is again that the rule of thumb cannot become operative in the RH.

To test these implications of our explanation for the much stickier expectations in the NH we conducted additional experiments with a positive money shock. 48 subjects (12 groups) participated in the RH and another 48 subjects (12 groups) participated in the NH with the positive money shock. The easiest way to implement a positive shock would be a reversal in the sequence of the money supply in our previous design. Unfortunately, this approach is not reasonable because the number of strictly dominated strategies is much larger in the pre-shock phase than in the post-shock phase. Therefore, the indirect effects of money illusion can play a much smaller role in the pre-shock phase. The fact that prices in the NH adjust much more quickly to the equilibrium in the pre-shock phase than in the post-shock phase (see Figure 1) is consistent with this argument. Therefore, if we just reversed the sequence of the money supply, we would probably observe that adjustment is indeed quicker after the positive shock. Yet, this increase in the adjustment speed would not count as evidence for our explanation of the stickier expectations in the NH.

What is, therefore, needed, is an experimental design in which the number of dominated strategies is roughly the same after the negative *and* after the positive shock. Our parameterization of the design with the positive shock serves this purpose. Except for three aspects, all experimental details in the positive-shock design are identical to the negative-shock design. In particular, all six features of the payoff functions, as described in section 3.2., are also present in the positive-shock design. The differences are the following: (i) We did not implement computerized players in the positive-shock design because the main purpose of this design was to observe whether the expectations of human players and, hence, also prices adjust more quickly to the equilibrium after a positive shock compared to the negative shock. (ii) In the positive-shock design the pre- and the post-shock phase consisted of 15 instead of 20 periods. This shortening of the phases was implemented because in the negative-shock design reliable equilibration was already achieved after 10-15 periods. (iii) To achieve roughly the same number of dominated strategies in the post-shock phase, equilibrium prices for *x*- and *y*-types in the positive-shock design were as follows: The pre-shock equilibrium price for *x*-types (*y*-types) is $P_x^* = 11$ ($P_y^* = 14$) and the post-shock equilibrium price is $P_x^* = 22$ ($P_y^* = 28$). As a consequence, the average pre-shock equilibrium price in a group is $\overline{P}_0^* = 12.5$ while in the post-shock equilibrium it is $\overline{P}_1^* = 25$. Thus, the difference in average prices between pre- and post-shock equilibrium is 12.5 in the positive-shock design while it is 12 in the negative shock design. This slightly bigger adjustment requirement in the positive shock design is, however, not a problem. If adjustment to equilibrium in the NH is faster after the positive shock, this is even more remarkable because it occurs despite the slightly bigger adjustment requirement in the positive shock design.

5.2. Prices and expectations after the positive nominal shock

Table 5 shows the evolution of pre- and post-shock average prices in the RH and the NH. In the NH pre-shock prices converge from above to the equilibrium $\overline{P}_0^* = 12.5$ and as in the negative shock design the vast majority of individuals plays exactly the equilibrium in the final pre-shock period. Then, in the first post-shock period prices make a big jump upwards to 20.5 and already in period four after the shock average prices are almost exactly at the new equilibrium of $\overline{P}_1^* = 25$. From that period onwards prices remain very close to the equilibrium. This contrasts sharply with the adjustment process after the negative shock where, *throughout the whole post-shock period*, average prices *never* came so close to the equilibrium. This difference in NH-adjustment paths after the negative and the positive shock is depicted in Figure 3. The heavy line in Figure 3 shows the difference in the post-shock deviations of average prices from the equilibrium between the positive and the negative shock.[18] The graph reveals to what extent in the NH the adjustment gap, i.e., the deviation of average prices from the equilibrium, is larger after the negative shock than after the positive shock. It shows that the deviation from equilibrium is substantially larger after the negative shock. Between period two and seven, e. g., the adjustment gap is four or more units bigger after the negative shock. Even in period ten the adjustment gap is still almost 3 units bigger.

Insert Table 5 here

Insert Figure 3 here

The impression conveyed by Figure 3 is confirmed by a more formal statistical analysis. If we perform regression (3) with the data after the *positive* shock, it turns out that in the NH the hypothesis of equilibrium play can only be rejected for the first *three* periods (at the five percent level). Remember that after the *negative* shock group prices were significantly above the equilibrium for *twelve* periods. Thus, the evidence unambiguously indicates that adjustment in the NH is much quicker after the positive shock, which is consistent with our hypothesis that there is less reluctance against adjustment after the positive shock.

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[18] Let $(\overline{P}_{1+}^* - \overline{P}_+)$ be the deviation of average prices from equilibrium in the positive-shock design and $(\overline{P}_- - \overline{P}_{1-}^*)$ the deviation in the negative-shock design. Then the heavy line in Figure 3 measures $(\overline{P}_- - \overline{P}_{1-}^*) - (\overline{P}_{1+}^* - \overline{P}_+)$ for the first 15 periods of the post-shock phase in the NH.

If there is indeed less reluctance against adjustment after the positive shock, at least some subjects should anticipate this. Therefore we should also observe that expectations are less sticky after the positive shock. The dashed heavy line in Figure 3 shows the differences in the average expectations about $\overline{P}_{-i}$ across shocks in the NH. Since this graph is constructed analogously to the previous graph it shows to what extent the adjustment gap in the expectations, i.e., the deviation of average expectations from equilibrium, is larger after the negative shock than after the positive one. The graph indicates that the adjustment gap in the expectations is much larger after the negative shock for many time periods. Interestingly, the graph is hump-shaped, i.e., the relative stickiness of expectations after the negative shock increases in the first few periods. This is due to the fact that between period two and five after the positive shock expectations rapidly converge to equilibrium while they are very sticky after the negative shock.

Finally, since the rule of thumb of taking nominal payoffs as a proxy for real payoffs cannot be operative in the RH, we should observe no differences in price adjustment in the RH across negative and positive shocks. Table 5 shows the evolution of average prices in the RH after the positive shock and Figure 3 illustrates the differences in average prices and average expectations across shocks. Table 5 indicates that in the pre-shock phase of the RH the average price is very close to the equilibrium $\overline{P}_0^* = 12.5$ already after three periods. Immediately after the positive shock there is a big upward jump in prices to 22.5, only 2.5 units below the new equilibrium. Already in the third post-shock period the average price is again very close to the equilibrium. This indicates that price adjustment after the positive shock is rather quick in the RH – similar to the pattern after the negative shock. This similarity is also displayed in Figure 3 and by formal statistical analysis. The thin line in Figure 3 shows that price adjustment in the RH is only slightly faster after the positive shock. If we perform regression (3) with the post-shock data from the positive-shock design we get the following results: The hypothesis that average prices in the RH are in equilibrium can only be rejected for the first two periods (at the five percent level). Note that this is exactly the same number of out-of-equilibrium periods as after the negative shock. This suggests that the differences in the price adjustment across shocks in the RH are indeed negligible. The dashed thin line in Figure 3 indicates that we can basically make a similar conclusion with regard to the differences in the adjustment of expectations across shocks. While in the NH there are large differences in the stickiness of expectations across shocks, in the RH the differences in expectations are rather small.

Thus all major regularities are consistent with our hypothesis that there are beliefs that some subjects take nominal payoffs as a proxy for real payoffs. Nonetheless, it would be reassuring if subjects themselves expressed such a belief. To check to what extent subjects indeed believed this they could indicate their degree of agreement with the following statement after the experiment: "I believed that the other subjects would interpret high nominal payoffs as an indicator for high real payoffs". Participants could indicate whether they weakly (dis)agreed, whether they strongly (dis)agreed or whether they totally (dis)agreed with this statement. 30 percent of the subjects in the NH agreed either "strongly" or "totally" and further 25 percent indicated a weak agreement. In our view, this can be taken as direct evidence for the presence of a belief that other subjects are affected by money illusion. In any case, these answers nicely fit with our explanation for the large amount of nominal inertia observed in the NH after the negative shock.

6. Summary and concluding remarks

Most economic transactions are represented in nominal terms. Therefore, it seems likely that people often perceive and think about economic problems in nominal terms which may induce money illusion. However, for several decades money illusion has been considered as largely irrelevant for the nominal inertia of aggregate price levels. Instead, most economists have focused on informational frictions, costs of price adjustment and staggered contracts. This paper shows, however, that even in the absence of these factors a fully anticipated negative nominal shock can cause long-lasting nominal inertia that is associated with large real income losses during the adjustment phase. Our results indicate that a large part of this nominal inertia can be attributed to the direct and indirect effects of money illusion. The experiments in the setting with computerized opponents show that the direct effects of money illusion in the form of individual optimization mistakes are not very frequent: The introduction of the nominal frame in the setting with computerized opponents causes only a small amount of nominal inertia. However, the combined direct and indirect effects of money illusion generate a very large increase in nominal inertia. This is indicated by the fact that the introduction of the nominal frame in the setting with human opponents causes a huge increase in the sluggishness of prices. Instead of two it takes twelve periods until average prices reach the post-shock equilibrium in this setting.

The major cause for nominal inertia after the negative shock is that subjects' expectations are very sticky. In our view this stickiness of price expectations is related to the nature of money illusion in our experiment, i.e., to the belief that there are subjects who take nominal payoffs as a proxy for real payoffs. This conjecture is supported by direct questionnaire evidence and by the results of further experiments with a fully anticipated *positive* nominal shock. It turns out that price sluggishness is much smaller after a positive nominal shock than after the negative shock.

This result is also interesting insofar as there is field evidence indicating that positive and negative money shocks have asymmetric effects. While negative shocks have an output reducing effect, positive shocks do not seem to affect output (Cover 1992, De Long and Summers 1988). The asymmetric effects of money illusion on price sluggishness can be considered as a potential micro-foundation for this result.

Finally, another interesting result of our experiments is that we isolate – in addition to money illusion - a further source of nominal inertia that has been largely neglected by economists. This source of nominal inertia is related to the fact that in a strategic situation subjects do not merely face an individual optimization problem but that they also have to predict other agents' behavior. After any shock, the new equilibrium can only be achieved if subjects have equilibrium expectations, i.e., if they have coordinated expectations. The comparison of adjustment paths in the real treatments with computerized and with human opponents shows that after a fully anticipated nominal shock, it cannot be taken for granted that subjects instantaneously succeed in solving this coordination problem. They will, in general, go through a period of disequilibrium that is associated with nominal inertia. Note, however, that the coordination problem alone causes substantially less nominal inertia than money illusion. It also does not cause asymmetric effects: In the real treatment with human opponents the extent of nominal inertia is very similar after the positive and the negative nominal shock.

In our view the results of our experiments suggest that money illusion should be considered as a serious candidate in the explanation of nominal inertia and the real effects of nominal shocks. Paraphrasing Abraham Lincoln[19], one can say that, to render money illusion behaviorally relevant, it is not necessary to fool all the people some of the time, not to speak of fooling all the people all the time. All that is needed is the presence of a small amount of money illusion at the individual-level – a presupposition that seems quite plausible.

[19] In his speech on 8 Sept. 1858 A. Lincoln said: "You can fool all the people some of the time, and some of the people all the time, but you cannot fool all the people all the time."

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Appendices

Appendix A – Functional specification of payoffs

As explained in detail in section 3.2 our specification of subjects' payoff functions served several purposes. A particularly important purpose was to rule out that the adjustment to the equilibrium is confounded by subjects' attempts to achieve real payoff gains by non-equilibrium behavior. Note that this purpose rules out payoff functions that are derived from oligopolistic or monopolistic competition among firms. We achieved our aim by the payoff functions below because they imply that the equilibrium is the only efficient point in payoff space.

Note also that the equilibrium price for each individual i is a best reply not only to the equilibrium expectation for $\overline{P}_{-i}$ but also to out-of-equilibrium expectations that are *close* to the equilibrium expectation (see also payoff tables in Appendix C and D below). This feature of the payoff functions speeds up adjustment to equilibrium because it ensures that the equilibrium price choice is also a best reply for expectations that are not exactly in equilibrium. The arctan-function in the denominator reflects this property of the payoff functions.

The real payoff for agent i of type $k = x, y$ is given by:

Appendix B Instructions

The original instructions were in German. This section reprints a translation of the instructions used in the Nominal treatment with human opponents for agents of type *y*.

General instructions for participants

You are participating in a scientific experiment which is funded by the Swiss National Science Foundation. The purpose of this experiment is to analyze decision making in experimental markets. If you read instructions carefully and take appropriate decisions, you may earn a considerable amount of money. At the end of the experiment all the money you earned will be immediately paid out in cash.

Each participant is paid SFr.15.- for showing up. During the experiment your income will not be calculated in Swiss Francs but in points. The total amount of points you collected during the experiment will be converted into Swiss Francs, by applying the following exchange rate:

10 Points = 15 centimes.

Here is a brief description of the experiment. A more detailed description is given below. All participants are in the role of firms, selling some product. In this experiment, there are two types of firms: firms of type *x* and firms of type *y*. Each firm has to choose a selling price in every period. The income you earn depends on the price you choose and on the prices all other firms choose.

During the experiment you are **not allowed to communicate with any other participant. If you have any questions, the experimenters will be glad to answer them.** If you do not follow these instructions you will be excluded from the experiment and deprived of all payments.

The following pages describe the procedures of the experiment in detail.

Detailed information for firms of type *y*

This experiment lasts 20 periods plus one trial period. You are not paid for the trial period. You should nevertheless take the trial period seriously since you may gain experience in this period. This experience helps you to take decisions in the other periods which are paid out. You are in the role of a firm, just as all other participants in this experiment. All participants are in **groups of 4**, i.e. every participant is in a group with three other firms. There are two firms of type *x* and two firms of type *y* in every group.

