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Do Tips Increase Workers' Income?

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This paper constructs a model of service providers who compete in service and labor markets simultaneously to analyze the effects of tipping on hourly wages and total tip-inclusive hourly worker compensation. An increase in the tipping rate reduces hourly wages. Total worker compensation increases at different rates depending on the market structure, market coverage, and employment level, with the exception of price-taking (competitive) service providers, where the tip-inclusive hourly income declines with the tipping rate. The paper develops an index of "effective tipping" that measures the net percentage change in total hourly worker compensation associated with each tipping rate.

Keywords: tipping; hourly wage; tip-inclusive hourly income; tipping as a social norm
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1. Introduction

1.1. Motivation

It is very hard to avoid paying tips in America. To avoid paying tips, one must refrain from eating at non-fast-food restaurants, take public transportation instead of cabs, stick to do-it-yourself repair services, and turn haircuts into family entertainment. The following quote highlights some of the puzzles behind tipping behavior:

> With all the anxiety surrounding tipping, it's a miracle people leave their homes at all. When you think about it, tipping is a transaction within a transaction, and informal economy within a formal one. You're paying on top of something you've already paid for, almost like a *tax*. Who decides that, and why?
> (Dublanica 2010, p. 7)

The purpose of this paper is to investigate the effects of a long-term increase in the rate of tipping on hourly wages and total hourly (tip-inclusive) income. To gain full intuition, I construct a model of service providers who compete *simultaneously* in two markets: the market for the service offered to consumers and the labor market where service providers set wages to attract workers. To examine how varying the level (or rate) of tipping affects wages and total hourly income, the tipping rate is taken as an exogenously given social norm; see Azar (2004, 2007b).

Most tips consumers leave in restaurants are expressed as a *percentage* of the dollar amount of the service bill, commonly referred to as the *tipping rate*. Therefore, workers' income from tips should not be eroded with inflation, even if the tipping rate remains constant. Despite that, the tipping rate has been steadily rising. The paper by Azar (2004) and the references therein provide evidence of changes in tipping rates over the years, showing that a 10% tip was common from the end of the 19th century until after the Great Depression (although a minimum tip was also common for small bills). In the 1980s, 15% tips were already the standard, whereas today we observe 18% and even 20% tipping rates. Tips for taxi drivers have followed a similar trend.

The magnitude of the tipping rate as well as the large variety of service industries where tips account for a significant portion of workers' income makes the study of tipping very important. Azar (2011) highlights the economic significance of tipping by showing that the U.S. food industry alone generated $46.6 billion worth of tips in 2009, which is computed as 18.8% (average tipping rate) of $247.9 billion annual sales.

1.2. The Origins of Tipping Behavior and Its (Non)Relationship to Service Quality

The history of tipping in the United States is described in Segrave (1998), Azar (2004), and Dublanica (2010).[1] Tipping originated in Europe. There is evidence that guests who visited private British homes in the 17th century were expected to leave tips for the host's servants (Segrave 1998, pp. 1–7). In the United States, tipping was uncommon before the Civil War. One theory suggests that the emancipation era triggered the habit of tipping because it brought a large number of ex-slaves into the labor market, which allowed firms to reduce wages to extremely low levels (Dublanica 2010, pp. 15–19). Since then, tipping for services has become an integral part of workers' income in most

[1] For an extensive bibliography list on all aspects of tipping, see Michael Lynn's website, http://tippingresearch.com (accessed August 22, 2014).

service sectors, although there is evidence that some service workers were forced to hand their tips to their supervisors; see Segrave (1998, pp. 14–15) and Dublanica (2010, pp. 19–20).

To be able to pursue this investigation in a simple model that solves for equilibria in *both* the service and the labor markets, the model assumes that there is no particular correlation between the amount of tip and the level of service. This assumption is based on some evidence that tips need not be related to rewarding workers for exerting greater effort in order to obtain better service; see Azar (2007a), Lynn and McCall (2000), and Lynn et al. (2012).

Lynn and McCall (2000) combine 13 studies of the relationship between tip sizes and service evaluations involving more than 2,500 dining parties at 20 different restaurants. In most cases, zero-order correlations were obtained. Overall, there may be a statistically significant relationship between service evaluation and tip size, but it is quite small, accounting for less than 2% of the variability in tip percentages.

Lynn et al. (2012) further disaggregate the investigation of the relationship between the magnitude of tips and customers' perception of service quality. They show that this relationship is stronger for older customers than for younger ones and for parties with large bills than those with smaller bills.

