The Curse of Inflation

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ABSTRACT

We introduce two well-documented psychological assumptions into the standard macroeconomic model of monopolistic competition by Blanchard and Kiyotaki [1987]. First, we assume that consumers dislike paying a price that exceeds some “fair” markup on firms’ marginal costs. Second, we assume that consumers do not know firms’ marginal costs and fail to infer them from prices. Under the first assumption alone, the economy becomes more competitive, yet all of its qualitative properties remain unchanged; in particular, money remains neutral. Under both assumptions, money is no longer neutral: higher money supply induces lower monopolistic markups, higher output, and higher hours worked. Although an increase in money supply is expansionary, it angers consumers who misperceive higher markups. In fact, it is because consumers feel cheated by higher prices that an increase in money supply is expansionary. Moreover, the elasticity of the price level to money supply—the pass-through—is lower when people care more about fairness, and when the economy is less competitive. Last, an increase in technology induces higher output but higher monopolistic markup and lower hours worked. These theoretical properties accord well with available empirical evidence.

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1 Introduction

A trove of empirical evidence suggests that people dislike paying prices that they perceive as unfair. Kahneman, Knetsch and Thaler [1986] present survey evidence that most people regard it as acceptable for firms to raise prices in line with marginal costs but unfair to raise prices in response to elevated demand. Because consumers typically do not know firms’ marginal costs, their perceptions of prices’ fairness depend upon how they estimate these marginal costs. Rational consumers should invert firms’ equilibrium pricing strategies to infer marginal costs. Yet copious evidence across domains indicates that people infer less than rationally by failing to glean the informational content of other people’s actions. Consumers who underinfer information about marginal cost from price misattribute high prices to high markups rather than high marginal costs.

In this paper, we explore the implications of these two well-documented psychological assumptions into the standard macroeconomic model of monopolistic competition by Blanchard and Kiyotaki [1987]. First, we assume that consumers dislike paying a price that exceeds some fair markup on firms’ marginal costs. When they perceive prices to be unfairly high, consumers withhold demand because paying an unfair markup prevents them from enjoying the firm’s product. More precisely, we modify the standard constant-elasticity-of-substitution utility function to weight consumption of each good by a factor which measures the perceived fairness of the transaction. When a good has price $P$ and perceived marginal cost $MC$, the perceived markup is $\mu^p_p = P/\mu$. When the "fair" markup is $\mu^f$, then each unit of the good is weighted by a factor $\psi = 1 - \phi \cdot (\mu^p - \mu^f)$, where $\phi$ parametrizes fairness concerns. When $P$ exceeds the fair price $\mu^f \cdot MC$, malcontent at unfair pricing leads each unit of consumption to be discounted in the constant-elasticity-of-substitution aggregator.\(^1\)

In our model, consumers do not know firms’ marginal costs. The inferences that they draw about marginal costs from prices play a pivotal role. When consumers can rationally infer firms’ marginal costs and, hence, markups from prices, their distaste for unfair markups increases the elasticity of consumer demand and makes the economy more competitive. Firms optimally set

\(^1\)The preferences we use in this paper share features with those used in the literature on reciprocity and gift-exchange, in that consumers care not only about price and quantity but about the surplus that monopolists take away from the transaction. Akerlof [1982] and Akerlof and Yellen [1990] incorporate fairness considerations into the employment relationship. Rabin [1993] develops a game-theoretic solution concept that embeds reciprocal altruism motives. Fehr and Schmidt [1999] provide a model with social preferences exhibiting aversion to unequal outcomes.
lower markups the greater are fairness considerations. Output, hours worked, and real money balances all exceed their no-fairness levels. But the qualitative features of the economy do not differ from the case without fairness concerns; in particular, money is neutral.

In light of recent evidence that people fail to infer other people’s information from their equilibrium actions, assuming that consumer rationally infer firms’ marginal cost does not seem very plausible [for example, Kagel and Levin, 1986]. Our second assumption therefore is that consumers infer nothing about marginal costs from prices. This assumption is may be extreme but renders the model very tractable. Formally, we use the fully cursed equilibrium of Eyster and Rabin [2005], which marries the assumption that people infer nothing from others’ actions about their information to the traditional equilibrium assumption that people have rational expectations about others’ actions. In our model, this means that consumers infer nothing about firms’ marginal costs from their prices.²

When consumers care about fairness and are fully cursed, money is no longer neutral. For an intuition, suppose that starting from equilibrium in the economy the supply of money and also all prices were to double. In this case, the amount of output demanded by consumers, hours worked, and the cost of labor would remain the same. Accordingly, the real marginal cost faced by firms would not change. Observing higher prices, consumers who failed to infer increases in underlying marginal costs would mistakenly perceive higher markups, which would increase the elasticity of demand, leading firms to optimally set lower markups. This implies that the economy cannot be in equilibrium. Hence, the price level does not rise one-for-one with money supply; consequently, increased money supply leads to increased hours worked and output, increased real marginal costs, and decreased markups. In business cycles generated by money-supply shocks or other aggregate-demand shocks, markups are countercyclical in our model. This behavior is consistent with the findings of a large empirical literature, surveyed by Rotemberg and Woodford [1999]. Even though actual markups fall, perceived markups rise because prices rise: consumers become angry at what they perceive as unfair markups after an increase in money supply, as described by Shiller [1996].

In addition to finding that prices respond less than one-for-one to money supply, we also com-

²Our model shares two features with the model proposed by Rotemberg [2005]: fairness concerns of consumers imposes a constraint on price setters, and consumers have imperfect information about the producers’ costs. Beyond these similarities, our model differs from his in many ways, including how we model fairness concerns, the inference that consumers make about prices, what the norm of fair price is, the properties of the demand curve faced by monopolists, and the response of consumers to moderate price changes.
pute the elasticity of the price level to money supply—the pass-through. We express the pass-through as a function of the shape of the production function, the labor supply elasticity, the competitiveness of the economy (parametrized by the elasticity of substitution across goods), and the magnitude of fairness concerns. We find that the pass-through is lower when people care more about fairness and when the economy is less competitive. These properties accord with the empirical findings of Kackmeister [2007] and Carlton [1986].

Lastly, we analyze how the economy responds to technology shocks. We find that improved technology leads to higher consumption but higher markups and lower hours worked. The response of hours worked to technology shocks is consistent with the empirical findings of Galí [1999] and Basu, Fernald and Kimball [2006]. Although actual markups increase, perceived markups fall so people are happy. The reason is that consumers do not infer from lower prices that real marginal costs have fallen when technology increases.

A classical question in macroeconomics is why money is not neutral. There exist many macroeconomic models in which money is not neutral. The majority of those feature monopolistic firms selling goods subject to price-setting frictions. In these models, money supply shocks propagate to the economy through lower monopolistic markups. Indeed, the optimal pricing decision of each firm is to set their relative price at a markup over their real marginal cost. Averaging over all firms yields a relationship of the form $1 = \mu \cdot mc$, where $1$ is the average relative price, $\mu$ is the average monopolistic markup, and $mc$ is the average real marginal cost. The real marginal cost is an increasing function of output because of diminishing marginal returns in production and increasing marginal disutility of work, among other things. When a money supply shock expands the economy, it therefore increases $mc$ and lowers $\mu$.

In most models with non-neutral money, increasing money supply raises prices but lowers markups, and thus lowers the amount of profit that firms make on each item sold. This is puzzling because people usually feel cheated by rising prices. In a survey conducted by Shiller [1996], 85% of respondents report that they dislike inflation because when they “go to the store and see that prices are higher”, they “sometimes feel a little angry at someone”, the most commonly perceived

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3The price-setting frictions take different forms. Classical frictions include staggered nominal contracts as in Akerlof [1969], Fischer [1977], and Taylor [1979], a quadratic price-adjustment cost as in Rotemberg [1982], infrequent pricing as in Calvo [1983], and a menu cost as in Mankiw [1985] and Akerlof and Yellen [1985]. See Blanchard [1990] for a comprehensive survey of the early theories of money nonneutrality, and Mankiw and Reis [2010] and Sims [2010] for surveys of more recent theories.
culprits including “manufacturers”, “store owners”, and “businesses”, and the most commonly identified cause being “greed”. In this paper, we propose a model that reconciles the nonneutrality of money with the behavioral evidence presented by Shiller [1996]. In our model, it is because consumers feel cheated by higher prices that an increase in money supply is expansionary.

Section 2 presents evidence for the psychological assumptions of fairness concerns and cursedness that underlie our model, in addition to reviewing the literature on price-setting. Section 3 describes our model of the macroeconomy based on Blanchard and Kiyotaki [1987]. Section 4 analyzes the model without fairness concerns. Section 5 analyzes the model when consumers rationally infer firms’ marginal costs from their prices. Section 6 explores what happens when consumers are fully cursed and fail to infer marginal costs from prices. Finally, Section 7 concludes.

2 Motivation for the Fairness and Cursedness Assumptions

In this section we provide empirical evidence to support our assumptions that people care about the fairness of the markup charged by firms, and that people fail to infer firms’ marginal costs from equilibrium prices.

2.1 Fairness Matters for Consumers

In a seminal study, Kahneman, Knetsch and Thaler [1986] provide survey evidence showing that people care about the fairness of prices. In particular, their survey questions establish a pattern wherein consumers deem it fair for firms to raise prices in response to increases in marginal costs but not in response to increases in demand. By assuming that people dislike paying above a fair markup on marginal cost, our model incorporates this finding.\footnote{Kahneman, Knetsch and Thaler [1986] also identifying an asymmetry in consumers’ fairness attitudes. Whereas raising prices without an accompanying rise in marginal cost is deemed unfair, 53% find it acceptable for a small factory that reduces the cost of manufacturing a table by $20 to keep its price unchanged. Our model does not include this asymmetry.}

In our model, consumers do not mind a price increase that follows a cost increase as long as the markup remains the same. Kahneman, Knetsch and Thaler [1986] find such a pattern. They propose the following situation: “Suppose that, due to a transportation mixup, there is a local
shortage of lettuce and the wholesale price has increased. A local grocer has bought the usual quantity of lettuce at a price that is 30 cents per head higher than normal. The grocer raises the price of lettuce to customers by 30 cents per head.” 79% of consumers regard the grocer’s behavior as acceptable. Only 21% of consumers find the behavior unfair.