You are a firm of type *y*

Consequently, there are two other firms of type *x* and one more firm of type *y* in your group. No participant knows which persons are in his or her group. Yet, everybody knows that the group composition remains constant throughout the experiment. The decisions taken by other groups are irrelevant for your group.

In every period all firms simultaneously decide which selling price they set for the current period. Every firm has to choose an integer price from the interval 1 ≤ selling price ≤ 30.

How much you earn depends on the price you choose and on the average price of all other firms in your group. Independent of the type, the average price for every firm is calculated by the following formula:

Average price = (Sum of selling prices of other 3 firms) / 3

Consequently, the average price will be in the interval 1 ≤ selling price ≤ 30.

The average price is rounded to the next integer number.

How to read the income table for a firm of type *y*

The **green** income table shows your nominal income in points if you choose a specific price and a specific average price results in this period (see separate table). Your income at the end of the experiment is not based on nominal point income, but on real point income. The following relation between the two holds:

Real income = Nominal income / Average price of other firms

This formula holds for all firms. The real point income that will be paid out is rounded in every period to the next integer number.

Example:
Suppose, you choose a price of 2 and the actual average price is 4. In this case your nominal point income is 29 points. Your (rounded) real income is 7 points (= 29 / 4).

When you decide which price to choose, you do not yet know which average price will actually result in this period. The green income table can consequently help you to calculate your real point income given your **expectation** on the average price of other firms.

Example:
Given an expectation on the average price you can read off the green table the payoff you get when choosing different selling prices. For example, if you expect an average price of 30 and choose a price of 17, your expected nominal income is 141 points, your expected real income is 5 points (= 141 / 30). If you choose a price of 10 at this expected price, your expected nominal income is 86 points, your expected real income 3 points (= 86 / 30).

Please note that you are in a group with one firm of type *y* and two firms of type *x*. To determine the income of the other firm of type *y*, you have to use the green table. To determine the income of the other two firms of type *x*, you have to use the blue income table. This table also shows nominal income in points. The same formula above is used to calculate real payoffs for firms of type *x*.

What the screens show

On both screens described below the current period is indicated in the upper left corner, and the upper right corner displays remaining time in seconds to decide or to view the screen.

The upper half of the **input screen** (see figure on next page) has three cells, where you can enter data into the computer.

Price decision: Enter an integer number between 1 and 30 into the first cell. You can activate this cell (as well as the other cells) by clicking into the cell with your mouse. If you want to revise your decision, you can erase the number by hitting the backspace key.

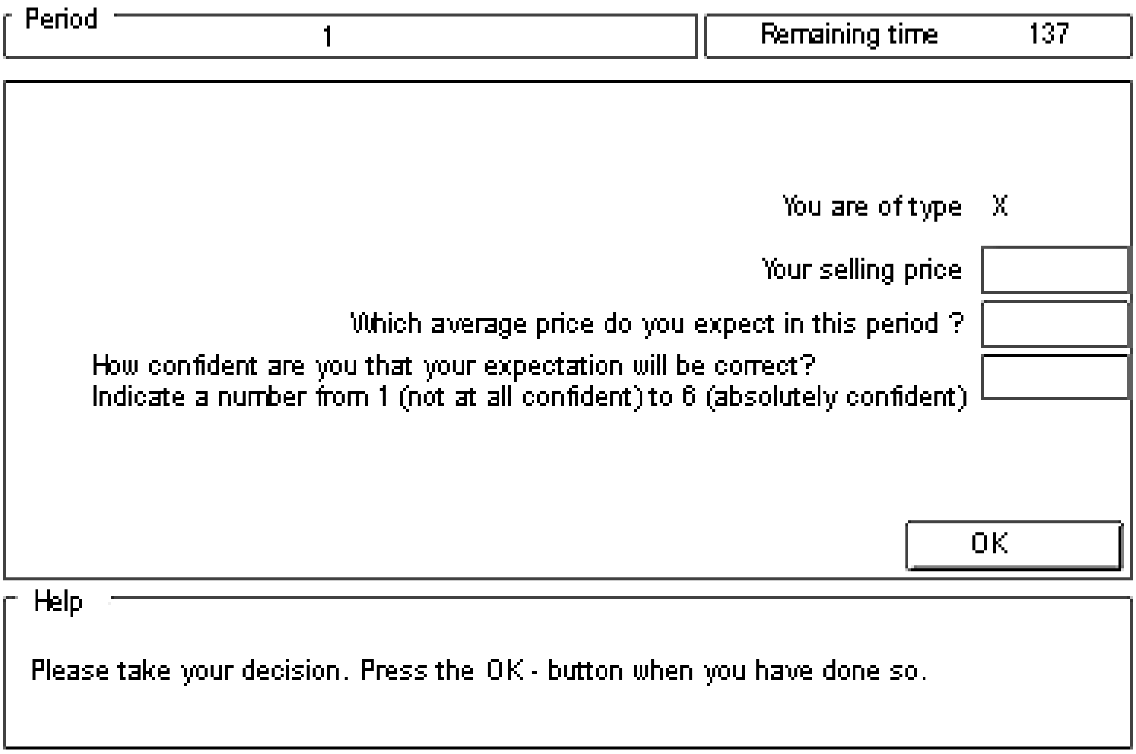
Expected average price: Enter an integer number between 1 and 30 into the second cell. This input does not affect your income and will not be known to other firms. Your payoff will be determined by the actual average price of this period. Please try to indicate an expectation that is as exact as possible since this is going to help you to take your own price decision.

Confidence: Enter an integer number from 1 to 6 to indicate how confident you are that the average price you expect (= number in the second cell) will actually result.

The numbers stand for:
1 = I am not at all confident that my expectation will be correct
2 = I have not much confidence that my expectation will be correct
3 = I am not quite confident that my expectation will be correct
4 = I am quite confident that my expectation will be correct
5 = I am very confident that my expectation will be correct
6 = I am absolutely confident that my expectation will be correct

When you finished entering the numbers into the respective cells, press the **OK-button**. Once you have pressed the button, you cannot revise your decision any more for this period.

Figure B1: Input screen

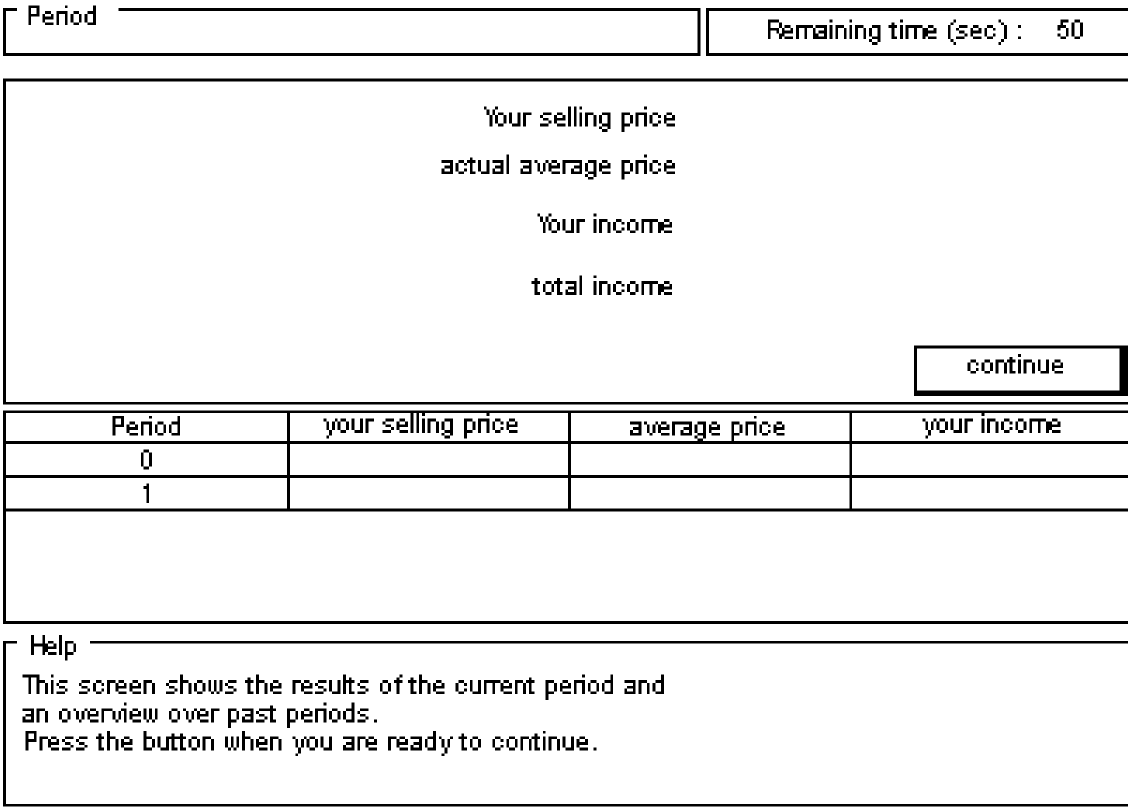


As soon as all firms have decided on their prices, the outcomes of this period will be shown in the outcome-screen.

The upper part of this screen shows the outcomes of the current period. This screen shows your decision of the current period, the average price, your real income of this period, and your total real payoff.

The lower part of this screen displays the outcomes of past periods.

Figure B2: Outcome screen



Overview: What you have to do in every period.

In every period every firm has to choose a price. Every integer price from 1 to 30 can be chosen ($1 \leq$ selling price ≤ 30)

- Enter your price decision into the first cell of the input screen.
- Enter into the second cell the average you expect for this period
  ($1 \leq$ selling price ≤ 30)
- Enter your confidence in your price expectation into the third cell (numbers **1 to 6**).

When you have completed the three cells, press the OK-Button. The remaining time to take your decisions is shown in the upper right corner of the screen.

When all participants have taken their decisions, or when the time has elapsed, all participants are shown the outcome screen. This screen shows your decisions, actual average prices and your real payoff in points for the current and the past periods.

To take your decisions the following aids are at your disposition:

Green **income table**: Helps you to estimate your expected nominal point income (You are a firm of type *y*). Your payoff is determined by your real income in points.

You can calculate your real income from the nominal income (= numbers shown in the income table) by applying the following formula:

Real income = Nominal income / Average price of other firms

Blue **income table**: Helps to estimate the nominal point income of the firms of type *x* in your group. The payoff of these firms are also determined by their real point income. To calculate the real income of firms of type *x*, you also apply the formula above.

Outcome screen: Displays your selling price, the actual average price and your real income for the present and the past periods.

Do you have any questions?

Control questions

You have to answer all of the following questions. If you do not answer a question, you will be excluded from the experiment and all payments. Wrong answers do not have any consequences. If you have any questions, please ask us.

1. Please indicate an expectation for the average price of other firms from 1 to 30.
   Expected average price ....

2. Please indicate a selling price from 1 to 30.
   Selling price ....

3) What is your expected nominal income in points at the prices you indicated in 1) and 2)?
   Your nominal income ....

4. What is your expected real income in points at the prices you indicated in 1) and 2)?
   Your real income ....

5. Suppose you choose a price of 1. The other firm of type *y* chooses a price of 30. The first firm of type *x* chooses a price of 7 and the second firm of type *x* chooses a price of 23.

a) What is your average price at the (fictitious) prices? ....
   What is your nominal income? ....
   What is your real income? ....

b) What is the average price of the other firm of type *y*? ....
   What is the nominal income of this firm? ....
   What is the real income of this firm? ....

c) What is the average price of the first firm of type *x*? ....

What is the nominal income of this firm? ....
What is the real income of this firm? ....

d) What is the average price of the second firm of type *x*? ....
What is the nominal income of this firm? ....
What is the real income of this firm? ....