Given this evidence, and because the sole goal of this paper is to explore the labor market consequences of tipping, the relationship between tipping and service quality will not be explored. The tipping rate will be treated as an exogenously given social norm, which also helps explain why people tip in establishments they will never revisit. Kahneman et al. (1986) point out that the adherence to a 15% tipping rule is observed even by one-time customers who pay and tip by credit cards and therefore have little reason to fear embarrassing retaliation by an irate server.

1.3. Results and Organization

The intuition derived from the model can be best explained by first examining the equilibria where some service workers remain unemployed and then compare the results to the full employment equilibrium. Under partial employment, or under an incomplete service market coverage, an increase in the tipping rate reduces firms' incentives to compete in the labor market. As the model shows, higher tipping rates weaken wage competition in the labor market because employers count part of their workers' income from tips as part of worker compensation. Therefore, higher tipping rates reduce service firms' incentives to attract additional workers via higher wages.

Under full employment, or when the service market is fully served, the service output level is fixed at the full employment or at the maximal level of demand. Therefore, the service market is not affected by the tipping rate. In the labor market, as with the partial employment case, higher tips weaken wage competition, so firms reduce their wage rate by keeping total hourly (tip-inclusive) income constant. I refer to this case as *tipping neutrality*.

The rest of this paper is organized as follows. Section 2 sets up a model of service providers interacting *simultaneously* in service and labor markets. The benchmark framework models the service as homogeneous and labor as heterogeneous. Sections 3–5 analyze the effects of tipping on wages and total hourly income when the labor market equilibrium results in partial employment. Section 3 investigates price-taking (competitive) service providers. Section 4 analyzes an imperfectly competitive (oligopoly) service market. Section 5 introduces minimum wage. Section 6 analyzes the effects of tipping under full employment. Section 7 deviates from the benchmark framework by modeling service as differentiated and labor as homogeneous. Section 8 summarizes the results.

2. A Model of Tipping

2.1. The Service Market

Consider two restaurants indexed by $i = 1, 2$ selling homogeneous meals priced at p dollars per meal. Let q_1 and q_2 denote the number of meals served by restaurant 1 and restaurant 2, respectively. Let τ $(0 \le \tau < 1)$ denote the exogenously given tipping rate. Hence, each buyer leaves τp dollars on each purchased meal. Therefore, the tip-inclusive meal's price (buyer's price) is $(1+\tau)p$. The inverse demand function for meals is assumed to take the form

$$(1+\tau)p = \alpha - \beta(q_1+q_2) \quad \text{or} \quad p = \frac{\alpha - \beta(q_1+q_2)}{1+\tau}, \tag{1}$$

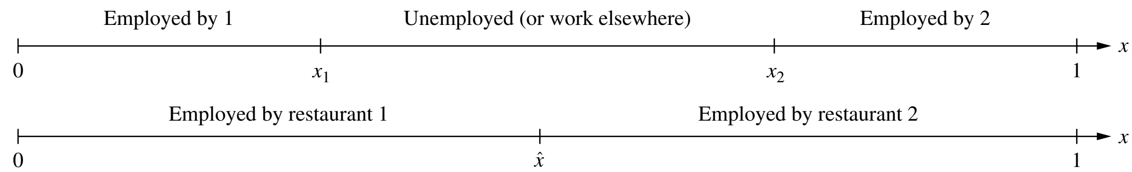
where α is the demand intercept, β is the absolute value of the slope, and $\alpha, \beta > 0$. A similar demand structure is assumed by Schwartz (1997), who investigates the effects of tipping on the profits made by service providers.

2.2. The Labor Market

The two restaurants are located on the opposite ends of a street of size $[0, 1]$, where all potential workers (waiters) reside. Restaurant 1 is located on the far left side and restaurant 2 on the right side. At each point $x \in [0, 1]$, there are n $(n \ge 1)$ potential waiters who may choose to work at restaurant 1, restaurant 2, or neither. Thus, x measures the distance between worker x and restaurant 1 and $1-x$ the distance from restaurant 2.[2]

[2] The assumption that workers bear significantly higher transportation costs to travel to restaurants 1 and 2 relative to consumers could be justified by looking at restaurants where consumers use private

Figure 1 Labor Allocation Between Restaurants



Note. Top: partial employment; bottom: full employment.

Normalizing the amount of work each worker can offer to one hour, let l_1 and l_2 denote the amount of waiter-hours employed by restaurant 1 and restaurant 2. Let k ($1 \le k \le \alpha/(\beta n)$) be a productivity parameter so that l_i waiter-hours produce kl_i units of service. For example, one waiter-hour can serve k meals in a restaurant. Therefore, the output produced (number of meals served) by restaurant 1 and restaurant 2, as functions of employment levels, is $q_1 = kl_1$ and $q_2 = kl_2$, respectively.