However, in our model, consumers are angry after a price increase if it follows a demand increase and thus triggers an increase in markup. Kahneman, Knetsch and Thaler [1986] also find such a pattern. They propose the following situation: “A hardware store has been selling snow shovels for $15. The morning after a large snowstorm, the store raises the price to $20.” Only 18% of consumers regard this pricing behavior as acceptable. 82% regard this behavior as unfair.

The findings of Kahneman, Knetsch and Thaler [1986] have been confirmed in many studies, especially using laboratory experiments. For instance, Campbell [1999] provides evidence that consumers’ inferences about the motives behind price increases influence how fair they judge the increase. Renner and Tyran [2004] provides additional evidence that price rigidity after a temporary cost shock is much more pronounced if price increases cannot be justified by cost increases.

2.2 Firms Understand that Fairness Matters for Consumers

Kahneman, Knetsch and Thaler [1986] establish that fairness matters for consumers who purchase goods for firms. Here we provide evidence that firms that sell goods and set prices are aware of consumers’ concern for fairness, and that these fairness concerns influence price setting.

Following Blinder et al. [1998], a number of researchers have surveyed firms about the reasons for price rigidity. The surveys were usually administered by mail or in person to firm managers tasked with setting prices. These managers were presented with a set of economic theories of price setting and asked to rate the importance of each as a cause of their own firm’s price stickiness. In this paper, we propose that customers care about the fairness of prices, and that firms take these concerns into account when setting prices. While the surveys do not explicitly offer our theory as a choice, they do report on the closely related theory of implicit contracts, described as follows:

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5 Table 5.1 in Blinder et al. [1998] provides a short summary of the most commonly proposed theories. Amongst the ten or so theories included in these surveys are three leading macroeconomic theories of price rigidity—menu costs, nominal contracts, and informational frictions. Infrequent pricing as in Calvo [1983] is a useful modeling device but does not provide a theory of price rigidity and therefore could not be evaluated in the surveys. The other theories are IO theories of price rigidity, including coordination failure, signaling quality, or psychological pricing points.
Table 1: The Prevalence of Implicit Contracts with Customers (“Firms tacitly agree to stabilize prices, perhaps out of fairness to customers”)

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Period</th>
<th>Sample</th>
<th>Prevalence of implicit contracts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apel, Friberg and Hallsten [2005]</td>
<td>Sweden</td>
<td>2000</td>
<td>626</td>
<td>1/13</td>
</tr>
<tr>
<td>Kwapil, Baumgartner and Scharler [2005]</td>
<td>Austria</td>
<td>2004</td>
<td>873</td>
<td>1/10</td>
</tr>
<tr>
<td>Aucremanne and Druant [2005]</td>
<td>Belgium</td>
<td>2004</td>
<td>1,979</td>
<td>1/15</td>
</tr>
<tr>
<td>Loupias and Ricart [2004]</td>
<td>France</td>
<td>2004</td>
<td>1,662</td>
<td>4/10</td>
</tr>
<tr>
<td>Lunnemann and Matha [2006]</td>
<td>Luxembourg</td>
<td>2004</td>
<td>367</td>
<td>1/15</td>
</tr>
<tr>
<td>Hoeberichts and Stokman [2006]</td>
<td>Netherlands</td>
<td>2004</td>
<td>1,246</td>
<td>1/8</td>
</tr>
<tr>
<td>Martins [2005]</td>
<td>Portugal</td>
<td>2004</td>
<td>1,370</td>
<td>1/12</td>
</tr>
<tr>
<td>Alvarez and Hernando [2005]</td>
<td>Spain</td>
<td>2004</td>
<td>2,008</td>
<td>1/9</td>
</tr>
</tbody>
</table>

Notes: Respondents to the surveys were presented with a set of price-setting theories, and were asked to rate how important each theory was as a cause of price stickiness in their own firms. This table presents the rank of the theory of implicit contracts. A rank of 4/12 means that the theory was the 4th most popular theory out of 12 possible theories. Table 5.1 in Blinder et al. [1998] provides a short summary of all the theories proposed to respondents. The ranking of the theories are reported in the following tables: in Table 5.2 in Blinder et al. [1998]; in Table 3 in Hall, Walsh and Yates [2000]; in Table 8 in Amirault, Kwan and Wilkinson [2006]; in Table 4 in Apel, Friberg and Hallsten [2005]; in Table 5 in Kwapil, Baumgartner and Scharler [2005]; in Table 18 in Aucremanne and Druant [2005]; in Table 6.1 in Loupias and Ricart [2004]; in Table 8 in Lunnemann and Matha [2006]; in Table 10 in Hoeberichts and Stokman [2006]; in Table 4 in Martins [2005]; and in Table 5 in Alvarez and Hernando [2005].

“Firms tacitly agree to stabilize prices, perhaps out of fairness to customers.” This theory receives abundant support from firms, as showed in Table 1: the theory always finishes in the five most relevant theories and in the top three outside of France, the UK, and the USA. It therefore seems that firms know that customers care about fairness and take these fairness concerns into account when setting prices.

The predictions of our model depend both on the assumption that consumers respond to unfair markups and on the assumption that firms understand how consumers trim demand at unfair prices. Blinder et al. [1998] find evidence that they do. 64% of firms say that customers do not tolerate price increase after increase in demand; 71% of firms say that customers do tolerate price increase after increase in cost. These responses suggest that the norm for fair pricing must look like a
markup over marginal cost. Indeed, based on a survey of businessmen in the UK, Hall and Hitch [1939] report that the fair price is widely perceived to be a markup over average cost. Okun [1975] also observed by discussing with business people that “empirically, the typical standard of fairness involves cost-oriented pricing with a markup”. Okun [1981] adds that “price increases that are based on cost increases are fair, while those based on demand increases often are viewed as unfair”.

Last, our assumption that buyers care not only about price and quantity but also about the markup charged by sellers has implications for what information about costs firms wish to transmit to consumers. When marginal costs are high, firms want consumers to learn their marginal costs in order to reduce their perceptions of markups. When marginal costs are low, firms wish to conceal their marginal costs from consumers whose estimates are too high. There is ample evidence that indeed, sellers try to explain and thus justify price increases caused by increases in costs. In their detailed study of the pricing process of a large industrial firm, Zbaracki et al. [2004] find that the firm spends a lot of resources to communicate and justify the price increase to customers, and hopefully convince them of the logic behind the price change. Okun [1975] also noted that firms aim to “justify cost-oriented price increases—a desire evident in the dedicated, if fuzzy, statements that firms issue, insisting that higher costs force them to raise prices”. Our own observations suggest that these statement are indeed prevalent, as showed in the pictures of Figure 1. Figure 1(a) is interesting because the shop specifically mentions that they want to offer a “fair price”. Figure 1(b) is also interesting, but for another reason. It was taken on an island in Hawaii where they were no other taquerias; hence, the sign is not posted to signal to consumers that competitors will increase their prices as well. Last, Figure 2 is composed of two displays that were posted next to each other in a bakery Ithaca, NY. The first display shows the evolution of crop prices over time. The graph shows in particular that the price of wheat dramatically increased in 2008. The second display explains that the increase in wheat price translated into an increase in flour price, and that wheat flour is a key ingredient for bagels. This display is interesting because it shows that the baker went to great length to justify the increase in cost.
2.3 What is Fair According to French Bakers

Survey of firms suggest that firms are aware that customers care about the fairness of the price, and that firms take these fairness concerns into account when pricing their goods. To understand better what customers care about, and how firms take these concerns into account, we interviewed 31 bakers in France in the summer of 2007. France provides a good example of a market in which seller and buyer are in long-term, frequent, personal relationships, in which fairness concerns are more likely to matter.\(^6\) Furthermore, the price of bread is not controlled in France and bakers are free to set their price.\(^7\) The French bread market is also a good case study because people care a lot about the price of bread in France.\(^8\)

\(^6\)65% of French households patronize a bakery at least once a week; those who patronize a bakery weekly average 3.7 visits a week [Fymard, 1999]. Indeed, the French bread market is quite large: traditional local bakeries employ broadly 148,000 workers, for a yearly turnover of 3.2 billion euros, which represents 68% of the total market [Fraichard, 2006].

\(^7\)Since August 1978, bakers are free to set the price of bread and pastries (arrêté 78-89P of August 9, 1978). However, in the inflationary period between 1979 and 1987, a number of modifications were added to this law to exert some control on bread prices such as price ceilings and agreement on growth rate of prices. On January 1987, bread prices are totally free again (ordonnance 86-1243 of December 1, 1986).

\(^8\)For centuries, bread prices have been a major cause of social upheaval in France. Before the Revolution, the King was often referred to as the “baker of the French people”. It was in the interest the monarch to make sure that bread was readily available at reasonable prices: Miller [1999] reminds us that “Affordable bread prices underlay any hopes for urban tranquility”. For instance, during the Flour Wars (May 1775), the mob was chanting: “If the price of bread does not go down, we will exterminate the king and the blood of the Bourbons”. Following these riots, the king
Crop Prices Are Soaring

The agricultural commodities that go into processed food are becoming more expensive, contributing to higher prices at the grocery store.

- Commodity prices
- Domestic new-crop futures
- Contract price per bushel
- Charts are plotted on comparable percentage-change scales.

Source: Bloomberg Financial Markets

February 28, 2008

TO OUR VALUED CUSTOMERS

Wheat is continuing to hit record prices, vastly increasing our costs for flour. To cope with this, we are forced to impose a surcharge on bread and bagels, effective immediately. This will include sandwiches. Each week, we will recalculate the surcharge, according to the price of wheat. We hope that this will be temporary, but industry experts do not know when—or if—prices will stabilize.

- Our flour cost has more than tripled in the past month.
- On Monday (2/25/08) the price of March spring wheat on the Minneapolis Grain Exchange hit $24 a bushel, double its cost two months ago and the highest price ever for wheat.
- The high-quality wheat we use to make artisan breads and bagels is getting harder to find.
- U.S. stocks of wheat are now at their lowest level in 60 years.