Appendix C Payoff Tables for treatments with negative shock

Payoff table C1a: Nominal, pre-shock, type *x*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	18	40	68	102	143	191	243	298	351	397	433	455	464	462	453	439	423	410	403	407	424	441	442	429	409	385	360	336	314	293
2	16	35	60	91	128	172	222	278	335	390	437	473	495	503	500	490	476	463	456	461	480	499	500	486	462	434	405	377	351	326
3	14	31	53	80	113	153	200	254	312	372	429	478	514	535	543	540	530	520	514	520	542	563	565	549	523	491	458	425	394	365
4	12	28	47	71	100	136	178	228	285	346	409	468	518	554	576	585	583	577	574	583	608	632	636	620	591	556	518	480	444	410
5	11	24	42	63	88	120	158	203	256	316	380	445	506	558	596	619	629	632	634	647	675	702	709	695	666	628	586	543	501	462
6	10	22	37	56	78	106	140	180	229	284	347	413	481	544	597	637	663	677	689	707	738	769	781	772	745	707	662	614	567	522
7	9	20	33	49	69	94	123	159	202	253	312	377	446	516	581	636	679	708	731	757	792	826	845	844	825	790	745	694	641	590
8	8	18	30	44	62	83	109	141	179	224	278	339	406	478	550	617	674	720	756	789	827	865	893	905	898	872	831	780	724	668
9	7	16	27	40	55	74	97	125	158	198	246	301	365	435	508	582	650	709	758	800	840	880	918	946	956	945	915	869	814	754
10	7	14	24	36	49	66	86	111	140	175	217	267	325	390	462	536	610	679	738	786	827	868	915	960	991	1002	990	956	906	847
11	6	13	22	32	45	59	77	99	124	155	192	236	287	347	414	486	561	633	698	751	792	832	885	945	998	1034	1046	1032	996	942
12	6	12	20	29	40	53	69	88	111	138	170	209	254	307	368	435	507	579	645	699	738	778	834	903	975	1035	1075	1088	1073	1034
13	5	11	18	27	36	48	62	79	99	123	151	185	225	271	325	386	453	521	586	638	675	711	768	842	925	1006	1072	1115	1129	1113
14	5	10	17	24	33	44	56	71	89	110	134	164	199	240	288	342	402	465	525	574	608	641	695	770	858	950	1038	1109	1155	1170
15	4	9	15	22	30	40	51	64	80	98	120	146	177	213	254	302	355	412	467	512	542	572	622	693	780	877	977	1070	1146	1194
16	4	8	14	20	28	36	46	58	72	89	108	131	157	188	225	267	314	364	413	453	480	507	552	617	700	796	900	1006	1104	1183
17	4	8	13	19	26	33	42	53	65	80	97	117	141	168	200	237	278	322	365	401	424	448	488	547	623	713	815	925	1035	1137
18	3	7	12	17	24	31	39	48	60	73	88	106	126	150	178	210	246	285	323	354	375	396	432	484	551	633	729	836	950	1065
19	3	6	11	16	22	28	36	44	54	66	80	95	114	135	160	188	219	253	286	314	332	351	382	428	487	561	647	747	858	977
20	3	6	10	15	20	26	33	41	50	60	73	87	103	122	143	167	195	225	254	278	295	311	338	378	431	495	573	663	767	882
21	3	6	10	13	19	24	30	38	46	55	66	79	93	110	129	151	175	201	227	248	262	277	301	336	382	438	506	587	680	787
22	3	6	9	13	17	22	28	35	42	51	61	72	85	100	117	136	157	180	203	221	234	247	268	299	339	388	448	518	602	698
23	3	5	9	12	16	20	26	32	39	47	56	66	78	91	106	123	142	162	182	199	210	222	240	267	302	345	397	458	532	617
24	2	5	8	11	15	20	24	30	36	43	51	61	71	83	97	112	129	147	164	179	189	199	216	239	270	307	353	406	470	546
25	2	4	8	11	14	18	23	27	34	40	48	56	66	76	89	102	117	133	148	162	171	180	195	216	242	275	315	361	417	483
26	2	4	7	10	13	17	21	26	31	37	44	52	60	70	81	93	107	121	135	147	155	163	176	195	218	247	282	322	371	428
27	2	4	7	9	13	16	20	24	29	34	41	48	56	65	75	86	98	110	123	133	141	149	160	177	198	223	253	289	331	381
28	2	4	6	9	12	15	19	23	27	32	38	45	52	60	69	79	90	101	112	122	129	136	146	161	179	202	228	260	297	340
29	2	4	6	8	11	14	18	21	26	30	36	41	48	56	64	73	83	93	103	112	118	124	134	147	163	183	207	234	267	305
30	2	4	6	8	11	13	17	20	24	28	33	39	45	52	59	67	76	86	95	103	108	114	123	135	149	167	188	212	241	274

Payoff table C1b: Nominal, pre-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	9	16	22	27	31	34	37	39	41	42	44	45	47	50	53	56	58	59	60	59	59	58	58	57	56	55	54	53	52	51
2	10	18	24	29	34	37	40	42	44	46	47	49	51	53	57	60	63	63	64	63	63	62	61	60	59	58	57	56	55	54
3	11	20	27	33	37	41	44	46	48	50	51	53	55	57	61	65	67	68	68	68	67	66	65	64	63	62	60	59	58	57
4	12	22	30	36	41	44	48	50	52	54	55	57	59	62	66	70	72	73	73	73	72	71	69	68	67	65	64	63	61	60
5	14	24	33	40	45	49	53	55	57	59	60	62	64	67	71	76	78	79	79	78	77	76	74	73	71	70	68	66	65	63
6	16	28	37	45	50	55	58	61	63	64	66	67	69	73	77	82	85	86	85	84	83	81	79	78	76	74	72	70	69	67
7	18	31	42	50	56	61	64	67	69	70	72	73	76	79	84	89	92	93	92	91	89	87	85	83	81	79	77	75	73	71
8	20	36	47	56	63	68	72	74	76	78	79	80	83	86	92	97	101	101	100	99	97	94	92	89	87	84	82	80	78	76
9	23	40	54	64	71	76	80	83	84	86	87	88	91	95	101	107	110	110	109	107	105	102	99	96	93	90	88	85	83	80
10	26	46	61	72	80	86	90	92	94	95	96	97	100	104	111	117	121	121	119	117	114	110	107	104	100	97	94	91	88	86
11	29	51	69	81	90	97	101	103	105	106	107	108	110	115	122	129	133	133	131	128	124	120	116	112	108	104	101	97	94	91
12	32	58	77	92	102	109	114	116	118	118	119	120	122	127	135	143	147	147	144	140	136	131	126	121	117	113	109	105	101	98
13	35	64	87	104	116	123	128	131	132	133	133	134	136	141	150	159	163	162	159	154	149	143	138	132	127	122	117	113	109	104
14	37	70	96	116	130	140	145	148	149	149	149	149	152	157	167	177	181	180	176	170	164	157	150	144	138	132	127	122	117	112
15	39	74	105	129	146	157	164	168	169	168	168	168	170	176	187	198	203	201	196	189	181	173	165	158	151	144	138	132	126	121
16	40	78	113	141	162	176	185	189	191	191	190	189	191	198	210	223	227	225	218	209	201	191	182	173	165	157	150	143	136	130
17	39	79	117	151	177	195	207	213	216	216	214	214	216	223	237	251	256	253	245	235	223	212	201	191	181	172	163	155	148	141
18	37	78	119	157	189	213	229	239	243	244	243	242	244	252	268	283	289	285	275	263	250	236	223	211	199	189	179	170	161	153
19	35	74	117	159	197	227	250	264	272	274	274	274	276	285	303	321	327	322	311	296	280	264	249	234	221	208	196	186	176	167
20	32	69	112	156	199	236	266	287	300	306	308	309	312	323	343	363	370	364	351	334	315	296	278	261	245	230	216	204	192	182
21	29	63	104	149	195	239	277	306	326	337	343	346	351	364	387	409	418	412	397	378	356	334	312	292	273	256	240	225	211	199
22	25	57	95	139	186	234	279	317	346	365	377	385	393	408	434	459	470	465	449	427	403	377	352	328	306	285	266	249	233	219
23	23	50	85	126	173	223	273	319	357	387	407	421	434	453	482	511	524	521	506	483	456	426	397	369	343	319	297	276	258	241
24	20	45	76	113	158	206	259	311	358	398	429	452	471	495	527	559	578	579	566	544	515	483	450	417	387	358	332	308	287	267
25	18	40	67	101	142	188	240	295	349	398	439	472	500	530	565	601	625	633	627	608	579	545	509	472	437	403	373	345	320	297
26	16	35	60	89	126	169	219	273	330	386	436	480	517	552	591	629	660	679	682	671	646	613	574	534	494	456	420	387	358	331
27	14	31	53	79	112	151	196	248	305	364	421	473	519	560	600	640	678	709	727	727	712	683	645	603	559	516	475	437	402	370
28	12	28	47	70	99	134	175	223	277	335	395	452	505	550	591	631	676	720	753	771	770	751	719	677	631	583	537	493	453	416
29	11	24	41	62	87	118	155	198	248	304	363	422	478	526	565	605	654	708	758	795	814	811	790	754	708	658	607	558	512	469
30	10	22	37	55	77	104	137	175	221	272	328	386	442	490	527	565	616	677	741	796	836	855	851	827	788	739	686	631	579	530

Payoff table C2a: Real, pre-shock, type *x*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	18	20	23	26	29	32	35	37	39	40	39	38	36	33	30	27	25	23	21	20	20	20	19	18	16	15	13	12	11	10
2	16	18	20	23	26	29	32	35	37	39	40	39	38	36	33	31	28	26	24	23	23	23	22	20	18	17	15	13	12	11
3	14	16	18	20	23	26	29	32	35	37	39	40	40	38	36	34	31	29	27	26	26	26	25	23	21	19	17	15	14	12
4	12	14	16	18	20	23	25	29	32	35	37	39	40	40	38	37	34	32	30	29	29	29	28	26	24	21	19	17	15	14
5	11	12	14	16	18	20	23	25	28	32	35	37	39	40	40	39	37	35	33	32	32	32	31	29	27	24	22	19	17	15
6	10	11	12	14	16	18	20	23	25	28	32	34	37	39	40	40	39	38	36	35	35	35	34	32	30	27	25	22	20	17
7	9	10	11	12	14	16	18	20	22	25	28	31	34	37	39	40	40	39	38	38	38	38	37	35	33	30	28	25	22	20
8	8	9	10	11	12	14	16	18	20	22	25	28	31	34	37	39	40	40	40	39	39	39	39	38	36	34	31	28	25	22
9	7	8	9	10	11	12	14	16	18	20	22	25	28	31	34	36	38	39	40	40	40	40	40	39	38	36	34	31	28	25
10	7	7	8	9	10	11	12	14	16	18	20	22	25	28	31	34	36	38	39	39	39	39	40	40	40	39	37	34	31	28
11	6	7	7	8	9	10	11	12	14	16	17	20	22	25	28	30	33	35	37	38	38	38	38	39	40	40	39	37	34	31
12	6	6	7	7	8	9	10	11	12	14	15	17	20	22	25	27	30	32	34	35	35	35	36	38	39	40	40	39	37	34
13	5	6	6	7	7	8	9	10	11	12	14	15	17	19	22	24	27	29	31	32	32	32	33	35	37	39	40	40	39	37
14	5	5	6	6	7	7	8	9	10	11	12	14	15	17	19	21	24	26	28	29	29	29	30	32	34	37	38	40	40	39
15	4	5	5	6	6	7	7	8	9	10	11	12	14	15	17	19	21	23	25	26	26	26	27	29	31	34	36	38	40	40
16	4	4	5	5	6	6	7	7	8	9	10	11	12	13	15	17	18	20	22	23	23	23	24	26	28	31	33	36	38	39
17	4	4	4	5	5	6	6	7	7	8	9	10	11	12	13	15	16	18	19	20	20	20	21	23	25	27	30	33	36	38
18	3	4	4	4	5	5	6	6	7	7	8	9	10	11	12	13	14	16	17	18	18	18	19	20	22	24	27	30	33	36
19	3	3	4	4	4	5	5	6	6	7	7	8	9	10	11	12	13	14	15	16	16	16	17	18	19	22	24	27	30	33
20	3	3	3	4	4	4	5	5	6	6	7	7	8	9	10	10	11	13	13	14	14	14	15	16	17	19	21	24	26	29
21	3	3	3	3	4	4	4	5	5	6	6	7	7	8	9	9	10	11	12	12	12	13	13	14	15	17	19	21	23	26
22	3	3	3	3	3	4	4	4	5	5	6	6	7	7	8	9	9	10	11	11	11	11	12	12	14	15	17	19	21	23
23	3	3	3	3	3	3	4	4	4	5	5	6	6	7	7	8	8	9	10	10	10	10	10	11	12	13	15	16	18	21
24	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6	7	8	8	9	9	9	9	9	10	11	12	13	15	16	18
25	2	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6	7	7	8	8	8	8	8	9	10	11	12	13	14	16
26	2	2	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6	7	7	7	7	7	8	8	9	10	10	12	13	14
27	2	2	2	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	7	7	8	9	9	10	11	13
28	2	2	2	2	2	3	3	3	3	3	3	4	4	4	5	5	5	6	6	6	6	6	6	7	7	8	8	9	10	11
29	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	5	5	5	5	6	6	6	6	6	7	7	8	8	9	10
30	2	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	5	5	5	5	5	5	6	6	6	7	8	8	9

Payoff table C2b: Real, pre-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	9	8	7	7	6	6	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2	2	2	2
2	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2
3	11	10	9	8	7	7	6	6	5	5	5	4	4	4	4	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2
4	12	11	10	9	8	7	7	6	6	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	2	2	2	2
5	14	12	11	10	9	8	8	7	6	6	5	5	5	5	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2	2
6	16	14	12	11	10	9	8	8	7	6	6	6	5	5	5	5	5	5	4	4	4	4	3	3	3	3	3	3	2	2
7	18	16	14	13	11	10	9	8	8	7	7	6	6	6	6	6	5	5	5	5	4	4	4	3	3	3	3	3	3	2
8	20	18	16	14	13	11	10	9	8	8	7	7	6	6	6	6	6	6	5	5	5	4	4	4	3	3	3	3	3	3
9	23	20	18	16	14	13	11	10	9	9	8	7	7	7	7	7	6	6	6	5	5	5	4	4	4	3	3	3	3	3
10	26	23	20	18	16	14	13	12	10	10	9	8	8	7	7	7	7	7	6	6	5	5	5	4	4	4	3	3	3	3
11	29	26	23	20	18	16	14	13	12	11	10	9	8	8	8	8	8	7	7	6	6	5	5	5	4	4	4	3	3	3
12	32	29	26	23	20	18	16	15	13	12	11	10	9	9	9	9	9	8	8	7	6	6	5	5	5	4	4	4	3	3
13	35	32	29	26	23	21	18	16	15	13	12	11	10	10	10	10	10	9	8	8	7	7	6	6	5	5	4	4	4	3
14	37	35	32	29	26	23	21	19	17	15	14	12	12	11	11	11	11	10	9	9	8	7	7	6	6	5	5	4	4	4
15	39	37	35	32	29	26	23	21	19	17	15	14	13	13	12	12	12	11	10	9	9	8	7	7	6	6	5	5	4	4
16	40	39	38	35	32	29	26	24	21	19	17	16	15	14	14	14	13	13	11	10	10	9	8	7	7	6	6	5	5	4
17	39	40	39	38	35	33	30	27	24	22	19	18	17	16	16	16	15	14	13	12	11	10	9	8	7	7	6	6	5	5
18	37	39	40	39	38	36	33	30	27	24	22	20	19	18	18	18	17	16	14	13	12	11	10	9	8	7	7	6	6	5
19	35	37	39	40	39	38	36	33	30	27	25	23	21	20	20	20	19	18	16	15	13	12	11	10	9	8	7	7	6	6
20	32	35	37	39	40	39	38	36	33	31	28	26	24	23	23	23	22	20	18	17	15	13	12	11	10	9	8	7	7	6
21	29	32	35	37	39	40	40	38	36	34	31	29	27	26	26	26	25	23	21	19	17	15	14	12	11	10	9	8	7	7
22	25	29	32	35	37	39	40	40	38	37	34	32	30	29	29	29	28	26	24	21	19	17	15	14	12	11	10	9	8	7
23	23	25	28	32	35	37	39	40	40	39	37	35	33	32	32	32	31	29	27	24	22	19	17	15	14	12	11	10	9	8
24	20	23	25	28	32	34	37	39	40	40	39	38	36	35	35	35	34	32	30	27	25	22	20	17	15	14	12	11	10	9
25	18	20	22	25	28	31	34	37	39	40	40	39	38	38	38	38	37	35	33	30	28	25	22	20	17	16	14	12	11	10
26	16	18	20	22	25	28	31	34	37	39	40	40	40	39	39	39	39	38	36	34	31	28	25	22	20	18	16	14	12	11
27	14	16	18	20	22	25	28	31	34	36	38	39	40	40	40	40	40	39	38	36	34	31	28	25	22	20	18	16	14	12
28	12	14	16	18	20	22	25	28	31	34	36	38	39	39	39	39	40	40	40	39	37	34	31	28	25	22	20	18	16	14
29	11	12	14	16	17	20	22	25	28	30	33	35	37	38	38	38	38	39	40	40	39	37	34	31	28	25	22	20	18	16
30	10	11	12	14	15	17	20	22	25	27	30	32	34	35	35	35	36	38	39	40	40	39	37	34	32	28	25	23	20	18

Payoff table C3a: Nominal, post-shock, type *x*

Average price of other firms

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Selling price																														
1	18	51	104	159	181	173	181	183	153	122	98	80	66	56	48	42	37	33	30	27	25	23	21	20	18	17	16	15	14	13
2	12	35	76	137	199	226	246	257	221	174	135	107	86	71	60	51	45	39	35	31	28	26	24	22	20	19	18	17	16	14
3	9	24	53	100	169	236	280	315	305	251	193	148	116	93	76	64	54	47	41	37	33	30	27	25	23	21	19	18	17	16
4	7	18	37	69	123	193	246	301	358	344	279	212	161	124	99	81	67	57	49	43	38	34	31	28	26	23	22	20	19	18
5	5	13	27	49	85	137	181	231	326	398	382	306	230	173	133	105	85	71	60	52	45	40	35	32	29	26	24	22	21	19
6	4	10	20	35	59	95	125	161	243	355	437	417	332	247	185	141	111	90	74	63	54	47	41	37	33	30	27	25	23	21
7	3	8	15	26	43	67	87	112	169	262	386	474	451	356	264	196	149	117	94	78	66	56	49	43	38	34	31	28	26	24
8	3	6	12	20	32	49	63	80	118	182	284	417	511	485	381	281	208	157	123	99	81	68	58	51	45	40	35	32	29	27
9	2	5	10	16	25	37	47	59	84	127	196	305	447	548	518	405	297	219	165	129	103	85	71	61	53	46	41	37	33	30
10	2	4	8	13	20	29	36	45	63	91	137	212	328	478	583	550	429	313	230	173	135	108	88	74	63	54	48	42	38	34
11	2	4	7	11	16	23	29	35	48	68	99	148	227	349	508	619	581	452	329	241	181	140	112	92	77	65	56	49	44	39
12	1	3	6	9	13	18	23	28	38	52	74	107	159	242	371	538	653	612	475	345	251	188	146	116	95	79	67	58	51	44
13	1	2	5	8	11	15	19	23	30	41	57	80	114	169	257	393	567	687	643	497	360	262	196	151	120	98	82	69	60	52
14	1	2	4	7	9	13	16	19	25	33	45	61	85	122	180	272	414	596	721	673	519	375	273	203	157	125	102	85	72	62
15	1	2	4	5	8	11	13	16	21	27	36	48	66	91	130	190	286	435	625	754	703	541	390	283	211	163	129	105	87	74
16	1	2	3	5	7	9	12	14	18	23	30	39	52	70	97	137	200	301	455	653	787	732	563	406	293	219	168	133	108	90
17	1	2	3	4	6	8	10	11	15	19	25	32	42	55	75	103	145	211	315	476	681	820	762	585	421	304	226	174	137	112
18	1	2	3	4	5	7	9	10	13	17	21	27	34	45	59	79	108	152	221	329	496	709	852	791	607	435	314	233	179	142
19	1	1	2	3	5	6	8	9	11	14	18	23	29	37	48	62	83	114	159	231	343	516	737	884	820	628	450	325	241	185
20	1	1	2	3	4	6	7	8	10	13	16	20	24	31	39	50	66	88	119	167	240	357	536	764	916	849	649	465	335	248
21	1	1	2	3	4	5	6	7	9	11	14	17	21	26	33	42	53	69	92	124	174	250	371	556	792	948	878	671	480	345
22	0	1	2	3	4	5	6	7	8	10	12	15	18	22	28	35	44	56	73	96	130	181	260	385	576	818	980	906	692	494
23	0	0	2	2	3	4	5	6	7	9	11	13	16	19	24	29	37	46	59	76	100	135	188	270	399	596	846	1012	935	713
24	0	0	1	2	3	4	5	5	6	8	10	12	14	17	21	25	31	39	48	61	79	104	140	195	279	412	616	873	1044	964
25	0	0	1	1	3	3	4	5	6	7	9	10	13	15	18	22	27	33	40	50	64	82	108	146	202	289	426	635	901	1075
26	0	0	1	1	2	3	4	4	5	6	8	9	11	13	16	19	23	28	34	42	53	67	86	112	151	209	298	440	655	928
27	0	0	1	1	2	2	3	4	5	6	7	8	10	12	14	17	20	24	29	36	44	54	69	89	116	156	216	308	453	674
28	0	0	1	1	2	2	3	3	5	5	6	8	9	11	13	15	18	21	26	31	37	46	57	72	92	120	161	223	317	467
29	0	0	1	1	2	2	3	3	4	4	6	7	8	10	11	13	16	19	22	27	32	39	48	59	74	95	124	166	230	327
30	0	0	1	1	2	2	3	3	4	4	5	6	8	9	10	12	14	17	20	23	28	33	40	49	61	77	98	128	172	236

Payoff table C3b: Nominal, post-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	9	14	16	17	20	23	22	21	20	19	18	17	16	15	14	13	13	12	12	11	11	10	10	9	9	9	8	8	8	8
2	12	18	21	22	26	29	28	26	24	22	21	19	18	17	16	15	14	13	13	12	12	11	11	10	10	9	9	9	8	8
3	18	25	28	29	34	37	35	32	29	27	25	23	21	19	18	17	16	15	14	13	13	12	11	11	10	10	10	9	9	9
4	26	36	39	40	45	49	45	40	36	33	29	27	24	22	21	19	18	17	16	15	14	13	13	11	11	11	10	10	10	9
5	35	52	56	56	62	67	60	53	46	40	36	32	29	26	24	22	20	19	18	16	15	15	14	13	12	12	11	11	10	10
6	40	71	81	81	89	95	83	70	60	51	44	39	34	31	28	25	23	21	20	18	17	16	15	14	14	12	12	12	11	11
7	35	80	109	115	129	137	119	97	80	66	56	48	42	37	33	30	27	24	22	21	19	18	17	16	15	14	13	13	12	11
8	25	68	119	151	176	193	172	139	111	89	73	61	52	45	39	35	31	28	26	24	22	20	19	17	16	15	14	13	13	12
9	18	50	102	157	200	236	237	201	158	123	98	79	66	56	48	42	37	33	30	27	25	23	21	19	18	17	16	15	14	13
10	12	34	74	129	176	226	279	275	229	177	136	107	86	71	59	51	44	39	35	31	28	26	23	22	20	19	17	16	15	14
11	9	24	51	92	129	173	253	318	312	255	195	148	115	92	75	63	54	46	41	36	32	29	27	24	22	21	19	18	17	16
12	7	18	36	63	89	121	189	284	357	348	281	212	160	124	98	80	67	57	49	43	38	34	30	28	25	23	21	20	19	17
13	5	13	26	45	62	84	131	210	316	395	382	305	229	172	132	104	84	70	59	51	45	39	35	32	29	26	24	22	21	19
14	4	10	19	33	45	60	91	145	232	347	433	416	331	246	183	140	110	89	74	62	53	46	41	36	33	30	27	25	23	21
15	3	8	15	25	34	44	66	102	161	254	379	470	449	355	262	194	148	116	93	77	65	56	48	43	38	34	31	28	26	24
16	3	6	12	19	26	34	49	73	112	176	277	410	506	481	378	278	206	156	122	98	81	68	58	50	44	39	35	32	29	26
17	2	5	10	15	20	26	37	54	81	123	192	300	440	541	513	402	294	217	164	127	102	84	70	60	52	46	41	36	33	30
18	2	4	8	12	16	21	29	42	60	89	134	207	322	471	576	544	425	310	227	171	133	107	87	73	62	54	47	41	37	34
19	2	4	7	10	14	17	24	33	46	66	97	145	223	344	500	611	575	448	326	238	179	139	111	91	76	64	56	49	43	39
20	1	3	6	9	11	14	19	27	37	51	72	105	156	238	365	530	645	606	470	341	249	186	144	115	94	79	67	58	50	44
21	1	2	5	7	10	12	16	22	30	40	56	78	112	166	253	386	559	679	636	492	357	259	194	150	119	97	81	69	59	52
22	1	2	4	6	8	10	14	18	24	32	44	60	84	120	177	267	407	588	712	666	514	372	270	202	156	124	101	84	71	61
23	1	2	4	5	7	8	12	15	20	27	35	48	65	90	128	187	282	428	616	745	695	536	387	280	209	161	128	104	87	73
24	1	2	3	5	6	8	10	13	17	22	29	38	51	69	95	135	197	296	449	645	778	725	558	402	291	217	167	132	108	89
25	1	2	3	4	6	7	9	11	15	19	24	32	41	55	73	101	143	207	311	469	673	811	754	580	417	301	224	172	136	111
26	1	2	3	4	5	6	8	10	13	16	21	26	34	44	58	78	107	150	218	325	490	701	843	783	601	432	312	232	178	141
27	1	1	2	3	4	5	7	9	11	14	18	22	28	36	47	61	82	112	157	227	339	510	728	875	813	623	447	322	239	183
28	1	1	2	3	4	5	6	8	10	12	15	19	24	30	39	50	65	86	117	164	237	353	530	755	908	842	644	461	332	247
29	1	1	2	3	4	4	6	7	9	11	13	17	21	26	32	41	52	68	90	123	171	247	367	550	784	940	870	666	477	343
30	0	1	2	3	3	4	5	6	8	10	12	15	18	22	27	34	43	55	72	95	128	179	257	381	570	811	972	899	687	491

Payoff table C4a: Real, post-shock, type *x*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	18	26	35	40	36	29	26	23	17	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0
2	12	18	25	34	40	38	35	32	25	17	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0
3	9	12	18	25	34	39	40	39	34	25	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1
4	7	9	12	17	25	32	35	38	40	34	25	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1
5	5	7	9	12	17	23	26	29	36	40	35	26	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1
6	4	5	7	9	12	16	18	20	27	36	40	35	26	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1
7	3	4	5	7	9	11	12	14	19	26	35	40	35	25	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1
8	3	3	4	5	6	8	9	10	13	18	26	35	39	35	25	18	12	9	6	5	4	3	3	2	2	2	1	1	1	1
9	2	3	3	4	5	6	7	7	9	13	18	25	34	39	35	25	17	12	9	6	5	4	3	3	2	2	2	1	1	1
10	2	2	3	3	4	5	5	6	7	9	12	18	25	34	39	34	25	17	12	9	6	5	4	3	3	2	2	2	1	1
11	2	2	2	3	3	4	4	4	5	7	9	12	17	25	34	39	34	25	17	12	9	6	5	4	3	3	2	2	2	1
12	1	2	2	2	3	3	3	4	4	5	7	9	12	17	25	34	38	34	25	17	12	9	6	5	4	3	2	2	2	1
13	1	1	2	2	2	3	3	3	3	4	5	7	9	12	17	25	33	38	34	25	17	12	9	6	5	4	3	2	2	2
14	1	1	1	2	2	2	2	2	3	3	4	5	7	9	12	17	24	33	38	34	25	17	12	8	6	5	4	3	2	2
15	1	1	1	1	2	2	2	2	2	3	3	4	5	7	9	12	17	24	33	38	33	25	17	12	8	6	5	4	3	2
16	1	1	1	1	1	2	2	2	2	2	3	3	4	5	6	9	12	17	24	33	37	33	24	17	12	8	6	5	4	3
17	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	9	12	17	24	32	37	33	24	17	12	8	6	5	4
18	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	12	16	24	32	37	33	24	17	12	8	6	5
19	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	12	16	23	32	37	33	24	17	12	8	6
20	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	32	37	33	24	17	12	8
21	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	32	36	33	24	17	12
22	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36	32	24	16
23	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36	32	24
24	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36	32
25	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36
26	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31
27	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	4	5	6	8	11	16	22
28	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	4	5	6	8	11	16
29	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	4	5	6	8	11
30	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	4	5	6	8