We can direct customers to substantial references for information about the wheat situation, online and in print.

When prices return to normal, we will drop the surcharge. Please bear with us as we try to address this very serious situation. Sincerely,
The Brous & Mehaffey Family

(b) The justification for higher prices

Figure 2: Another Example, from a Bakery in Ithaca, NY, 2008
Following the approach of Bewley [1999], the interviews were only loosely directed. We sampled bakeries from large cities, small towns, and small rural villages, in three regions: around Grenoble and Aix-en-Provence in the southeast, around Paimpol in the northwest, and around Paris. The number of answers does not permit statistical analysis, but the answers provide insight about fairness constraints on pricing.

A critical aspect is that the effort to keep customers loyal constrain price variations. Prices adjustments are guided by norms of fairness to avoid antagonizing customers. In particular, cost-based pricing is widely used. Seven bakers explained that they would rise the price of bread only in response to cost increases: when the price of flour goes up (generally once a year in September at the end of harvest), when utilities go up (especially gas, required to operate the oven), or when the wage of their employees go up. One baker explained that they had maintained the price of bread for the past two years because the price of flour had not changed. Some bakers explained that their largest costs were the wages of their employees, which are linked to a minimum wage that the government update every July 1st; since they only change their price in response to a cost change, they only change their price once a year, on July 1st.

In fact, it is so important for bakers to convince their customers that their markups do not increase that the trade union of bakers decomposes in minute details the cost of bread and how and why the price of bread increase. They emphasize that increases are only responses to cost increases. The union computes what the markups for various types of bread are, and explains the evolution of markups over time. In particular, we learn on the webpage that the markup for bread is 6.4%. We also learn that the price of bread has increased much more slowly than the wage of a low-skill worker between 1800 and 2010.\footnote{The webpage is at http://www.boulangerie.net/forums/bnweb/prixbaguette.php.}

When there is a price increase that follows a cost increase, it is announced long in advance and explained carefully. This behavior suggest that a price increase is tolerated by customers only if it can be justified by a cost increase. We have seen several signs posted on the counter of the bakery that explain that in \( x \) weeks, prices will increase by \( z\% \) due to an increase of ingredient \( y \). These capped the price of bread at 2 sous per pound, which constituted the “ordinary” price of bread in the 18th century. During periods of scarcity, bakers were required to sell at some fair, historical price determined by the people. In case of refusal, warehouses were sometimes looted, or bread was stolen directly from bakeries. The Archives Nationales describe crowds pillaging bakeries in Paris during the Flour War, shouting “we must have bread” [Kaplan, 1996]. Bakers sometimes even required police protection.
signs were almost identical to those pictured in Figure 1.

Not only do bakers seem to set their price as a fixed markup over their cost, but they also consciously refuse to increase prices when the demand increases. The bakers find it unfair to respond to demand shocks. In fact, five bakers explained that they refuse to change prices during the weekends (when more people typically shop at bakeries), when another baker in the neighborhood is on vacation (such that the level of demand and their market power significantly increases), or in the summer season when there are many tourists visiting their region (again, such that the level of demand and their market power significantly increases). They feel that regular customers would be upset and leave in response to such an increase.

2.4 What is Fair According to Religious and Legal Texts

In this paper, we assume that consumers form a fair price as a markup above the marginal cost. Survey of consumers, firms, and French bakers suggest that this norm of fairness is widespread today in the Western world. Religious and legal texts written over the ages suggest that this norm corresponds to a general principle of fairness.

Religious texts are evidence that norms of fair pricing have existed for a long time, and that the fair price often is a fair markup over cost of production or purchase for resale. For example, Talmudic law (Mishnah, Gemarah) states that there is a maximum percentage markup over cost that is fair and acceptable and should be allowed in trade [Wahrhaftig, 1999]. In particular, it is claimed that a good cannot be sold at a markup higher than 20% over the cost of producing the good—1/6 of the final price.10 If the price deviates by more, the buyer is entitled to a refund.

Norms of fair pricing are not only described in religious texts, but also in legal texts. For instance, during most of the 18th century in France, bread prices were fixed by local authorities. The police, supported by the Parliament, would determine a price of bread that would be “fair” for bakers and consumers; this fair price would be announced in an official decree. For example, in the city of Rouen, bread price schedules would take into account the price of grain, costs of rent, milling, wood and labor, and grant a “modest profit” to the baker [Miller, 1999]. The schedule

10 See the statement of Shmuel, page 49b of Bava Metzhia, Nezikin, halakhah.com/pdf/nezikin/Baba_Metzia.pdf. The 20% rule also applies to middlemen, so that if someone sells an item that this person has bought from a producer, the price can now be 44% more expensive than the production cost to compensate the effort of selling.
was decreed by the policy, and could be adjusted with large fluctuations in the price of grain. The entire price-cap map could be revised if the grain prices were too high during a dearth: bakers could petition to have the price cap increased. Price caps could also be lowered, thus reducing the price of bread. Police officers would patrol the marketplace to enforce the price caps.

2.5 Evidence of Cursedness

Based on evidence from strategic situations, in Bayesian games by the requirement that every player correctly predicts the behavior of other players but fails to fully attend to its informational content. Cursed equilibrium is meant to capture the intuitive psychology behind the “winner’s curse” in common-values auctions as well as related phenomena in other strategic settings: bidders in common-values auctions infer too little about other bidders’ private signals from the event that their bid is pivotal; someone buying an asset in a financial market underinfrs the private information that leads the seller to sell; etc. Cursedness explains the voluminous evidence on over-bidding in common-values auctions, reviewed in Kagel and Levin [2002], better than Bayesian Nash equilibrium does. In addition, numerous experimental studies support the hypothesis that people underinfr other people’s information from their actions. See for instance Samuelson and Bazerman [1985], Holt and Sherman [1994], and Carillo and Palfrey [2011] in the context of bilateral bargaining, Kagel and Levin [2002] in the context of common-value auctions, Weizsäcker [2010] in the context of social learning, and Esponda and Vespa [2014] in the context of voting. In the most extreme variant of Oyster and Rabin [2005] solution concept, fully cursed equilibrium, players infer nothing about one another’s types from actions.

Consistent with the assumption of cursedness, Bolton, Warlop and Alba [2003] find evidence that consumers attribute price changes to profiteering and underestimate the role of inflation and cost changes. They also find that providing historical price information, explaining price differences, and cueing costs are modestly effective to explain and justify price increases that are otherwise seen as unfair, suggesting that judgements of fairness depend on consumers’ beliefs.
3 The Model

The model extends a variant of the model of Blanchard and Kiyotaki [1987] to include fairness concerns. In the model, firms with some degree of monopoly power sell their production on the product market. Firms hire workers on a perfectly competitive labor market.

The economy is composed of a continuum of firms indexed by \( i \in [0, 1] \) and a continuum of households portrayed by a representative household. The goods produced by firms are imperfect substitutes for each other so that each firm has some monopoly power.

3.1 Households

The household derives utility from leisure, consumption of produced goods, and consumption of real money balances. The utility from consumption of produced goods is weighted by the perceived fairness of the terms of trade. Specifically, an amount \( c_i \) of good \( i \) bought at a unit price of \( P_i \) when the perceived marginal cost of production is \( MC_i \) yields the fairness-weighted consumption

\[
z_i = \psi_i \cdot c_i,
\]

where the fairness weight \( \psi_i = \psi(\mu_i^p, \mu_i^f) \) is a function of the fair markup \( \mu_i^f \geq 1 \) and the perceived markup \( \mu_i^p \equiv P_i/MC_i \). The fair markups are parameters, while the perceived markups are endogenous variables. For concreteness, we assume that the fairness function takes the form

\[
\psi(\mu_i^p, \mu_i^f) = 1 - \phi \cdot \mu_i^p - \mu_i^f.
\]

The parameter \( \phi \geq 0 \) indicates the importance of fairness concerns.\(^\text{11}\) The fairness function is decreasing in \( \mu_i^p \), increasing in \( \mu_i^f \), and normalized such that \( \psi(\mu, \mu) = 1 \). When consumers perceive good \( i \) to be priced above its fair markup—that is, when \( P_i > \mu_i^f \cdot MC_i \)—they lose a fraction of their consumption of good \( i \) to indignation at its price. When consumers perceive good \( i \) to be priced below its fair markup—that is, when \( P_i < \mu_i^f \cdot MC_i \)—they enjoy heightened consumption utility from consuming what they perceive to be an underpriced good. The fact that the fairness function

\(^{11}\text{We focus on situations where perceived markups satisfy } \mu_i^p \leq \mu_i^f + 1/\phi \text{ so the fairness function remains positive. These conditions are always satisfied in equilibrium.}\)
is homogenous of degree zero in prices implies that consumers evaluate fairness in real rather than nominal terms; in particular, consumers suffer no money illusion. Finally, the fairness function is differentiable everywhere and does not exhibit a kink at the fair markup. This assumption implies that consumers enjoy a price reduction below the fair price as much as they dislike a price increase by the same amount above the fair price. This assumption renders the model very tractable, but it may be unrealistic if consumers are more sensitive to price being above the fair price than to price being below it, as loss aversion might suggest [Kahneman and Tversky, 1979; Tversky and Kahneman, 1991].\textsuperscript{12} We are confident however that the results would hold, and would possibly be stronger, with a kink in the preferences.

The fairness-weighted consumption of the different goods are aggregated into a constant-elasticity-of-substitution fairness-weighted consumption index,

\[
Z = \int_0^Z \frac{1}{z_i} \frac{1}{z_i^{\frac{\epsilon-1}{\epsilon}}} \, \frac{\epsilon}{\epsilon-1} \, di,
\]  

(3)

where \( \epsilon > 1 \) is the elasticity of substitution between different goods. This functional form captures consumers love of variety; as \( \epsilon \to \infty \), goods become perfect substitutes.