Payoff table C4b: Real, post-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	9	7	5	4	4	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
2	12	9	7	6	5	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
3	18	13	9	7	7	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
4	26	18	13	10	9	8	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
5	35	26	19	14	12	11	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
6	40	36	27	20	18	16	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0
7	35	40	36	29	26	23	17	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0
8	25	34	40	38	35	32	25	17	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0
9	18	25	34	39	40	39	34	25	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0
10	12	17	25	32	35	38	40	34	25	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0
11	9	12	17	23	26	29	36	40	35	26	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1
12	7	9	12	16	18	20	27	36	40	35	26	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1
13	5	7	9	11	12	14	19	26	35	40	35	25	18	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1
14	4	5	6	8	9	10	13	18	26	35	39	35	25	18	12	9	6	5	4	3	3	2	2	2	1	1	1	1	1	1
15	3	4	5	6	7	7	9	13	18	25	34	39	35	25	17	12	9	6	5	4	3	3	2	2	2	1	1	1	1	1
16	3	3	4	5	5	6	7	9	12	18	25	34	39	34	25	17	12	9	6	5	4	3	3	2	2	2	1	1	1	1
17	2	3	3	4	4	4	5	7	9	12	17	25	34	39	34	25	17	12	9	6	5	4	3	3	2	2	2	1	1	1
18	2	2	3	3	3	4	4	5	7	9	12	17	25	34	38	34	25	17	12	9	6	5	4	3	2	2	2	1	1	1
19	2	2	2	3	3	3	3	4	5	7	9	12	17	25	33	38	34	25	17	12	9	6	5	4	3	2	2	2	1	1
20	1	2	2	2	2	2	3	3	4	5	7	9	12	17	24	33	38	34	25	17	12	8	6	5	4	3	2	2	2	1
21	1	1	2	2	2	2	2	3	3	4	5	7	9	12	17	24	33	38	33	25	17	12	8	6	5	4	3	2	2	2
22	1	1	1	2	2	2	2	2	3	3	4	5	6	9	12	17	24	33	37	33	24	17	12	8	6	5	4	3	2	2
23	1	1	1	1	1	1	2	2	2	3	3	4	5	6	9	12	17	24	32	37	33	24	17	12	8	6	5	4	3	2
24	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	12	16	24	32	37	33	24	17	12	8	6	5	4	3
25	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	12	16	23	32	37	33	24	17	12	8	6	5	4
26	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	32	37	33	24	17	12	8	6	5
27	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	32	36	33	24	17	12	8	6
28	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36	32	24	16	11	8
29	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36	32	24	16	11
30	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	8	11	16	23	31	36	32	24	16

Appendix D Payoff Tables for treatments with positive shock

Payoff table D1a: Nominal, pre-shock, type x

Average price of other firms

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Selling price																														
1	38	74	85	78	67	56	48	42	37	33	31	29	31	32	30	28	26	24	22	20	19	17	16	15	14	14	13	12	12	11
2	29	76	112	115	99	80	67	56	48	42	38	36	38	39	36	33	30	27	25	23	21	20	18	17	16	15	14	13	13	12
3	20	58	114	151	145	120	96	77	64	54	48	45	47	48	45	40	36	32	29	26	24	22	20	19	18	17	15	15	14	13
4	14	40	88	152	189	175	141	111	89	73	63	58	59	61	55	49	43	38	34	31	28	25	23	21	20	18	17	16	15	14
5	9	27	60	117	190	229	207	164	128	102	85	76	77	79	71	61	53	46	41	36	32	29	26	24	22	20	19	18	17	15
6	7	18	41	80	146	228	269	240	189	147	118	103	105	106	93	79	66	57	49	43	38	34	30	27	25	23	21	20	18	17
7	5	14	28	53	100	175	266	309	275	217	171	146	147	147	126	103	85	71	60	52	45	40	35	32	29	26	24	22	20	19
8	4	10	21	37	67	119	202	303	351	315	254	214	214	213	178	142	113	91	75	63	54	47	41	37	33	30	27	25	23	21
9	3	8	15	27	47	80	138	229	338	394	364	317	318	317	261	201	154	121	97	80	67	57	49	43	38	34	31	28	25	23
10	3	6	12	21	34	56	93	155	253	370	438	436	449	456	387	295	220	166	129	103	84	70	59	51	45	39	35	32	29	26
11	2	5	10	16	26	41	65	105	172	273	394	477	520	556	537	437	324	237	177	136	108	88	73	62	53	46	41	36	33	30
12	2	4	8	13	20	31	47	74	116	184	284	390	449	508	598	592	478	350	253	187	143	113	92	76	64	55	48	42	38	34
13	2	4	6	10	16	24	36	54	82	126	191	271	318	370	497	630	639	515	374	268	197	150	118	96	79	67	57	50	44	39
14	1	3	5	9	13	19	28	41	60	88	131	183	214	250	347	504	662	681	549	396	283	207	157	123	99	82	69	59	51	44
15	1	2	5	7	11	15	22	32	45	64	93	126	147	170	234	348	520	695	722	582	418	296	217	164	128	103	85	71	61	53
16	1	2	4	6	9	13	18	25	35	49	68	91	105	120	161	234	357	540	729	761	613	439	311	226	171	133	107	88	74	63
17	1	2	3	5	8	11	15	20	28	38	52	68	77	88	115	163	241	369	562	762	799	644	460	324	235	177	138	110	91	76
18	1	2	3	5	7	9	13	17	23	31	41	52	59	67	86	117	168	250	383	585	796	836	674	480	338	244	184	143	114	93
19	1	2	3	4	6	8	11	14	19	25	33	41	47	53	66	87	121	174	259	399	608	829	872	703	500	350	253	190	147	118
20	1	1	2	4	5	7	9	12	16	21	27	33	38	42	52	68	91	126	181	269	414	632	862	908	731	519	364	262	196	152
21	1	1	2	3	4	6	8	11	14	18	22	27	31	34	42	54	70	95	131	188	280	430	655	895	943	759	538	376	271	202
22	1	1	2	3	4	5	7	9	12	14	19	23	26	29	35	43	56	73	99	137	196	291	446	679	927	978	787	557	389	279
23	0	1	2	3	4	5	6	8	10	13	16	19	22	24	29	36	45	58	77	103	142	203	302	461	702	959	1012	814	575	401
24	0	0	2	2	3	4	6	7	9	11	14	17	19	20	25	30	37	47	61	80	107	148	211	312	477	726	991	1046	841	594
25	0	0	1	2	3	4	5	6	8	10	12	15	16	18	21	26	31	39	50	64	83	111	154	219	323	493	749	1022	1080	868
26	0	0	1	1	3	4	5	6	7	9	11	13	14	16	18	22	27	33	41	52	66	87	116	159	226	334	509	772	1054	1113
27	0	0	1	1	2	3	4	5	6	8	10	11	12	14	16	19	23	28	34	43	54	69	90	120	165	234	345	524	795	1085
28	0	0	1	1	2	2	4	5	6	7	9	10	11	12	14	17	20	24	29	36	45	56	72	93	124	170	241	355	540	818
29	0	0	1	1	2	2	3	4	5	6	8	9	10	11	13	15	18	21	25	31	38	47	58	74	97	129	176	249	366	555
30	0	0	1	1	2	2	3	3	5	6	7	8	9	10	11	13	16	18	22	26	32	39	48	61	77	100	133	181	256	376

Payoff table D1b: Nominal, pre-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	13	18	20	20	20	19	18	18	17	16	16	17	18	18	17	16	15	14	14	13	12	12	11	11	10	10	9	9	9	8
2	19	26	28	27	26	24	23	21	20	19	19	20	21	20	19	18	17	16	15	14	14	13	12	11	11	10	10	10	9	9
3	28	38	40	37	34	31	29	26	24	23	23	24	25	24	22	21	19	18	17	16	15	14	13	13	12	11	11	10	10	9
4	37	56	59	53	47	41	37	33	30	28	27	28	30	28	26	24	22	21	19	18	17	16	15	14	13	12	12	11	11	10
5	38	74	86	79	67	57	49	43	38	34	33	35	36	34	31	28	26	24	22	20	19	17	16	15	14	14	13	12	12	11
6	29	76	113	116	100	82	68	57	49	44	41	43	45	42	38	34	30	28	25	23	21	20	18	17	16	15	14	13	13	12
7	20	58	114	152	146	121	97	79	66	57	53	55	56	52	46	41	36	32	29	26	24	22	20	19	18	16	15	15	14	13
8	14	40	88	152	191	177	144	113	91	77	69	71	73	66	57	50	44	38	34	31	28	25	23	21	20	18	17	16	15	14
9	9	27	60	117	190	230	210	168	132	107	94	97	98	87	74	62	53	46	41	36	32	29	26	24	22	20	19	18	16	15
10	7	18	40	80	145	228	270	245	196	156	134	136	137	118	97	80	67	57	49	43	38	34	30	27	25	23	21	20	18	17
11	5	14	28	53	99	173	265	312	284	231	196	197	198	166	133	106	86	71	60	52	45	39	35	31	28	26	24	22	20	19
12	4	10	21	37	67	118	200	301	354	331	291	293	294	244	188	145	114	92	76	63	54	47	41	37	33	29	27	24	22	21
13	3	8	15	27	47	80	136	225	333	398	399	414	423	361	277	207	157	122	97	80	67	57	49	43	38	34	31	28	25	23
14	3	6	12	21	34	56	92	153	246	358	437	480	517	501	410	305	224	168	129	103	84	70	59	51	45	39	35	32	29	26
15	2	5	10	16	26	41	65	104	166	258	358	414	472	558	555	450	330	240	178	137	108	88	73	62	53	46	41	36	33	29
16	2	4	8	13	20	31	47	73	113	174	249	293	343	464	591	601	486	354	255	188	144	113	92	76	64	55	48	42	37	34
17	2	4	6	10	16	24	35	53	80	119	167	197	232	324	473	623	643	520	376	269	198	150	118	95	79	66	57	49	43	39
18	1	3	5	9	13	19	28	40	58	84	116	136	158	218	326	490	657	684	553	398	283	207	157	123	99	82	69	59	51	44
19	1	2	5	7	11	15	22	31	44	62	83	97	112	150	220	336	510	690	723	584	419	297	217	164	128	103	85	71	61	53
20	1	2	4	6	9	13	18	25	34	47	62	71	82	108	152	227	349	532	724	761	615	440	311	226	170	133	106	87	73	63
21	1	2	3	5	8	11	15	20	28	37	48	55	62	80	110	158	236	363	556	758	798	644	460	324	235	177	137	110	90	76
22	1	2	3	5	7	9	13	17	23	30	38	43	49	62	82	114	164	246	379	579	791	834	673	480	337	244	183	142	114	93
23	1	2	3	4	6	8	11	14	19	24	30	35	39	48	63	85	119	171	256	394	603	824	870	702	499	350	253	189	147	117
24	1	1	2	4	5	7	9	12	16	20	25	28	32	39	50	66	89	124	179	267	410	626	857	906	730	518	363	261	195	151
25	1	1	2	3	4	6	8	10	13	17	21	24	27	32	41	53	69	94	130	187	278	426	650	890	941	758	537	375	270	202
26	1	1	2	3	4	5	7	9	12	14	18	20	23	27	34	43	55	73	98	136	194	289	442	674	922	974	785	556	388	278
27	0	1	2	3	4	5	6	8	10	13	15	17	19	23	28	35	45	58	76	102	141	202	299	458	698	954	1009	812	574	400
28	0	0	2	2	3	4	6	7	9	11	13	15	17	20	24	30	37	47	60	79	106	147	210	310	474	721	986	1043	839	592
29	0	0	1	2	3	4	5	6	8	10	12	13	15	17	21	25	31	39	49	63	83	111	153	217	321	490	744	1017	1076	865
30	0	0	1	1	3	4	5	6	7	9	10	12	13	15	18	22	26	33	41	51	66	86	115	158	225	332	505	767	1049	1109

Payoff table D2a: Real, pre-shock, type *x*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	38	37	28	20	13	9	7	5	4	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0
2	29	38	37	29	20	13	10	7	5	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0
3	20	29	38	38	29	20	14	10	7	5	4	4	4	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0
4	14	20	29	38	38	29	20	14	10	7	6	5	5	4	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0
5	9	14	20	29	38	38	30	21	14	10	8	6	6	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1
6	7	9	14	20	29	38	38	30	21	15	11	9	8	8	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1
7	5	7	9	13	20	29	38	39	31	22	16	12	11	11	8	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1
8	4	5	7	9	13	20	29	38	39	32	23	18	16	15	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1
9	3	4	5	7	9	13	20	29	38	39	33	26	24	23	17	13	9	7	5	4	3	3	2	2	2	1	1	1	1	1
10	3	3	4	5	7	9	13	19	28	37	40	36	35	33	26	18	13	9	7	5	4	3	3	2	2	2	1	1	1	1
11	2	3	3	4	5	7	9	13	19	27	36	40	40	40	36	27	19	13	9	7	5	4	3	3	2	2	2	1	1	1
12	2	2	3	3	4	5	7	9	13	18	26	33	35	36	40	37	28	19	13	9	7	5	4	3	3	2	2	2	1	1
13	2	2	2	3	3	4	5	7	9	13	17	23	24	26	33	39	38	29	20	13	9	7	5	4	3	3	2	2	2	1
14	1	2	2	2	3	3	4	5	7	9	12	15	16	18	23	32	39	38	29	20	13	9	7	5	4	3	3	2	2	1
15	1	1	2	2	2	3	3	4	5	6	8	11	11	12	16	22	31	39	38	29	20	13	9	7	5	4	3	3	2	2
16	1	1	1	2	2	2	3	3	4	5	6	8	8	9	11	15	21	30	38	38	29	20	14	9	7	5	4	3	3	2
17	1	1	1	1	2	2	2	3	3	4	5	6	6	6	8	10	14	21	30	38	38	29	20	14	9	7	5	4	3	3
18	1	1	1	1	1	2	2	2	3	3	4	4	5	5	6	7	10	14	20	29	38	38	29	20	14	9	7	5	4	3
19	1	1	1	1	1	1	2	2	2	3	3	3	4	4	4	5	7	10	14	20	29	38	38	29	20	13	9	7	5	4
20	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	5	7	10	13	20	29	37	38	29	20	13	9	7	5
21	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	4	5	7	9	13	20	28	37	38	29	20	13	9	7
22	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	4	5	7	9	13	19	28	37	38	29	20	13	9
23	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	4	5	7	9	13	19	28	37	37	29	20	13
24	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	28	37	37	29	20
25	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	28	37	37	29
26	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	28	36	37
27	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	27	36
28	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	27
29	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19
30	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	6	9	13

Payoff table D2b: Real, pre-shock, type y

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	13	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
2	19	13	9	7	5	4	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
3	28	19	13	9	7	5	4	3	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
4	37	28	20	13	9	7	5	4	3	3	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0	0
5	38	37	29	20	13	10	7	5	4	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0	0
6	29	38	38	29	20	14	10	7	5	4	4	4	3	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0	0
7	20	29	38	38	29	20	14	10	7	6	5	5	4	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0	0
8	14	20	29	38	38	30	21	14	10	8	6	6	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1	0
9	9	14	20	29	38	38	30	21	15	11	9	8	8	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1	1
10	7	9	13	20	29	38	39	31	22	16	12	11	11	8	6	5	4	3	3	2	2	2	1	1	1	1	1	1	1	1
11	5	7	9	13	20	29	38	39	32	23	18	16	15	12	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1	1
12	4	5	7	9	13	20	29	38	39	33	26	24	23	17	13	9	7	5	4	3	3	2	2	2	1	1	1	1	1	1
13	3	4	5	7	9	13	19	28	37	40	36	35	33	26	18	13	9	7	5	4	3	3	2	2	2	1	1	1	1	1
14	3	3	4	5	7	9	13	19	27	36	40	40	40	36	27	19	13	9	7	5	4	3	3	2	2	2	1	1	1	1
15	2	3	3	4	5	7	9	13	18	26	33	35	36	40	37	28	19	13	9	7	5	4	3	3	2	2	2	1	1	1
16	2	2	3	3	4	5	7	9	13	17	23	24	26	33	39	38	29	20	13	9	7	5	4	3	3	2	2	2	1	1
17	2	2	2	3	3	4	5	7	9	12	15	16	18	23	32	39	38	29	20	13	9	7	5	4	3	3	2	2	1	1
18	1	2	2	2	3	3	4	5	6	8	11	11	12	16	22	31	39	38	29	20	13	9	7	5	4	3	3	2	2	1
19	1	1	2	2	2	3	3	4	5	6	8	8	9	11	15	21	30	38	38	29	20	14	9	7	5	4	3	3	2	2
20	1	1	1	2	2	2	3	3	4	5	6	6	6	8	10	14	21	30	38	38	29	20	14	9	7	5	4	3	3	2
21	1	1	1	1	2	2	2	3	3	4	4	5	5	6	7	10	14	20	29	38	38	29	20	14	9	7	5	4	3	3
22	1	1	1	1	1	2	2	2	3	3	3	4	4	4	5	7	10	14	20	29	38	38	29	20	13	9	7	5	4	3
23	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	5	7	10	13	20	29	37	38	29	20	13	9	7	5	4
24	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	4	5	7	9	13	20	28	37	38	29	20	13	9	7	5
25	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	4	5	7	9	13	19	28	37	38	29	20	13	9	7
26	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	4	5	7	9	13	19	28	37	37	29	20	13	9
27	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	28	37	37	29	20	13
28	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	28	37	37	29	20
29	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	28	36	37	29
30	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3	3	4	5	7	9	13	19	27	36	37

Payoff table D3a: Nominal, post-shock, type *x*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	38	78	112	133	142	142	136	128	120	111	103	96	89	84	78	74	70	66	63	60	58	56	54	54	54	56	58	58	57	56
2	34	75	117	149	167	170	166	156	145	133	123	113	104	97	90	84	79	74	70	67	64	62	60	59	60	62	64	64	63	61
3	29	68	113	156	187	200	200	190	177	162	147	135	123	113	104	97	90	84	79	75	71	68	66	65	66	68	70	70	69	66
4	24	58	102	151	196	224	235	230	215	197	179	161	147	133	122	112	103	96	90	84	80	76	74	72	73	75	77	78	76	73
5	20	48	88	137	189	235	263	270	259	240	218	196	176	159	144	131	120	111	103	96	90	86	82	80	81	83	86	86	84	80
6	16	40	73	117	171	228	275	301	304	290	266	239	214	191	171	155	140	128	118	109	102	97	92	90	90	93	96	96	93	89
7	13	32	60	97	146	205	266	315	340	339	320	291	261	232	206	184	166	150	137	126	117	110	105	101	102	105	108	108	104	99
8	11	27	49	80	122	176	239	304	355	379	375	351	317	283	250	222	198	177	160	146	135	126	119	115	115	118	122	121	117	111
9	9	22	41	65	100	146	205	274	342	394	418	411	382	344	305	269	238	212	190	172	157	145	137	131	131	135	139	138	132	125
10	8	18	34	54	82	120	170	234	308	380	435	457	447	414	372	328	289	255	227	203	184	169	158	151	150	155	159	158	151	142
11	7	16	28	45	68	98	140	195	263	342	418	475	497	484	447	400	352	310	273	243	218	199	185	176	174	179	184	181	173	162
12	6	14	24	37	56	81	115	160	219	292	376	456	515	537	521	480	429	378	332	293	261	236	218	206	203	209	215	212	200	186
13	5	12	20	32	47	67	95	131	179	243	321	409	494	556	577	559	515	460	405	356	316	283	259	244	240	246	253	248	234	216
14	4	10	18	27	40	56	79	107	147	199	266	349	442	532	596	618	599	551	492	435	384	343	311	292	286	294	301	295	276	253
15	4	8	15	24	34	48	66	90	121	163	219	290	377	475	569	636	659	638	589	528	468	417	377	352	344	353	362	353	328	299
16	4	8	14	21	30	41	56	75	101	134	179	238	313	405	507	605	676	701	681	630	568	509	460	428	417	428	439	426	395	357
17	3	7	12	18	26	35	48	64	85	112	148	195	257	336	432	539	641	716	744	725	676	616	561	522	509	522	535	519	479	430
18	3	6	11	16	23	31	41	55	72	94	123	161	211	275	358	458	569	676	755	787	773	728	676	634	620	636	652	633	584	522
19	3	6	9	14	20	27	36	47	62	80	103	134	174	226	293	379	483	598	709	793	832	825	792	757	745	766	786	767	711	637
20	2	5	9	13	18	24	32	41	53	68	88	112	145	186	241	311	400	506	625	740	829	876	883	871	871	898	923	911	857	774
21	2	4	8	11	16	21	28	36	46	59	75	95	121	155	199	255	328	419	528	649	767	862	920	946	967	1000	1033	1039	1003	927
22	2	4	7	10	14	19	25	32	41	51	65	82	103	130	165	211	269	343	436	546	668	787	886	954	1000	1040	1080	1113	1117	1073
23	2	4	6	9	13	17	22	28	36	45	56	71	88	111	139	175	222	282	357	451	561	680	795	890	957	1000	1044	1104	1159	1175
24	2	4	6	9	12	15	20	25	32	40	50	62	76	95	118	148	185	233	294	369	462	568	679	781	855	898	940	1017	1114	1195
25	2	3	5	8	11	14	18	23	29	35	44	54	67	82	101	125	156	194	243	304	378	467	564	658	728	766	805	883	998	1125
26	1	3	5	7	10	13	16	21	26	32	39	48	58	71	88	107	132	163	203	251	311	383	463	543	604	636	669	740	852	993
27	1	2	5	7	9	12	15	19	23	29	35	42	52	62	76	93	114	139	171	209	258	315	380	445	495	522	549	609	707	840
28	1	2	4	6	8	11	14	17	21	26	31	38	46	56	67	81	98	119	145	177	216	261	313	365	406	428	451	499	580	694
29	1	2	4	5	8	10	13	16	19	23	28	34	41	49	59	71	86	103	125	151	182	219	261	302	335	353	371	411	476	569
30	1	2	4	5	7	9	12	14	18	21	26	31	37	44	53	63	75	90	108	129	155	185	219	252	279	294	309	340	393	467

Payoff table D3b: Nominal, post-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	13	22	27	31	34	35	36	35	36	36	35	35	34	33	33	32	32	31	31	30	30	30	31	32	33	34	34	33	33	32
2	16	26	33	37	39	40	41	41	40	40	39	38	38	37	36	35	34	34	33	33	32	32	33	35	36	36	36	36	35	34
3	19	32	39	44	46	47	47	47	46	45	44	43	42	41	40	39	38	37	36	36	35	35	36	37	39	39	39	38	37	36
4	23	38	47	52	55	55	55	54	53	51	50	48	47	45	44	43	41	40	39	39	38	38	39	40	42	42	42	41	40	39
5	28	46	58	64	66	66	65	63	61	59	57	55	53	51	49	47	46	44	43	42	41	41	42	44	45	46	45	44	43	42
6	33	56	71	77	80	79	77	75	72	68	65	62	60	57	55	53	51	49	47	46	45	45	46	48	49	50	49	48	47	44
7	37	66	85	94	97	96	93	89	84	80	76	72	68	65	62	59	56	54	52	51	50	49	50	52	54	54	53	52	50	49
8	39	74	100	113	119	117	113	107	100	94	88	83	78	74	70	66	63	60	58	56	55	54	55	57	59	59	58	57	55	53
9	38	78	112	133	143	143	137	129	121	112	104	97	90	85	79	75	71	67	65	62	60	60	60	63	65	65	64	62	60	57
10	34	76	117	149	168	172	167	158	146	134	124	114	106	98	91	85	80	76	72	69	67	66	67	69	72	72	71	68	65	62
11	29	68	114	157	188	202	202	192	178	163	149	136	125	115	106	98	92	86	82	78	75	74	74	77	80	80	78	75	72	68
12	24	58	103	152	196	226	237	232	217	199	181	164	149	135	124	114	106	98	93	88	84	83	83	86	89	89	87	83	79	75
13	20	48	88	137	190	236	264	272	262	243	221	199	179	161	146	133	123	113	106	100	95	93	93	97	100	100	97	93	88	83
14	16	40	73	117	171	228	276	303	307	292	269	242	217	194	174	158	144	132	122	114	109	106	106	109	113	113	109	104	98	92
15	14	32	60	97	146	205	266	315	342	342	323	295	264	236	210	188	170	155	142	132	125	120	120	125	129	128	123	117	110	102
16	11	27	49	80	122	176	239	304	356	381	378	355	322	287	255	227	203	183	167	154	144	139	138	143	148	146	140	132	123	115
17	9	22	41	65	100	146	205	273	342	396	421	415	387	350	311	275	244	219	198	181	169	161	160	165	171	168	161	151	140	130
18	8	18	34	54	82	120	170	234	307	380	436	460	452	420	378	336	297	264	236	215	199	189	187	193	199	196	187	174	160	147
19	7	16	28	45	68	98	140	194	262	341	418	476	500	489	454	409	362	321	286	257	237	224	221	227	235	231	218	201	184	168
20	6	14	24	37	56	80	114	159	218	291	374	456	516	541	528	490	441	391	347	311	284	267	263	271	279	274	257	236	214	194
21	5	12	21	32	47	67	94	131	179	241	319	407	493	557	582	567	527	475	424	379	345	323	316	326	335	328	306	279	251	226
22	5	10	18	27	40	56	78	107	147	198	265	347	440	530	597	623	609	567	514	463	420	392	384	395	406	396	368	333	298	265
23	4	9	15	24	34	48	66	90	121	163	217	288	374	472	566	636	666	653	612	560	512	478	468	482	495	482	446	401	356	314
24	4	8	14	21	30	41	56	75	101	134	178	236	310	401	502	601	676	709	699	662	617	581	570	587	604	588	544	487	430	377
25	3	7	12	18	26	35	48	64	85	112	147	194	254	332	426	532	635	714	753	750	723	694	686	707	728	713	662	594	523	455
26	3	6	11	16	23	31	41	55	72	94	122	160	209	272	353	450	559	666	750	797	807	799	801	828	855	846	798	723	638	554
27	3	6	10	14	20	27	36	47	61	79	103	133	172	223	289	372	472	584	694	783	840	867	889	923	957	965	934	866	774	676
28	2	5	9	13	18	24	32	41	53	68	87	112	143	184	237	305	390	492	605	716	809	874	920	960	1000	1033	1040	1002	923	820
29	2	4	8	11	16	21	28	36	46	59	75	95	121	154	196	251	320	406	507	618	726	816	880	923	967	1025	1079	1097	1059	974
30	2	4	7	10	14	19	25	32	41	51	65	81	102	129	163	207	263	332	418	516	620	716	787	828	871	944	1037	1115	1145	1110