The household’s utility function is given by

\[
\ln(z) + \frac{1}{\eta} \ln \frac{M}{\hat{P}} - v \cdot \frac{\xi}{1 + \xi} \cdot \frac{1 + \xi}{1 + \xi}.
\]  

(4)

Utility depends upon real money balances, \( M/\hat{P} \), upon the number of hours worked, \( h \in (0, 1) \), and upon the consumption index, \( z \). Real money balances are the ratio of nominal money balances, \( M \), and the hedonic price index,

\[
\hat{P} = \int_0^1 \frac{P_i}{\Psi_i} \, \frac{1 - \epsilon}{1 - \epsilon} \, di.
\]  

(5)

The hedonic price index corrects the price of each good \( i \), \( P_i \), to account for any differential in

\textsuperscript{12}Sibly [2002] and Heidhues and Koszegi [2008] incorporate loss aversion into a model of price competition with differentiated products. These models capture the fact that consumers may be more sensitive to the price being above the reference price than to the price being below it. Indeed, loss aversion introduces a kink in preferences at the reference point. This kink produces price rigidity in response to cost shocks. However, since gains and losses are defined in real utility, money, if it were introduced in these models, would remain neutral: a monetary shock, which does not change firms’ ability to charge the same real prices, would have no effect.
the fairness weight, \( \psi_i \), which in turn translate into differences in the utility derived from good \( i \). Indeed, the price of \( z_i \) is \( P_i/\psi_i \). The hedonic price index is the natural price index in our model because it is the price of the fairness-weighted consumption index, \( z \). The parameter \( \eta > 0 \) measures the propensity to spend money out of income, the parameter \( \nu > 0 \) measures the level of the disutility from labor, and the parameter \( \xi > 0 \) measures the curvature of the disutility for labor.

Money is the numeraire. The household faces the following budget constraint, expressed in nominal terms:

\[
M_0 + W \cdot h + P - M - \sum_0^1 P_i \cdot c_i di = 0, \tag{6}
\]

where \( M \) is money balances of the household, \( P_i \) is the price set by firm \( i \) for a product of type \( i \), \( W \) is the nominal hourly wage, \( P \) is aggregate nominal profits distributed to the household, and \( M_0 > 0 \) is the money supply, which the household receives as an endowment.

Given \( \{P_i\} \), the household chooses \( \{c_i\} \), \( M \), and \( h \) to maximize (4) subject to (6). Let \( A \) be the Lagrange multiplier on the budget constraint. We start with the first-order conditions with respect to \( c_i \) for all \( i \in [0, 1] \):

\[
\frac{\psi_i}{z} \cdot \frac{z_i}{z}^{-1/\epsilon} = A \cdot P_i,
\]

where we used the fact that \( \partial z/\partial z_i = (z_i/z)^{-1/\epsilon} \cdot d i \). We manipulate the first-order conditions to obtain an expression for \( A \) that will be useful later:

\[
A \cdot \hat{P} = \frac{1}{z}. \tag{7}
\]

Combining the last two equations, we obtain the optimal consumption of good \( i \) for the household, which constitutes the demand faced by firm \( i \):

\[
c_i = \frac{z}{\psi_i} \cdot \frac{P_i/\psi_i}{P}^{-\epsilon} \equiv c_i^d(P_i). \tag{8}
\]

The consumption index, \( z \), describes the level of aggregate demand. The ratio \( (P_i/\psi_i)/\hat{P} \) is the relative price of \( z_i \) compared to \( z \). The demand for good \( i \) increases with aggregate demand but
decreases with the relative price. Finally, everything is divided by \( \psi_i \) to translate the demand for \( z_i \) into a demand for \( c_i \).

Given the demand for good \( i \), the price index satisfies the property that the total cost of purchasing produced goods equals the price index times the fairness-weighted consumption index:

\[
\frac{Z}{P \cdot c_i \cdot d_i} = \hat{P} \cdot z.
\]

Due to this property, \( \hat{P} \) is the relevant price index by which to deflate nominal terms.\(^{13}\)

We use (8) to compute the price elasticity of the demand for good \( i \):

\[
e_i = \varepsilon - (\varepsilon - 1) \cdot e_i^\psi.
\]

where the elasticity \( e_i \) is normalized to be positive and

\[
e_i^\psi = -\phi \cdot \frac{\mu_i^p}{\psi_i}
\]

is the elasticity of the fairness weight \( \psi_i(P_i/MC_i, \mu_i^f) \) with respect to \( P_i \). With fairness concerns, \( e_i^\psi < 0 \) and the elasticity of the demand faced by firm \( i \) exceeds that of the standard model: \( e_i > \varepsilon \). The introduction of fairness concerns makes consumers more sensitive to prices, which increases the elasticity of the demand faced by firms.

We derive the first-order conditions with respect to money, \( M \), and hours, \( h \):

\[
\frac{1}{\eta} \cdot \frac{1}{M} = A
\]

\[
v \cdot h^{1/\xi} = A \cdot W.
\]

Combining these conditions with (7) produces two equations that summarize the trade-offs between working and consuming produced goods and between holding money and consuming pro-

\(^{13}\)This property can be verified by substituting in the expressions for demand (8):

\[
\frac{Z}{P \cdot c_i \cdot d_i} = \hat{P} \cdot \frac{P_i}{\hat{P}} \cdot c_i^\psi(P_i) d_i = \hat{P} \cdot z \cdot \frac{P_i}{\psi_i} \cdot \frac{1 - \varepsilon}{\hat{P} \cdot z} \cdot \frac{\hat{P}^{1 - \varepsilon}}{\hat{P}^{1 - \varepsilon}} = \hat{P} \cdot z.
\]
duced goods:

\[ z = \frac{M}{P} \cdot \eta \]  \hspace{1cm} (11)

\[ v \cdot h^{1/\xi} = \frac{W}{\eta \cdot M} \]  \hspace{1cm} (12)

Equation (11) expresses that the marginal utility from an extra dollar spent on consumption equals that from an extra dollar of money balances, while equation (12) expresses that the marginal utility of an extra unit of leisure time equals the marginal utility of the foregone wage put into money balances.

### 3.2 Firms

We assume that firms’ marginal costs are not observable—they are private information. Throughout the paper, we also assume that firms are not strategic: they do not try to influence consumers’ belief about their marginal cost, \( MC_i \), by choosing a specific price \( P_i \). Formally, firms take the demand (8) as given, and \( MC_i \) does not depend on \( P_i \) in \( \psi_i = \psi(P_i/MC_i, \mu_i) \). This assumption is without consequences when consumers do not care about fairness (in Section 4), because without fairness concerns marginal costs are irrelevant to consumers. It is also without consequences when consumers are fully cursed (in Section 6), because firms could not successfully signal any information about costs to consumers since they are unable to update their beliefs about costs based on prices. It has consequences when consumers care about fairness and are rational (in Section 5), because in that case there may exist signaling equilibria with properties that differ from those of the nonstrategic equilibrium. We do not delve into these signaling equilibria because the case with fairness concerns and rational consumers is not the main subject of the paper.

We use the demand equation (8) to solve the firm’s problem. Firm \( i \) hires labor to produce output according to the production function

\[ c_i = a_i \cdot h_i^\alpha, \]  \hspace{1cm} (13)

where \( c_i \) is output of good of type \( i \), \( a_i \) is the technology level, \( h_i \) is the number of hours hired by firm \( i \), and \( \alpha < 1 \) indicates diminishing marginal returns to scale.
Given $W$ and $P$, firm $i$ chooses $h_i$, $c_i$, and $P_i$ to maximize profits

$$P_i = P_i \cdot c_i - W \cdot h_i$$

subject to the constraints (8) (Lagrange multiplier $B_i$) and (13) (Lagrange multiplier $C_i$). The first-order conditions with respect to $c_i$, $P_i$, and $h_i$ are

$$P_i = B_i + C_i$$
$$c_i = -B_i \cdot \frac{\partial c_i^d}{\partial P_i}$$
$$W = C_i \cdot a_i \cdot \alpha \cdot h_i^{\alpha-1}.$$ 

A bit of algebra shows that firm $i$ sets its price at a markup $e_i / (e_i - 1) > 1$ over the marginal cost:

$$P_i = \frac{e_i}{e_i - 1} \cdot \frac{W}{a_i \cdot \alpha \cdot h_i^{\alpha-1}}.$$  

(15)

Since the price elasticity $e_i$, given by (9), is larger than in the standard model without fairness concerns, the markup of firm $i$ is lower than in the standard model. In other words, firms have less monopoly power in the presence of fairness concerns.

### 3.3 Definition of the General Equilibrium

The general equilibrium of the model consists of a collection of prices $\{P_i\}$, a collection of perceived markups $\mu_i^P$, a hedonic price index $\hat{P}$, a collection of productions $\{c_i\}$, a collection of weighted consumptions $\{z_i\}$, a fairness-weighted consumption index $z$, a collection of hours $\{h_i\}$, aggregate hours worked $h$, a real wage $w$, and real money balances $m$ that satisfy 10 conditions: the definitions of the fairness-weighted consumptions and fairness-weighted consumption index, given by (1) and (3); the definition of the hedonic price index, given by (5); the conditions for maximization of the household’s utility, given by (8), (11), and (12); the condition for maximization of firms’ profits, given by (15); the production constraint, given by (13); and 2 market-clearing conditions, $h = \int \mathbb{R} h_i d\bar{P}$, and $m = M_0 / \hat{P}$.

The equilibrium comprises 10 objects determined by the 10 conditions above, one of which is
redundant, in addition to one equation that does not appear above because we have not specified how consumers form their perceptions of markups $\mu^p_i$. Below, we study different equilibria built around different inference processes.

We simplify the equilibrium by focusing on a symmetric equilibrium, in which consumers perceive the same marginal costs for all goods, the fair markup is the same for all goods, and all firms share a common technology, set the same prices, and produce the same amounts. Let $a$ be the common technology, $P$ be the price set by all firms, $c$ be the amount of goods produced by all firms, $\mu^p$ be the perceived markup that consumers attribute to all firms, $\mu^f$ be the fair markup for all goods, $\psi$ be the fairness weight for all goods, and $e$ be the elasticity of demand for all goods. In the symmetric equilibrium, $h_i = h$ for all $i$, $z_i = z$ for all $i$, and $P/\psi = \hat{P}$.

### 3.4 Characterization of the General Equilibrium

At this stage we have have not specified how consumers form their perceptions of markups. Without the perceived markup we cannot determine the actual markup and thus the properties of the general equilibrium. However, for all the inference processes that we study in this paper, the general equilibria share a common structure. We describe this structure here.

By specifying the inference process, we will determine the equilibrium level of markup perceived by consumers and thus the actual markup charged by firms. Indeed, the actual markup is a function of the perceived markup given by

$$\mu(\mu^p) = 1 + \frac{1}{\varepsilon - 1} \cdot 1 - \frac{\phi \cdot \mu^p}{1 + \phi \cdot \mu^f}.$$  \hspace{1cm} (16)

This expression arises from the fact that $\mu = e/(\varepsilon - 1)$ where $e$, the price elasticity of the demand faced by firms, is given by (9) and (10). The function $\mu(\mu^p)$ plays a critical role in the analysis of the general equilibrium. It has the following properties:

**Lemma 1.** When consumers do not care about fairness ($\phi = 0$), the equilibrium markup coincides with the standard monopolistic markup: $\mu(\mu^p) = e/(\varepsilon - 1)$. But when consumers care about fairness ($\phi > 0$), the markup is below the standard monopolistic markup for any perceived markup: $\mu(\mu^p) < e/(\varepsilon - 1)$ for all $\mu^p \geq 0$. In fact, the markup reverts to the standard monopolistic markup when the perceived markup is 0: $\mu(0) = e/(\varepsilon - 1)$; and the markup strictly decreases
in the perceived markup: $\partial \mu / \partial \mu^p < 0$. The markup falls to the competitive markup when the perceived markup reaches its upper bound: $\mu(\mu^*) = 1$ where $\mu^* = \mu^f + 1 / \phi$. Last, if we impose that perceived and actual markup match, the markup is given by

$$
\mu^* = \frac{\epsilon}{\epsilon - 1 + \phi / (1 + \phi \cdot \mu^f)};
$$

the markup $\mu^*$ is the fixed point of the function $\mu$.

Figure 3 illustrates the results of the lemma. We will consider three cases below: (1) no fairness concerns ($\phi = 0$), (2) fairness concerns ($\phi > 0$) but rational consumers for which the perceived markup is the actual markup ($\mu^p = \mu$), and (3) fairness concerns ($\phi > 0$) and fully cursed consumers who do not infer anything and thus take the marginal cost faced by firms, $MC$, as a parameter. In case (1), the lemma shows that the actual markup is always $\mu = \epsilon / (\epsilon - 1)$. In case (2), the lemma shows that the actual markup is always $\mu = \mu^*$. In case (3), $\mu^p = P/MC$ so the markup becomes a function of the price, $\mu = \mu(P/MC)$, whose properties are described in the lemma.

We now show that a symmetric general equilibrium can be described by a pair $(P, \omega)$, where

$$
\omega \equiv \frac{W}{P \cdot a}
$$
is the effective labor cost. All the other endogenous variables can be directly obtained from \((P, \omega)\).

First, the production constraint, given by (13), relates output to hours:

\[
\ln \frac{c}{a} = \alpha \cdot \ln(h). \tag{17}
\]

Second, in a symmetric equilibrium, \(z = \psi \cdot c\) and \(\hat{P} = P / \psi\) so that the trade-off between consumption and saving, given by (11), relates output to money supply:

\[
\ln \frac{c}{a} = \ln \frac{M_0}{P \cdot a} + \ln(\eta). \tag{18}
\]

Third, the trade-off between consumption and work, given by (12), relates hours to wage and money supply:

\[
\ln(v) + \frac{1}{\xi} \cdot \ln(h) = \ln \frac{W}{P \cdot a} - \ln(\eta) - \ln \frac{M_0}{P \cdot a}. \tag{19}
\]

Combining this equation with (17) and (18) allows us to relate hours to the effective labor cost:

\[
\ln(h) = \frac{\xi}{1 + \alpha \cdot \xi} \cdot (\ln(\omega) - \ln(v)) \tag{19}
\]

Recombining (17), (18), and (19) allows us to relate the price to the effective labor cost:

\[
\ln(P) = \frac{\alpha \cdot \xi}{1 + \alpha \cdot \xi} \cdot (\ln(v) - \ln(\omega)) + \ln(M_0 \cdot \eta) - \ln(a) + \ln(\alpha). \tag{20}
\]

This is the first equation that the equilibrium pair \((P, \omega)\) must satisfy. This equation is constructed from the utility-maximization conditions of the household’s problem. It describes the price level as a decreasing function of the effective labor cost.

Fourth, the firms’ optimal pricing decision, given by (15), relates the equilibrium markup to the effective labor cost and hours:

\[
0 = \ln(\mu) + \ln(\omega) + (1 - \alpha) \cdot \ln(h) - \ln(\alpha). \tag{21}
\]

Using the expression (19) for hours, we rewrite the firms’ optimal pricing decision as a relationship
between effective labor cost and equilibrium markup:

\[ \ln(\mu) = -\frac{1 + \xi}{1 + \alpha \cdot \xi} \cdot \ln(\omega) + \frac{(1 - \alpha) \cdot \xi}{1 + \alpha \cdot \xi} \cdot \ln(v) + \ln(\alpha). \]  

(22)

This is the second equation that the equilibrium pair \((P, \omega)\) must satisfy. This equation combines the utility-maximization conditions of the household’s problem with the profit-maximization condition of firms’ problems. It describes the effective labor cost as a function of the actual markup and some parameters only.

To summarize, (20) and (22) determine \(P\) and \(\omega\), or equivalently \(P\) and \(W\). Having \(P\) and \(\omega\), we can use (19) to obtain \(h\) and (17) to obtain \(c\). With \(P\), we can also determine \(\mu\), \(\psi\), and \(\varepsilon\) using the definitions of these variables. Last, we determine nominal profits:

\[ P = P \cdot c \cdot \frac{1 - \alpha}{\mu}. \]  

(23)

This equation is easily obtained by combining the definition of nominal profits, given by (14), the optimal pricing decision of firms, given by (15), and the production constraint, given by (13).

4 The Case Without Fairness Concerns

We derive and describe the general equilibrium when consumers do not care about fairness. Without fairness concerns the equilibrium has the standard properties obtained in macroeconomic models of monopolistic competition, such as the Blanchard and Kiyotaki [1987] model. Of course, money is neutral.

Lemma 1 shows that without fairness concerns the actual markup is \(\mu = \varepsilon / (\varepsilon - 1)\). It is therefore simple to solve the system (20) and (22) and thus obtain the equilibrium value of the price level, \(P\), and the effective labor cost, \(\omega\). Figure 4 graphs (20) and (22) in a \((\ln(\omega), \ln(P))\) plane. Equation (20) defines a linear and downward-sloping curve and equation (22) defines a
vertical curve. The equilibrium is at the intersection of the two curves, where

\[
\ln(\omega) = \frac{1 + \alpha \cdot \xi}{1 + \xi} \cdot \ln(\alpha) - \ln \left( 1 - \frac{\varepsilon}{\varepsilon - 1} \right) + \frac{1 + \alpha \cdot \xi}{1 + \xi} \cdot \ln(\nu) \tag{24}
\]

\[
\ln(P) = \frac{\alpha \cdot \xi}{1 + \xi} \cdot \ln(\nu) + \ln \left( 1 - \frac{\alpha \cdot \xi}{\varepsilon - 1} \right) + \ln(M_0 \cdot \eta) - \ln(a) + 1 - \frac{\alpha \cdot \xi}{1 + \xi} \cdot \ln(\alpha). \tag{25}
\]

Using the equilibrium values of the effective labor cost and the price level, we obtain a number of comparative statics. From (24), we find that the effective labor cost, \( \omega \), depends neither on money supply, \( M_0 \), nor on technology, \( a \). Equation (19) implies that hours worked depends neither on money supply nor on technology. Equation (17) implies that output does not depend on money supply but is proportional to technology. From (25), we then find that the price level, \( P \), is proportional to money supply and inversely proportional to technology. The nominal wage satisfies \( W = \omega \cdot P \cdot a \), so it is proportional to money supply but does not depend on technology. Nominal profits satisfy (23), so they are proportional to money supply but do not depend on technology.

Money is neutral since hours, output, and real money balances \( M_0/P \) do not depend on the money supply. This result replicates the famous finding of Blanchard and Kiyotaki [1987] that money is neutral in an economy with monopolistic competition.

These comparative static results are summarized in the following proposition:

**PROPOSITION 1.** The equilibrium with consumers who do not care about fairness has the following features:

- **Money is neutral:** the money supply has no effect on monopolistic markup, output and hours worked; the price level, nominal wage, and nominal profits are proportional to the money supply.

- **Technology influences quantities and prices:** output is proportional to technology; the price level is inversely proportional to technology; but monopolistic markup, hours worked, nominal wage, and nominal profits do not depend on technology.

The proposition only considers money supply and technology shocks, which are the most interesting to us, but it is possible to study other types of shocks. For instance, we could study the effects of an aggregate demand shock parameterized by a change in the preference parameter \( \eta \).
An increase in $\eta$ lowers the marginal utility of money balances, which pushes the household to consume more of the produced goods, and can thus be interpreted as an increase in aggregate demand. Since $M_0$ and $\eta$ enter together in (25) and do not enter in the other equilibrium conditions, it is clear that increasing $\eta$ will have exactly the same effect as increasing $M_0$. In particular, aggregate demand is neutral without fairness concerns. We could also study the effects of a labor supply shock parameterized by a change in the preference parameter $v$.

5 The Case with Fairness Concerns and Rational Consumers

We now turn to the case in which consumers care about fairness. Given that the fair price is a fair markup over marginal cost and that consumers care about fairness, consumers care about firms’ marginal costs. As stated above, firms’ marginal costs are not observable. However, we assume that consumers are rational so that they are able to back out marginal costs by observing all the prices set by firms.\textsuperscript{14} We find that the general equilibrium is isomorphic to that obtained in Section 4 under the assumption that consumers do not care about fairness. All the comparative statics remain the same. The only difference is that fairness concerns make the demand schedules

\textsuperscript{14} The results in this section would remain the same if we assumed that marginal costs were observable so that consumers knew all the marginal costs.
faced by monopolists more price-elastic so the markups are smaller and output and employment are higher.