Payoff table D4a: Real, post-shock, type *x*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	38	39	37	33	28	24	19	16	13	11	9	8	7	6	5	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2
2	34	38	39	37	33	28	24	20	16	13	11	9	8	7	6	5	5	4	4	3	3	3	3	2	2	2	2	2	2	2
3	29	34	38	39	37	33	29	24	20	16	13	11	9	8	7	6	5	5	4	4	3	3	3	3	3	3	3	3	2	2
4	24	29	34	38	39	37	34	29	24	20	16	13	11	10	8	7	6	5	5	4	4	3	3	3	3	3	3	3	3	2
5	20	24	29	34	38	39	38	34	29	24	20	16	14	11	10	8	7	6	5	5	4	4	4	3	3	3	3	3	3	3
6	16	20	24	29	34	38	39	38	34	29	24	20	16	14	11	10	8	7	6	5	5	4	4	4	4	4	4	3	3	3
7	13	16	20	24	29	34	38	39	38	34	29	24	20	17	14	12	10	8	7	6	6	5	5	4	4	4	4	4	4	3
8	11	14	16	20	24	29	34	38	39	38	34	29	24	20	17	14	12	10	8	7	6	6	5	5	5	5	5	4	4	4
9	9	11	14	16	20	24	29	34	38	39	38	34	29	25	20	17	14	12	10	9	7	7	6	5	5	5	5	5	5	4
10	8	9	11	14	16	20	24	29	34	38	40	38	34	30	25	21	17	14	12	10	9	8	7	6	6	6	6	6	5	5
11	7	8	9	11	14	16	20	24	29	34	38	40	38	35	30	25	21	17	14	12	10	9	8	7	7	7	7	6	6	5
12	6	7	8	9	11	14	16	20	24	29	34	38	40	38	35	30	25	21	17	15	12	11	9	9	8	8	8	8	7	6
13	5	6	7	8	9	11	14	16	20	24	29	34	38	40	38	35	30	26	21	18	15	13	11	10	10	9	9	9	8	7
14	4	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	35	31	26	22	18	16	14	12	11	11	11	11	10	8
15	4	4	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	35	31	26	22	19	16	15	14	14	13	13	11	10
16	4	4	5	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	36	32	27	23	20	18	17	16	16	15	14	12
17	3	4	4	5	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	36	32	28	24	22	20	20	20	19	17	14
18	3	3	4	4	5	5	6	7	8	9	11	13	16	20	24	29	33	38	40	39	37	33	29	26	25	24	24	23	20	17
19	3	3	3	4	4	5	5	6	7	8	9	11	13	16	20	24	28	33	37	40	40	38	34	32	30	29	29	27	25	21
20	2	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	24	28	33	37	39	40	38	36	35	35	34	33	30	26
21	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	23	28	32	37	39	40	39	39	38	38	37	35	31
22	2	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	23	27	32	36	39	40	40	40	40	40	39	36
23	2	2	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	23	27	31	35	37	38	38	39	39	40	39
24	2	2	2	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	15	18	22	26	30	33	34	35	35	36	38	40
25	2	2	2	2	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	15	18	21	25	27	29	29	30	32	34	38
26	1	2	2	2	2	2	2	3	3	3	4	4	4	5	6	7	8	9	11	13	15	17	20	23	24	24	25	26	29	33
27	1	1	2	2	2	2	2	2	3	3	3	4	4	4	5	6	7	8	9	10	12	14	17	19	20	20	20	22	24	28
28	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4	5	6	7	8	9	10	12	14	15	16	16	17	18	20	23
29	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4	5	6	7	8	9	10	11	13	13	14	14	15	16	19
30	1	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4	5	6	6	7	8	10	11	11	11	11	12	14	16

Payoff table D4b: Real, post-shock, type *y*

Average price of other firms

Selling price	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	13	11	9	8	7	6	5	4	4	4	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
2	16	13	11	9	8	7	6	5	4	4	4	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1
3	19	16	13	11	9	8	7	6	5	5	4	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1
4	23	19	16	13	11	9	8	7	6	5	5	4	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1	1	1
5	28	23	19	16	13	11	9	8	7	6	5	5	4	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1	1
6	33	28	24	19	16	13	11	9	8	7	6	5	5	4	4	3	3	3	2	2	2	2	2	2	2	2	2	2	2	1
7	37	33	28	24	19	16	13	11	9	8	7	6	5	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2	2
8	39	37	33	28	24	20	16	13	11	9	8	7	6	5	5	4	4	3	3	3	3	2	2	2	2	2	2	2	2	2
9	38	39	37	33	29	24	20	16	13	11	9	8	7	6	5	5	4	4	3	3	3	3	3	3	3	3	2	2	2	2
10	34	38	39	37	34	29	24	20	16	13	11	10	8	7	6	5	5	4	4	3	3	3	3	3	3	3	3	2	2	2
11	29	34	38	39	38	34	29	24	20	16	14	11	10	8	7	6	5	5	4	4	4	3	3	3	3	3	3	3	2	2
12	24	29	34	38	39	38	34	29	24	20	16	14	11	10	8	7	6	5	5	4	4	4	4	4	4	3	3	3	3	3
13	20	24	29	34	38	39	38	34	29	24	20	17	14	12	10	8	7	6	6	5	5	4	4	4	4	4	4	3	3	3
14	16	20	24	29	34	38	39	38	34	29	24	20	17	14	12	10	8	7	6	6	5	5	5	5	5	4	4	4	3	3
15	14	16	20	24	29	34	38	39	38	34	29	25	20	17	14	12	10	9	7	7	6	5	5	5	5	5	5	4	4	3
16	11	14	16	20	24	29	34	38	40	38	34	30	25	21	17	14	12	10	9	8	7	6	6	6	6	6	5	5	4	4
17	9	11	14	16	20	24	29	34	38	40	38	35	30	25	21	17	14	12	10	9	8	7	7	7	7	6	6	5	5	4
18	8	9	11	14	16	20	24	29	34	38	40	38	35	30	25	21	17	15	12	11	9	9	8	8	8	8	7	6	6	5
19	7	8	9	11	14	16	20	24	29	34	38	40	38	35	30	26	21	18	15	13	11	10	10	9	9	9	8	7	6	6
20	6	7	8	9	11	13	16	20	24	29	34	38	40	39	35	31	26	22	18	16	14	12	11	11	11	11	10	8	7	6
21	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	35	31	26	22	19	16	15	14	14	13	13	11	10	9	8
22	5	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	36	32	27	23	20	18	17	16	16	15	14	12	10	9
23	4	5	5	6	7	8	9	11	13	16	20	24	29	34	38	40	39	36	32	28	24	22	20	20	20	19	17	14	12	10
24	4	4	5	5	6	7	8	9	11	13	16	20	24	29	33	38	40	39	37	33	29	26	25	24	24	23	20	17	15	13
25	3	4	4	5	5	6	7	8	9	11	13	16	20	24	28	33	37	40	40	38	34	32	30	29	29	27	25	21	18	15
26	3	3	4	4	5	5	6	7	8	9	11	13	16	19	24	28	33	37	39	40	38	36	35	35	34	33	30	26	22	18
27	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	23	28	32	37	39	40	39	39	38	38	37	35	31	27	23
28	2	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	23	27	32	36	39	40	40	40	40	40	39	36	32	27
29	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	16	19	23	27	31	35	37	38	38	39	39	40	39	37	32
30	2	2	2	3	3	3	4	4	5	5	6	7	8	9	11	13	15	18	22	26	30	33	34	35	35	36	38	40	39	37

Appendix E: Additional pre-shock tables in treatments with computerized opponents (RC and NC)

Pre-shock, Type *x*	
Your price decision	Average price of the *other* three (computerized) firms
1	20
2	20
3	20
4	20
5	21
6	21
7	21
8	21
9	21
10	21
11	21
12	21
13	21
14	21
15	22
16	22
17	22
18	22
19	23
20	23
21	24
22	24
23	24
24	25
25	25
26	25
27	25
28	25
29	25
30	25

Pre-shock, Type *y*	
Your price decision	Average price of the *other* three (computerized) firms
1	6
2	6
3	6
4	6
5	6
6	7
7	7
8	7
9	7
10	7
11	7
12	8
13	9
14	10
15	11
16	11
17	12
18	12
19	13
20	14
21	15
22	15
23	15
24	15
25	15
26	15
27	15
28	15
29	15
30	15

Appendix E: Additional post-shock tables in treatments with computerized opponents (RC and NC)

Post-shock, Type *x*	
Your price decision	Average price of the *other* three (computerized) firms
1	7
2	7
3	7
4	7
5	7
6	7
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	28
30	28

Post-shock, Type *y*	
Your price decision	Average price of the *other* three (computerized) firms
1	3
2	3
3	3
4	3
5	4
6	4
7	5
8	5
9	5
10	5
11	5
12	5
13	5
14	6
15	7
16	8
17	9
18	10
19	11
20	12
21	13
22	14
23	15
24	16
25	17
26	18
27	19
28	20
29	21
30	22

Table 1: **Treatment conditions**

	Payoffs in Real Terms	**Payoffs in Nominal Terms**
Computerized Opponents	Real treatment with computerized opponents **(RC)**: 22 groups with 1 human and *n*-1 computerized players in each group	Nominal treatment with computerized opponents **(NC)**: 24 groups with 1 human and *n*-1 computerized players in each group
	Measures nominal inertia caused by individual optimization errors that are not due to money illusion	*Comparison with RC measures nominal inertia caused by individual-level money illusion*
Human Opponents	Real treatment with human opponents **(RH)**: 10 groups with *n* human players in each group	Nominal treatment with human opponents **(NH)**: 11 groups with *n* human players in each group
	Comparison with RC measures nominal inertia caused by the difficulties of coordinating expectations and actions	*Comparison with RH measures the total (direct and indirect) effects of money illusion in a strategic setting*

Table 2: Experimental parameters (negative money shock)

All periods	Representation of payoffs in the nominal frame	$\overline{P}_{-i}\pi_i$
	Representation of payoffs in the real frame	π_i
	Group size	$n = 4$
	Information feedback in period t	$\overline{P}_{-i}$, π_i
	Real equilibrium payoff	40
	Choice variable	$P_i \in \{1,2,\ldots,30\}$
	Length of pre- and post-shock phase in treatment with computerized opponents	$T = 10$
	Length of pre- and post-shock phase in treatment with human opponents	$T = 20$
Pre-shock values	Money supply M_0	42
	Average equilibrium price $\overline{P}^*$ and average equilibrium expectation for the *whole* group	18
	Equilibrium price for type x	9
	Equilibrium expectation $\overline{P}^e_{-i}$ for type x	21
	Equilibrium price for type y	27
	Equilibrium expectation $\overline{P}^e_{-i}$ for type y	15
Post-shock values	Money supply M_1	14
	Average equilibrium price $\overline{P}^*$ and average equilibrium expectation for the *whole* group	6
	Equilibrium price for type x	3
	Equilibrium expectation $\overline{P}^e_{-i}$ for type x	7
	Equilibrium price for type y	9
	Equilibrium expectation $\overline{P}^e_{-i}$ for type y	5

Table 3: Evolution of prices and efficiency losses over time

	Average price				Average efficiency loss (percent)			
	Computerized opponents		Human opponents		Computerized opponents		Human opponents	
period	Real (RC)	Nominal (NC)	Real (RH)	Nominal (NH)	Real (RC)	Nominal (NC)	Real (RH)	Nominal (NH)
-20			17.6	18.5			14.4	19.0
-19			18.2	19.3			21.5	14.6
-18			17.8	19.1			14.1	10.2
-17			17.7	19.4			9.5	11.7
-16			17.9	19.2			8.8	6.8
-15			18.3	19.1			10.8	13.2
-14			17.6	18.2			8.0	9.9
-13			17.9	18.6			8.2	4.2
-12			17.9	18.7			6.3	3.1
-11			17.6	18.3			5.5	7.5
-10	17.9	15.2	17.8	18.4	1.0	16.4	9.4	3.4
-9	18.1	17.0	17.5	18.2	0.5	12.6	3.6	1.6
-8	17.8	17.2	17.6	19.0	1.6	9.0	3.3	6.0
-7	18.0	18.0	17.7	18.3	0.5	3.0	2.4	1.8
-6	17.6	17.2	17.6	18.2	2.4	10.4	10.9	1.3
-5	18.0	17.7	18.1	18.3	0.3	5.4	7.0	2.7
-4	18.0	18.1	18.1	18.4	0.0	3.5	7.3	2.5
-3	17.8	16.1	17.6	18.6	1.3	12.6	3.7	2.8
-2	18.4	18.3	17.9	18.2	2.3	1.9	2.2	0.7
-1	18.0	17.0	18.0	18.2	0.0	5.3	0.9	0.9
1	6.0	8.0	9.1	13.1	0.0	10.4	51.8	65.1
2	7.0	7.4	7.7	12.9	3.6	8.2	20.0	47.5
3	6.0	6.8	7.4	11.4	0.0	4.4	15.0	34.8
4	6.0	6.4	6.9	10.4	0.6	6.5	9.1	27.4
5	6.0	6.9	7.0	9.9	0.0	8.0	14.8	17.4
6	6.0	6.8	6.6	10.2	0.0	15.6	7.7	15.9
7	6.0	7.5	6.3	9.7	0.0	9.3	4.5	16.4
8	6.0	6.8	6.4	9.1	0.0	15.5	4.6	10.7
9	6.0	6.5	6.3	8.7	0.0	4.3	3.8	9.5
10	5.9	6.5	6.8	8.6	1.6	3.8	11.0	13.8
11			6.1	8.1			4.6	8.2
12			6.2	7.6			3.3	6.4
13			6.2	7.2			2.1	6.2
14			6.2	6.9			2.8	4.6
15			6.1	6.7			2.6	2.6
16			6.1	7.3			2.1	9.6
17			6.0	6.8			0.9	5.2
18			6.1	7.2			1.8	14.2
19			6.1	7.5			1.4	12.5
20			6.2	7.0			3.0	2.4

Table 4: Deviation from post-shock equilibrium in treatments with human opponents

$$\overline{P}_{it} - \overline{P}^* = \sum_{t=1}^{19} \alpha_t d_t + \sum_{t=1}^{20} \beta_t (1 - d_t) + u$$

where $\overline{P}_{it}$ denotes the average price of group i in period t and $d_t = 1$ if the price observation in period t comes from the RH.