Firms understand that consumers are rational and therefore able to infer their marginal cost, \( MC \). Rational consumers understand the pricing strategy of firms. They understand that in equilibrium, the price level satisfies \( P/MC = \mu(P/MC) \), where \( \mu \) is the function described in Lemma 1. Equivalently, the equilibrium markup is the fixed point of \( \mu \). Thus the equilibrium markup is

\[
\mu = \mu^* = \frac{\varepsilon}{\varepsilon - 1 + \phi/(1 + \phi \cdot \mu^*)}.
\]  

(26)

Clearly, this markup lies below the markup without fairness concerns, \( \varepsilon/(\varepsilon - 1) \). The markup is smaller when consumers care about fairness, and in that sense the economy is more competitive. The markup can converge to the competitive markup of 1 only on one condition: that consumers care infinitely about fairness (\( \phi \to \infty \)) and the fair markup is 1.

The equilibrium when consumers care about fairness and are rational is isomorphic that when consumers do not care about fairness. Once \( \varepsilon/(\varepsilon - 1) \) is replaced by \( \mu^* < (\varepsilon - 1)/\varepsilon \), the equilibrium \( (P, \omega, c, h) \) remains described by the system of equations \{(17), (19), (24), (25)\}. The equilibrium is depicted in Figure 5. Indeed, the equilibrium with fairness concerns and elasticity of substitution \( \varepsilon > 1 \) is exactly the same as an equilibrium without fairness concerns and an elasticity
of substitution

\[ \varepsilon' = \varepsilon \cdot \left(1 + \frac{1}{\mu' - 1 + 1/\phi} \right). \]

The elasticity \( \varepsilon' \) is obtained by solving \( \varepsilon'/(\varepsilon' - 1) = \mu^* \). Since \( \varepsilon' > \varepsilon \), we see again that the economy is more competitive with fairness concerns. And since \( \lim_{\phi \to 0} \varepsilon' = \varepsilon \), we verify that the economy with fairness concerns reverts to the economy without fairness concerns when the fairness parameter, \( \phi \), goes to 0.

Since the markup is lower, the vertical curve describing (22) shifts outside. Hence, the price level, \( P \), is lower but the effective labor cost, \( \omega = W/(P \cdot a) \), is higher. Since \( \omega \) is higher, (19) implies that hours worked are higher. Then, (17) implies that output is higher. Intuitively, monopolistic competition leads to inefficiently low production because firms mark their prices up above marginal costs. The markup set by firms decreases with the elasticity of demand. Greater concern for fairness increases the elasticity of demand and thus improves efficiency. Greater efficiency means higher output and more hours worked.

Of course, the variables \( z = \psi \cdot c \) and \( \hat{P} = P/\psi \) may differ in the equilibria with and without fairness concerns, even if \( c \) and \( P \) are the same, because \( \psi \), the fairness weight, is 1 without fairness concerns but may be above or below 1 with fairness concerns. Whether \( \psi > 1 \) or \( \psi < 1 \) depends on the level of the fair markup compared to the equilibrium markup. Since welfare critically depends on the level of \( z \) and \( \hat{P} \), the level of the fair markup plays a critical role when comparing welfare in the equilibria with and without fairness concerns.

Here we compare welfare when the fair markup is at the level of the equilibrium markup. This case is particularly simple to analyze because the fairness weight is 1 so the hedonic price index equals the price level and the fairness-weighted consumption index equals output: \( \psi = 1, P = \hat{P} \), and \( z = c \). In that case, \( \hat{P} \) is lower and \( z \) is higher. Real money balances, \( M_0/\hat{P} \), are also higher. Since output and real money balances are higher, and hours worked are unchanged, the welfare, given by (4), is higher.\(^{15}\)

In addition to welfare, we also compare profits in the equilibria with and without fairness

\(^{15}\)If the fair markup is not at the level of the equilibrium markup, the effect on welfare is ambiguous. We can only assert that welfare is higher in the presence of fairness concerns if \( \psi \geq 1 \). This is the case when the fair markup is at or below the equilibrium markup. Otherwise \( \psi < 1 \) and the effect on welfare depends on the cost from feeling unfairly treated relative to the gains from lower markups.
concerns. We focus on the case \( \psi = 1 \). Equation (23) says that real profits satisfy \( \frac{P}{P} = c \cdot (1 - \alpha/\mu) \). The effect on real profits depends on the initial level of markups and thus on the elasticity of substitution between goods, \( \varepsilon \). Indeed, the elasticity of profits with respect to the markup is

\[
\frac{d \ln \left( \frac{P}{P} \right)}{d \ln (\mu)} = \alpha \cdot \frac{1}{\mu - \alpha} - \frac{\xi}{1 + \xi},
\]

which can be positive or negative.\(^{16}\) Since \( \xi/(1 + \xi) < 1 \), the elasticity is positive as long as \( 1/(\mu - a) > 1 \) or \( \mu < 1 + \alpha \). The conventional value of \( \mu \) in macroeconomics is in the range of 1.05–1.3. The conventional value of \( \alpha \) is in the range 0.66–1. Therefore, for conventional parameter values, the elasticity is positive and profits are lower when consumers care about fairness.

The equilibrium variables \( (P, \omega, c, h) \) satisfy the exact same equilibrium system in Section 4, except for the value of the markup. In addition, \( \psi = 1 - \phi \cdot (\mu^* - \mu^f) \) is constant in the face of money supply or technology shocks because \( \mu^* \) is only a function of \( \varepsilon, \phi, \) and \( \mu^f \). Thus, \( z \) and \( \tilde{P} \) are proportional to \( c \) and \( P \), respectively. The comparative statics are therefore exactly the same as in Section 4. This means that money remains neutral when rational consumers care about fairness.

The results from the analysis are summarized in the following proposition:

**Proposition 2.** The equilibrium with rational consumers who care about fairness is more competitive that the equilibrium with consumers who do not care about fairness: the effective labor cost, output, and hours worked are higher; monopolistic markup and price level are lower.

The equilibrium admits the following comparative statics:

- **Money is neutral:** the money supply has no effect on monopolistic markup, output, fairness-weighted consumption, and hours worked; price level, hedonic price index, nominal wage, and nominal profits are proportional to the money supply.

- **Technology influences quantities and prices:** output and fairness-weighted consumption are proportional to technology; the price level and hedonic price index are inversely proportional to technology; but monopolistic markup, hours worked, nominal wage, and nominal profits do not depend on technology.

\(^{16}\)We obtain this elasticity by computing a number of elasticities from the equilibrium conditions. Equation (17) implies that \( d \ln (c)/d \ln (h) = \alpha \). Equation (24) implies that \( d \ln (\omega)/d \ln (\mu) = (1 + \alpha \cdot \xi)/(1 + \xi) \). Equation (19) therefore implies that \( d \ln (h)/d \ln (\mu) = -\xi/(1 + \xi) \). In sum, \( d \ln (c)/d \ln (\mu) = -\alpha \cdot \xi/(1 + \xi) \). The definition of real profits implies that \( d \ln (\tilde{P}/P)/d \ln (\mu) = d \ln (c)/d \ln (\mu) + \alpha/(\mu - \alpha) = \alpha \cdot [1/(\mu - \alpha) - \xi/(1 + \xi)] \).
6 The Case With Fairness Concerns and Cursed Consumers

We maintain the assumption that customers care about fairness but dispense with the assumption that they can infer marginal cost from price. Instead, we assume that customers are fully cursed in the sense of Eyster and Rabin [2005]. Cursed consumers attribute any price increase to sellers’ greed, which angers them. Under the combination of assumptions that customers care about fairness and make cursed inferences, money is no longer neutral: when the money supply increases, prices increase but not one-for-one because sellers strive to alleviate customers’ anger; therefore, the monopolistic markup decreases and output and employment increase.

6.1 The Concept of Cursed Equilibrium

Rational consumers use all available information to infer firms’ nominal marginal costs, \(MC_i\), including all prices, \(\{P_i\}\), as well as possibly the level of money supply, \(M_0\), and the parameter that characterizes technology, \(a\). With this information, they would form expectations of utility

\[
\E[U|\{P_i\},M_0,a] = \E \ln \int_0^Z \left(\psi \cdot c_i\right) \frac{e^{-x}}{x^{\xi+1}} \, dx + \frac{1}{\eta} \cdot \ln \frac{M}{\hat{P}} + \nu \cdot \frac{\xi}{1+\xi} \cdot h^{\frac{1+\xi}{\xi}} \{P_i\},M_0,a. 
\]

The only terms unknown to consumers in this expression are the \(MC_i\) terms that enter the fairness weights, \(\psi_i = 1 - \phi \cdot P_i/MC_i - \mu_i\), and the hedonic price index, \(\hat{P}\). Rational consumers would use their understanding of firms’ pricing rules as well as their observations of \(\{P_i\}, M_0,\) and \(a\) to infer these marginal costs.

We assume that consumers are not rational but instead fully cursed in the sense of Eyster and Rabin [2005]: they fail to draw any inference about marginal costs from any observable information.\(^{17}\) Cursedness can be interpreted as a form of neglect: consumers simply do not think through the information that prices convey about marginal costs. Of course, consumers observe prices and have downward-sloping demand as described in Section 3, but they do not use prices to infer marginal costs. Instead, they use their prior beliefs about nominal marginal cost to form expectations of their utility. Whereas rational consumers condition their expectations upon all their

\(^{17}\)A richer model would include some rational consumers who infer marginal costs from prices, and some fully cursed consumers. We suspect but have not proven that this sort of mixture model would deliver the same qualitative results as ours, most likely with muted effects.
available information \( \{P_i, M_0, a\} \), cursed consumers form their expectations unconditionally.\(^{18}\)

To simplify, we assume that consumers’ priors about nominal marginal costs are highly concentrated around a given nominal marginal cost, \( MC \), so that we can replace consumers’ expected utility with their utility given cost \( MC \).\(^{19}\) As a consequence, all of our comparative statics describe reactions to surprise shocks. Overall, we find that introducing cursedness has important macroeconomic implications, summarized in Table 2.