	Real treatment with human opponents (RH)	Nominal treatment with human opponents (NH)
Post-shock period	Coefficient α_t	Coefficient β_t
1	3.10***	7.14***
2	1.68**	6.86***
3	1.43	5.43***
4	0.90	4.41***
5	1.00	3.86***
6	0.55	4.18***
7	0.25	3.77***
8	0.35	3.05***
9	0.25	2.70***
10	0.83	2.59***
11	0.13	2.05***
12	0.23	1.61**
13	0.18	1.18
14	0.18	0.89
15	0.10	0.70
16	0.13	1.25
17	0.03	0.80
18	0.13	1.20
19	0.05	1.45
20	-	0.95

*** = significant at the 1 percent level, ** = significant at the 5 percent level.

Table 5: Evolution of prices over time in treatments with positive shock

	Average price	
Period	Real (RH)	Nominal (NH)
-15	13.0	14.9
-14	13.0	14.7
-13	12.7	14.6
-12	12.7	14.3
-11	12.7	14.3
-10	12.5	14.1
-9	12.5	13.6
-8	12.5	13.4
-7	12.4	13.7
-6	12.5	13.8
-5	12.5	13.8
-4	12.5	13.9
-3	12.5	13.6
-2	12.6	13.1
-1	12.5	13.1
1	22.5	20.5
2	24.3	22.8
3	24.8	24.1
4	24.9	24.8
5	25.0	25.0
6	25.0	25.1
7	25.0	25.2
8	25.0	25.1
9	25.0	25.0
10	25.0	25.2
11	25.0	25.2
12	25.0	25.0
13	25.0	25.0
14	24.3	24.5
15	24.6	24.9

Figure 1: Evolution of average prices

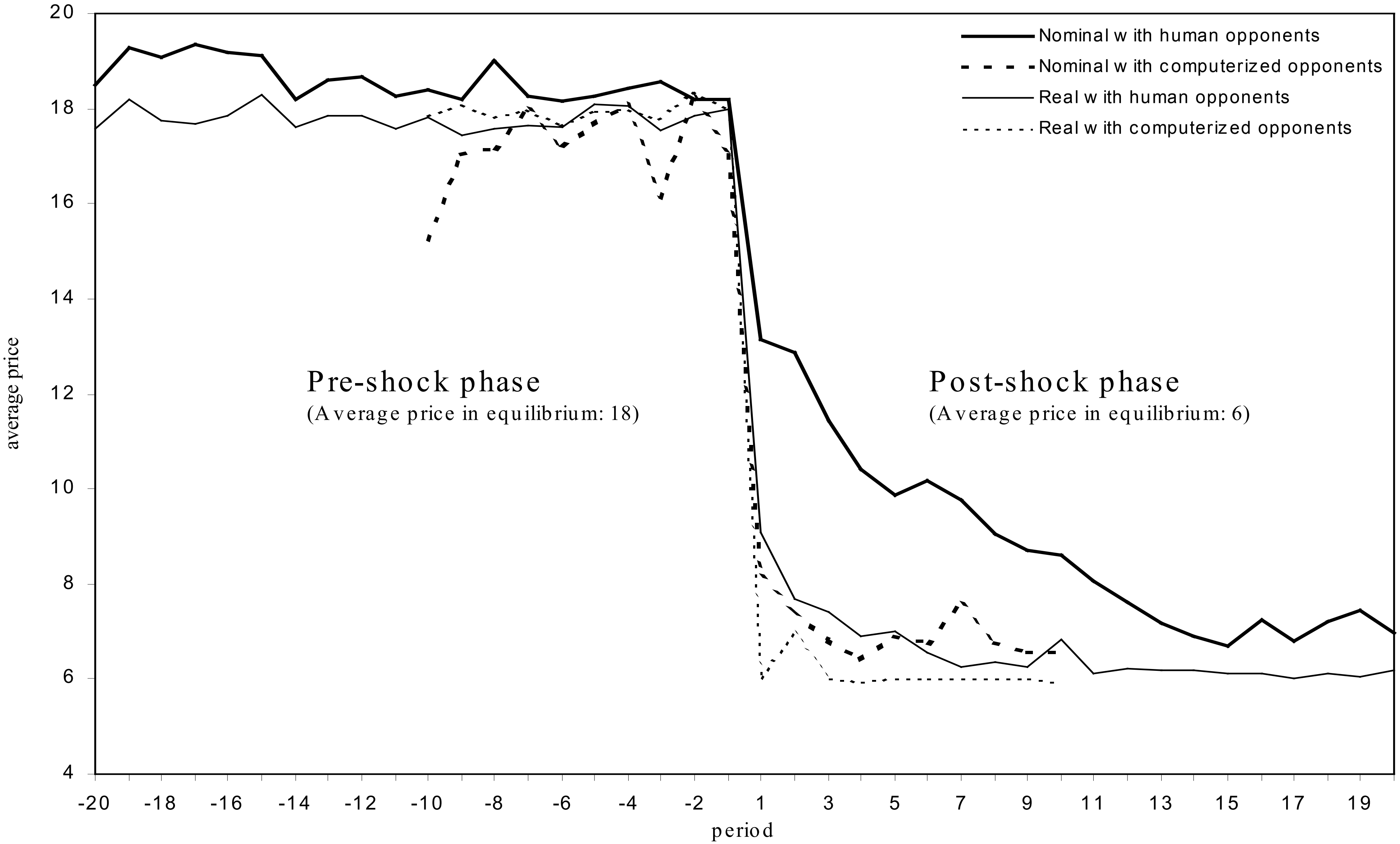


Figure 2: Evolution of average expectations

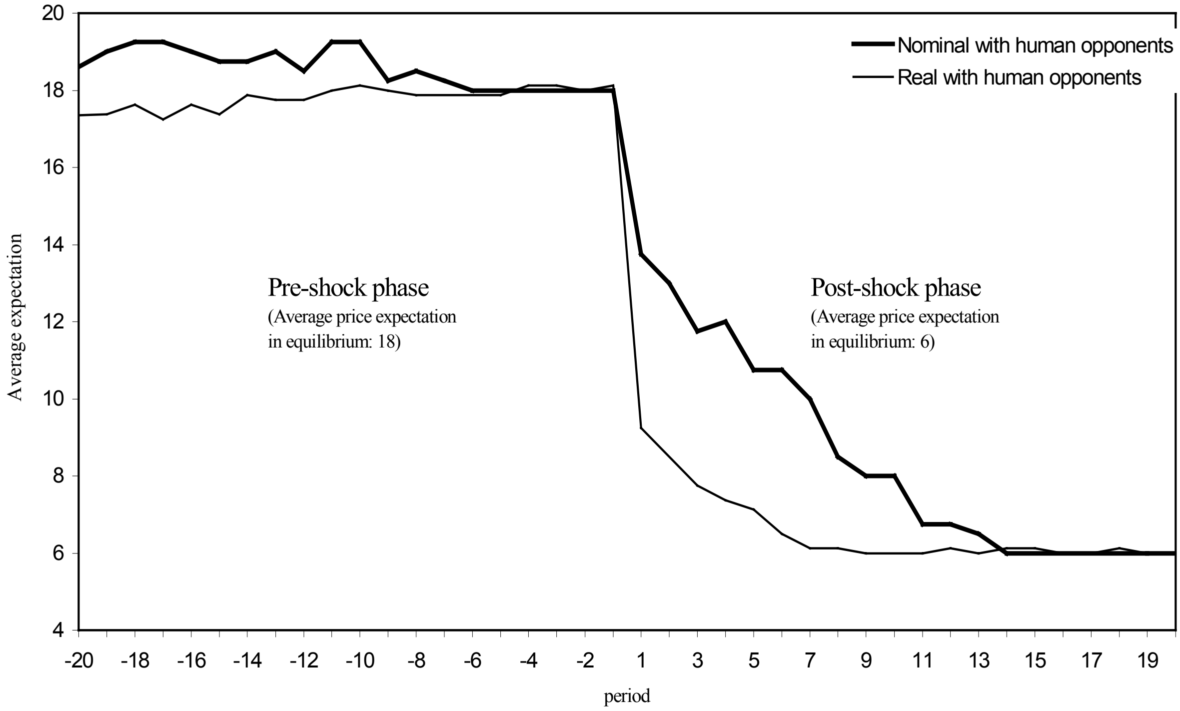
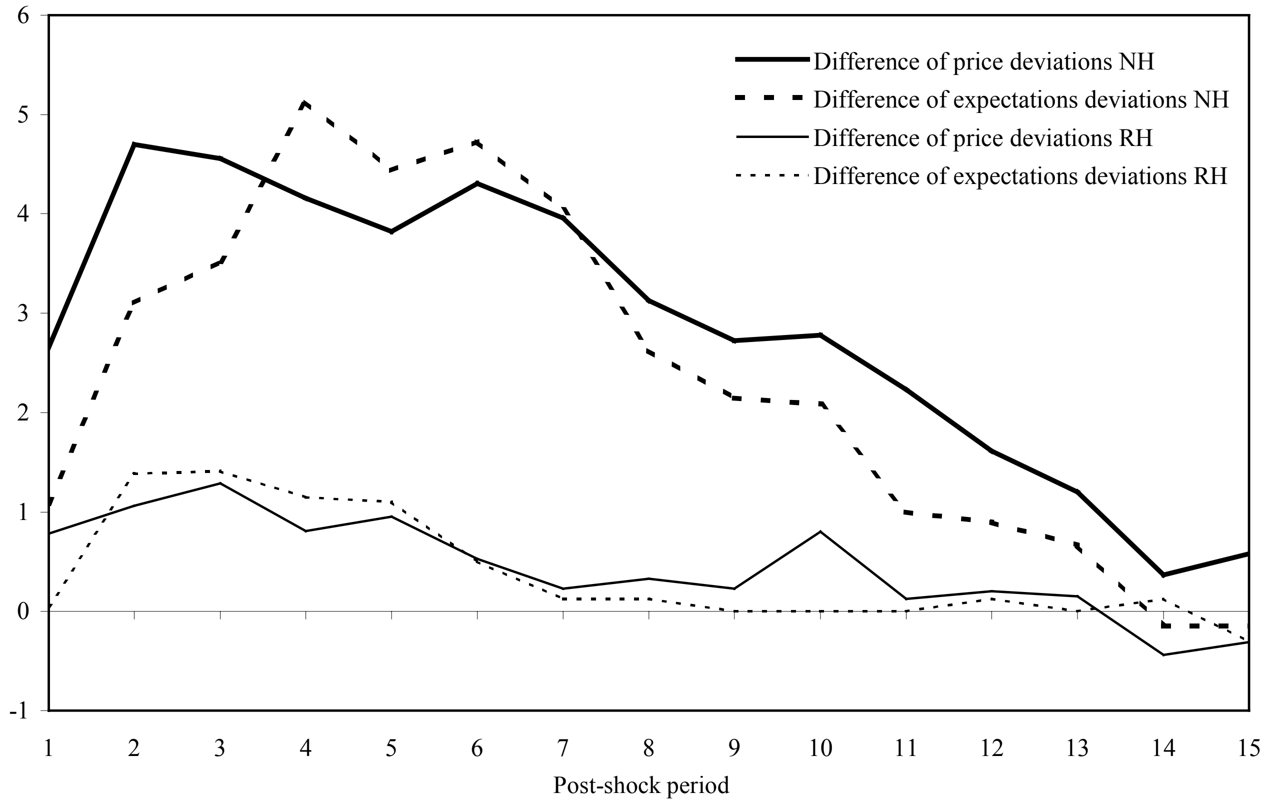


Figure 3: Differences in deviations from equilibrium across the negative and the positive shock



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