### 6.2 Characterization of the Cursed General Equilibrium

We proceed to analyze the general equilibrium with fairness concerns and cursedness. Equation (20) retains the same properties: it describes a linear and downward-sloping curve in a \((\ln(\omega), \ln(P))\) plane, as depicted in Figure 6. The properties of equation (22) are modified, however, because with cursedness the monopolistic markup is not a constant but a function of the price level: \( \mu = \mu(P/MC) \), where the function \( \mu \) is analyzed in Lemma 1 and depicted in Figure 3, \( MC \) is the parameter that measures the nominal cost perceived by cursed consumers, and \( P/MC \) is the markup perceived by cursed consumers. The lemma implies that \( \ln(\mu(P/MC)) \) decreases from \( \ln(\varepsilon/(\varepsilon - 1)) \) to 0 when \( P \) increases from 0 to \( \mu \cdot MC \). Hence, equation (22) describes an upward-sloping curve in the \((\ln(\omega), \ln(P))\) plane, as depicted in Figure 6. When \( \ln(\omega) \) is at the level prevailing in the equilibrium without fairness concerns, which is given by (24), \( \ln(P) \) asymptotes to \(-\) . When

\[
\ln(\omega) = \frac{1 + \alpha \cdot \xi}{1 + \xi} \cdot \ln(\alpha) + \frac{1 - \frac{1 + \alpha \cdot \xi}{1 + \xi}}{\ln(\nabla)}, \tag{28}
\]

\( \ln(\mu) = 0 \) so \( \ln(P) = \ln(\mu \cdot MC) \). In that case, the perceived markup is at its upper bound and the actual markup is 1.

It is clear from the representation of the general equilibrium in Figure 6 that the general equi-

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\(^{18}\)Eyster and Rabin [2005] extend cursed equilibrium to the case where people are partially cursed in the sense of appreciating that firms’ prices signal marginal costs while underappreciating how much prices signal. Partially cursed consumers in our model would maximize a convex combination of unconditional expected utility and expected utility conditional upon \( \{P_i, M_0, a\} \).

\(^{19}\)We expect but have not proven that none of the qualitative results depend upon this simplifying assumption.
librium exists if and only if

\[
\ln(\bar{\pi} \cdot MC) \geq \frac{\alpha \cdot \xi}{1 + \xi} \cdot \ln(v) + \ln(M_0 \cdot \eta) - \ln(\alpha) + 1 - \frac{\alpha \cdot \xi}{1 + \xi} \cdot \ln(\alpha). \tag{29}
\]

This is the condition such that the two curves cross: it imposes that when \(\ln(\omega)\) is given by (28), the curve representing equation (20) is below the highest possible price of \(\ln(\bar{\pi} \cdot MC)\). This condition imposes that the perceived cost is high enough. We assume that (29) holds such that the equilibrium always exists. In that case, the equilibrium is clearly unique.

It is easy to see how the equilibrium responds to different realizations of money supply and technology because these parameters only influence the intercept of the downward-sloping curve without affecting the slope of the downward-sloping curve or the upward-sloping curve. This is what we do next.

### 6.3 Money Supply Shocks

We compare a high and a low realization of money supply, \(M_0\). We find that money is not neutral any more: an increase in money supply stimulates the economy. As showed in Figure 7, a high realization of money supply shifts the downward-sloping curve upward. Hence, the price level, \(P\),

Figure 6: The General Equilibrium with Fairness Concerns and Cursed Consumers
and the effective labor cost, \( \omega \), are higher. Following the usual logic, hours worked and output are higher.

Fairness concerns combined with cursedness lead to a mild form of price rigidity: the price does not move as much as money supply. This can readily be seen in equation (18). The amount of output demanded by consumers increases so the amount of real money balances \( M_0/P \) demanded by consumers must increase. This implies that \( P \) does not rise as much as \( M_0 \).

After the increase in money supply, perceived and actual markups diverge. Since \( P \) is higher and the perceived cost, \( MC \), remains the same, the perceived markup \( \mu^p = P/MC \) is higher. But when the perceived markup is higher, Lemma 1 tells us that the actual markup is lower. The response of the markup determines the response of real profits. The elasticity of real profits with respect to the markup given by (27) remains valid here. As we have argued, this elasticity is positive when \( \mu < 1 + \alpha \), which holds in any conventional macroeconomic calibration. In this case, real profits fall after the increase in money supply.

The effect of an increase in money supply on welfare is ambiguous. On the one hand, the economy is more efficient since the monopolistic markup falls; on the other hand, people are angered by the price increase. Formally, the effect on fairness-weighted consumption \( z \) and on money balances \( M_0/P \hat{P} \) is ambiguous because \( c \) and \( M_0/P \) increase while \( \psi \) decreases.

Imagining what would happen if prices were flexible is interesting and clarifies the mecha-
nisms behind the nonneutrality of money. Suppose that starting from the initial equilibrium, \( P \) were to increase proportionally with \( M_0 \). Equation (18) implies that the amount of output demanded by consumers, \( c \) would remain the same because \( M_0/P \) is unchanged. This is because consumers equalize the marginal utilities from consumption of output and real money balances. Equation (17) implies that hours worked, \( h \), would remain the same. This is because the amount of \( c \) that must be produced from \( h \) is unchanged. Equation (19) then implies that the effective labor cost, \( \omega \), is unchanged. This is because the amount of \( h \) supplied by the household has not changed. Since \( h \) and \( \omega \) are unchanged, the real marginal cost faced by firms, \( \omega \cdot h^{1-\alpha} \), remains the same. Equation (21) implies that the monopolistic markup, \( \mu \), must remain unchanged for this situation to be an equilibrium.

But it is impossible that \( \mu \) remains unchanged. As we have discussed above, because the fairness-weighted consumptions depend upon prices, demand no longer has constant price-elasticity and the optimal markup for firms is no longer constant. As people get angry, the price-elasticity of demand increases. Hence, the optimal markup decreases with the perceived markup. Consumers are ignorant of the increase in nominal marginal costs in the new situation because they infer nothing from higher prices. Observing higher prices, they mistakenly perceive higher markups. Since perceived markup increase, \( \mu \) must decrease. Therefore, (21) cannot hold. The economy cannot be in equilibrium. This gives an intuition for why after an increase in money supply, the price level does not rise one-for-one with money, hours worked and output increase, effective labor costs increase, actual markup falls, and perceived markup increases.

The following proposition summarizes the effects of an increase in money supply:

**PROPOSITION 3.** With consumers care about fairness and are cursed, money is not neutral. An increase in money supply leads to an increase in output, hours worked, and effective labor cost, and a decrease in monopolistic markups. In addition, prices are somewhat rigid: the price level increases less than proportionally with the money supply. Even though the actual markup falls when the money supply increases, consumers are angry because the perceived markup increases.

With fairness concerns and cursedness, money is not neutral any more and prices are somewhat rigid—they do not move as much as the money supply. Unlike in traditional macroeconomic models, this happens without the introduction of any constraint on price setting: there are no long-
term nominal contracts, price-adjustment costs, or staggered pricing. Instead, the assumption that consumers care about perceived markup, combined with a misperception of marginal cost, leads to the nonneutrality of money. Those are assumptions on consumers’ preference and inference; they are very different from assumptions on price setting.

The model also explains why expansionary monetary policy may be unpopular: profits fall but perceived markup increases. Hence, both firms and consumers dislike an expansionary policy. The response of consumers to an expansionary monetary policy accords well with the survey responses in Shiller [1996]: in our model as in the survey, consumers become angry at what they perceive as unfair markups after the increase in price following an increase in money supply.

In this, our model has very different welfare implications than other macroeconomic models with sticky prices. For instance, the textbook New Keynesian model predicts that the cost of inflation derives from the price dispersion that results from staggered pricing [Gál, 2008]. In our model, by contrast, inflation imposes a welfare cost through high perceived markups which anger consumers.

In business cycles generated by money supply shocks or other aggregate demand shocks, markups are countercyclical in our model: an increase in money supply leads to higher output and lower markups, and a decrease in money supply leads to lower output and higher markups. The countercyclical behavior of markups is consistent with a large empirical literature that finds that markups are countercyclical in the data. However, the empirical measurement of markups is complicated, and the results may be sensitive to the empirical specifications used to estimate the cyclicality of markups. For instance, using alternative methods and new data, Nekarda and Ramey [2013] do not find a significant response of markups to aggregate demand shocks. More empirical work would be beneficial to improve our understanding of the response of markups to various types of macroeconomic shocks.

While the empirical response of markups is consistent with our model, it is also consistent with many other macroeconomic theories of the business cycle. Of course, markups are countercyclical under aggregate demand shocks in New Keynesian models because firms take time to adjust their prices. Since firms are slow to increase their prices after an increase in aggregate demand, markups

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For a survey of this literature, see Rotemberg and Woodford [1999]. For more recent work estimating countercyclical markups, see Bils and Kahn [2000] and Gál, Gertler and Lopez-Salido [2007]
are temporarily lower.

Unlike in the New Keynesian model, firms’ desired markups vary over time in our model. In that respect, our model is closer to models of business-cycle fluctuations based on endogenous markups. These theories propose that markups fluctuate over time, and that these fluctuations lead to business cycles. A broad class of models studies endogenous markups over the business cycle. In this class, our model is most closely related to models that generate cyclical markups from cyclical variations in the elasticity of demand faced by monopolists. This idea dates back to Robinson [1932]. She argues that consumers buy durables in recessions when they are forced to replace an old durable that broke down, whereas consumers buy new durables in expansions. She predicts that the demand for durables is much more elastic in expansions than in recessions, which leads to counter-cyclical fluctuations in markups. Another model of this type was proposed by Gali [1994]. He argues that the elasticity of demand for consumption and investment goods have different elasticities, and that the relative share of these goods in output varies systematically around the business cycle, leading to cyclical fluctuations in markup. Other models generate cyclical markups through other mechanisms. For example, Rotemberg and Saloner [1986] predict that markups are lower in good times because of price wars among oligopolists when demand is high. Another example is Bils [1989], who predicts that markups are low in periods of high demand because firms choose to expand their customer base, whereas they are high in periods of low demand because firms choose to exploit their existing customers.

6.4 Technology Shocks

We compare a high and a low realization of technology, $a$. As showed in Figure 7, a high realization of technology shifts the downward-sloping curve downward. Hence, the price level and the effective labor cost are lower. Equation (19) implies that hours worked are lower. Equation (22) also implies that $P \cdot a$ increases; in other words, the price does not decrease as much as $1/a$, and there is some price rigidity. Since $P \cdot a$ increases but $P$ decreases, (18) implies that output $c$ increases but $c/a$ decreases. In other words, output does not increase as much as technology.

The perceived markup decreases because $P$ decreases. An implication is that the actual markup increases. Another implication is that people are happy after the price decrease, even tough the ac-

\[^{21}\]See for instance the discussion in Stiglitz [1984].
tual markup rises. Fairness-weighted consumption $z$ and real money balances $M_0/P$ both increase because $c, M_0/P, \text{ and } \psi$ increase.

The following proposition summarizes the effects of an increase in technology:

**PROPOSITION 4.** With consumers care about fairness and are cursed, technology influences quantities and prices. An increase in technology leads to an increase in output, albeit less than proportional to technology. The monopolistic markup increases and hours worked and effective labor cost decrease. In addition, prices are somewhat rigid: the price level decreases but less than proportionally with technology. Even though the actual markup increases when technology increases, consumers are happy because the perceived markup decreases.

The result that an increase in technology leads to higher output but lower hours worked is consistent with the empirical evidence provided by Galí [1999] and Basu, Fernald and Kimball [2006], among others. Markups are procyclical under technology shocks: an increase in technology leads to higher output and higher markups, and a decrease in technology leads to lower output and lower markups. This property is consistent with the empirical evidence provided by Nekarda and Ramey [2013].

### 6.5 The Pass-Through After Money Supply and Technology Shocks

The pass-through is the elasticity of the price level with respect to the underlying shock. The simplicity of the model allows us to express the pass-through in response to money supply and technology shocks as a function of the parameters of the model, in particular the competitiveness of the economy and the extent of fairness concerns. We find that the pass-through is smaller in economies that are less competitive and when consumers care more about fairness. We provide some empirical evidence supporting these predictions.

We begin by calculating the pass-through $\sigma \equiv d \ln(P)/d \ln(M_0)$ after a money supply shock. Simple algebra shows that the price-elasticity of the function $\mu(P/MC)$, defined by (16), admits a simple expression:

$$
\frac{d \ln(\mu(P/MC))}{d \ln(P)} = 1 - \frac{\varepsilon}{\varepsilon - 1} \cdot \frac{1}{\mu} < 0.
$$
Table 2: Summary of the Comparative Statics

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>No fairness</th>
<th>Fairness</th>
<th>Fairness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No cursedness</td>
<td>No cursedness</td>
<td>Cursedness</td>
</tr>
<tr>
<td><strong>A. Effect of an increase in money supply (M_0)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output (c)</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Hours worked (h)</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Price level (P)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Effective labor cost (\omega)</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Actual markup (\mu)</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>Perceived markup (\mu^p)</td>
<td>0</td>
<td>0</td>
<td>+</td>
</tr>
<tr>
<td><strong>B. Effect of an increase in technology (a)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output (c)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Hours worked (h)</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>Price level (P)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Effective labor cost (\omega)</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>Actual markup (\mu)</td>
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<td>0</td>
<td>+</td>
</tr>
<tr>
<td>Perceived markup (\mu^p)</td>
<td>0</td>
<td>0</td>
<td>–</td>
</tr>
</tbody>
</table>

Notes: This table summarizes the results of Propositions 1, 2, 3, and 4. The case without fairness concerns and cursedness is examined in Section 4, the case with fairness concerns but no cursedness is examined in Section 5, and the case with fairness concerns and cursedness is examined in Section 6.

The elasticity is negative because, as discussed above, the markup \(\mu\) is always below the standard monopolistic markup, \(\varepsilon/(\varepsilon - 1)\). The reason is that an increase in price raises the perceived markup, forcing firms to reduce their markup. Next, (22) and (20) imply that

\[
\frac{d \ln(\omega)}{d \ln(\mu)} = -\frac{1 + \alpha \cdot \xi}{1 + \xi}
\]

\[
\frac{d \ln(P)}{d \ln(M_0)} = 1 - \frac{\alpha \cdot \xi}{1 + \alpha \cdot \xi} \cdot \frac{d \ln(\omega)}{d \ln(\mu)} \cdot \frac{d \ln(\mu)}{d \ln(P)} \cdot \frac{d \ln(P)}{d \ln(M_0)}.
\]

Combining these results we obtain the value of the pass-through in response to a money supply shock:

\[
\sigma = \frac{d \ln(P)}{d \ln(M_0)} = 1 + \frac{\alpha \cdot \xi}{1 + \xi} \cdot \frac{\varepsilon}{\varepsilon - 1} \cdot \frac{1}{\mu} - 1^{-1} < 1.
\]

(30)
The pass-through is less than 1. As discussed above, our model exhibits a mild form of price rigidity: the price level does not adjust one-for-one with a money supply shock. The expression for the pass-through depends on the shapes of the labor supply and production function, and on the competitiveness of the economy.

The pass-through $\sigma$ is evaluated at an equilibrium markup of $\mu$, which also depends on the parameters of the model. To get a deeper understanding of the pass-through, we can evaluate it at $\mu^*$, the equilibrium markup when consumers care about fairness and know firms’ marginal costs. The pass-through at $\mu^*$ can be interpreted as the pass-through around a steady state where consumers have learned firms’ marginal costs. Using the expression for $\mu^*$, given by (26), we obtain

$$\sigma^* = \left(1 + \frac{\alpha \cdot \xi}{1 + \xi} \cdot \frac{1}{\epsilon - 1} \cdot \frac{1}{\mu^f + 1/\phi}\right)^{-1}. \tag{31}$$

The pass-through $\sigma^*$ exhibits three interesting properties. First, it is increasing with the elasticity of substitution across goods, $\epsilon$, which implies that the pass-through is larger in economies that are more competitive. This property echoes the finding of Carlton [1986] that prices are more rigid in industries that are more concentrated.

Second, $\lim_{\epsilon \to 1} \sigma^* = 0$ but $\lim_{\epsilon \to +} \sigma^* = 1$. The first limit means that as the monopoly power of firms goes to infinity, the pass-through goes to 0: prices are completely rigid. The second limit means that as the economy becomes perfectly competitive, the pass-through goes to 1. An implication is that an increase in money supply is unlikely to be desirable when demand is highly elastic and the economy is very competitive. The pass-through goes to 1 so increased money supply has negligible, albeit slightly stimulatory, effects on all output and hours. However, increased money supply increases the price level and thus perceived markups, which significantly lowers the fairness weight, $\psi$. Because output, hours worked, and money balances $M/P$ all change negligibly, this decrease in fairness weight leads consumer welfare to fall with money supply.

Third, the pass-through is decreasing with the fairness parameter, $\phi$. The more consumers care about fairness, the lower the pass-through, and the larger the effects of money supply shocks on output and hours worked. Our theory provides a links between two important empirical findings reported by Kackmeister [2007], who provides evidence that the personal relationship between
retailer and customer is significantly weaker today than it was at the end of the 19th century. He infers that the fairness of a transaction matters less today than it did in 1890. In other words, \( \phi \) is lower today than it was in 1890. Our model implies that the pass-through should be higher today than it was in 1890. This is what Kackmeister’s work shows: retail prices were much more rigid in 1889–1891 than in 1997–1999.

Following the same steps, we can compute the pass-through of prices after a technology shock. The price level declines after an increase in technology, because higher technology means lower marginal costs. It is convenient to have a positive pass-through, so we define it as \(-d \ln(P)/d \ln(a)\). It is easy to show that the pass-through admits exactly the same expression as for technology shocks as for money supply shocks; hence, \(-d \ln(P)/d \ln(a)\) is given by (30). The reason is that \(\ln(a)\) and \(\ln(M_0)\) enter similarly in the system of (20) and (22). An implication is that an increase in marginal cost caused by lower technology leads to a smaller price increase when the economy is less competitive and when consumers care more about fairness.

7 Conclusion

In this paper, we have built a macroeconomic model in which the nonneutrality of money arises from two two well-documented psychological assumptions: (1) consumers are averse to paying prices that exceed a fair markup over marginal cost; and (2) consumers do not know firms’ marginal costs and fail to infer them from prices. Assumption (2) implies that consumers mistakenly attribute higher prices following higher money supply to higher markup instead of higher nominal marginal cost. Assumption (1) implies that the demand curve faced by monopolists is not isoelastic but has an elasticity increasing with the markup perceived by consumers. Combined, these effects induces higher perceived markups but lower actual markups after an increase in money supply. In other words, it is because consumers feel cheated by higher prices and because they withdraw demand when they feel unfairly treated that an increase in money supply is expansionary.

It is worth emphasizing that our model focuses on only two channels through which monetary policy affects social welfare. First, higher money supply induces lower monopolistic markups, thus increasing economic efficiency and welfare. Second, higher money supply induces a misperception that higher prices reflect price gauging, which angers people and lowers welfare. The first welfare
effect would not exist without the second one: it is because consumers are angered by higher prices that an increase in money supply is expansionary.

The model abstracts from many other channels that may also matter in reality. These omissions prevent us at this stage from drawing conclusions about optimal monetary policy. The main limitation of the model is that our modeling of the labor market is less than ideal. This influences the welfare analysis in two ways. First, as Akerlof, Dickens and Perry [1996] proposed, one benefit of moderate inflation is that it tends to erode real wages if nominal wages are somewhat rigid. Hence, inflation may be useful to reduce unemployment. Second, people seem to fear that rising prices will outpace wages, and that inflation will impoverish them. This reason features preeminently in Shiller [1996]. To build a coherent theory of the Phillips curve and design of optimal monetary policy when consumers and workers care about fairness but are cursed, it seems necessary to integrate these two other mechanisms. We leave this task for future research.

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