Let w_1 and w_2 denote the endogenously determined hourly wage rates paid to waiters employed by restaurant 1 and restaurant 2, respectively. Let I_1 and I_2 denote those waiters' total (tip-inclusive) hourly income. Given that each waiter-hour produces k meals,

$$I_1 = w_1 + \tau kp \quad \text{and} \quad I_2 = w_2 + \tau kp. \tag{2}$$

Thus, the utility of a waiter residing at x ($x \in [0, 1]$) is

$$U_x = \begin{cases} I_1 - \delta x = w_1 + \tau kp - \delta x \\ \quad \text{if employed by restaurant 1,} \\ I_2 - \delta(1-x) = w_2 + \tau kp - \delta(1-x) \\ \quad \text{if employed by restaurant 2,} \\ \hat{w} \quad \text{otherwise,} \end{cases} \tag{3}$$

where $\delta > 0$ is the cost of traveling one unit of distance to the place of employment, and $\hat{w}$ is the hourly wage if a worker decides to work elsewhere (or receive unemployment benefits). With no loss of generality, the reservation wage $\hat{w}$ is normalized to zero.

From (3) we can define the thresholds x_1 and x_2 so that all waiters (measured in labor-hours) indexed on $[0, x_1]$ choose to work at restaurant 1 and all waiters indexed on $[x_2, 1]$ work at restaurant 2, as illustrated in Figure 1.

Figure 1 illustrates how partial and full employment are modeled in this paper. Formally,[3]

Definition 1. (a) The labor market is said to be in a state of *unemployment* if $x_1 < x_2$. In this case, the *unemployment rate* is measured by the difference $x_2 - x_1$.

(b) The labor market exhibits *full employment* if $x_2 = x_1 \stackrel{\text{def}}{=} \hat{x}$.

In view of Figure 1 and workers' utility function (3), hiring leaves $(x_2 - x_1)n$ waiters unemployed when the transportation (distance) cost parameter δ is sufficiently high, so potential workers who reside in the middle of the linear city would not find it beneficial to work in either restaurant. From workers' utility function (3), the fraction of workers employed by restaurant 1 is determined from $0 = \hat{w} = w_1 + k\tau p - \delta x_1$. Similarly, the fraction of workers employed by restaurant 2 is determined from $0 = \hat{w} = w_2 + k\tau p - \delta(1 - x_2)$. Therefore,

$$x_1 = \frac{w_1 + k\tau p}{\delta} \quad \text{and} \quad x_2 = \frac{\delta - w_2 - k\tau p}{\delta}. \tag{4}$$

Under *full employment*, workers indexed by $\hat{x}$ are indifferent between working at restaurant 1 and restaurant 2. It follows from Definition 1 and the bottom part of Figure 1 that $x_1 = x_2 = \hat{x}$ under full employment. Hence, the workers' utility function (3) implies that $\hat{x}$ is determined from $w_1 + \tau kp - \delta\hat{x} = w_2 + \tau kp - \delta(1 - \hat{x})$, or

$$\hat{x} = \frac{w_1 - w_2 + \delta}{2\delta}. \tag{5}$$

Thus, an increase in the wage rate paid by restaurant 1 would increase employment with restaurant 1 and reduce employment with restaurant 2.

2.3. Production of Service

Definition 1 implies that $l_1 = x_1 n$ waiter-hours are employed by restaurant 1, $l_2 = (1 - x_2)n$ waiter-hours are employed by restaurant 2, and $(x_2 - x_1)n$ remain unemployed (if $x_1 < x_2$). Therefore, the number of meals served in each restaurant and aggregate industry output are

$$\begin{gathered} q_1 = kl_1 = kx_1 n, \quad q_2 = kl_2 = k(1 - x_2)n, \quad \text{and} \\ Q = q_1 + q_2 = k(x_1 + 1 - x_2)n. \end{gathered} \tag{6}$$

Hence, $Q = kn$ under full employment, whereas $Q < kn$ when some workers are unemployed.

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or company cars during lunch time, whereas workers use much slower means of transportation such as public buses, biking, or even walking. Therefore, under significant differences, we can normalize consumers' transportation costs to zero and treat the two restaurants as homogeneous service providers. Section 7 explores the polar case where only consumers bear transportation costs.

[3] For the purpose of this paper, unemployment could be also interpreted as working at a different industry and earning $\hat{w}$ (normalized to zero). The terms "unemployment," "partial employment," and "partial unemployment" are used interchangeably in this paper.

2.4. Effective Tipping Rate

The model developed in this paper generates predictions on how an increase in the tipping rate affects worker's hourly wage. Therefore, there is a need to develop a measure of effective tipping rate that would take into account the reduction in hourly wages relative to a market without tipping.

Definition 2. Let $0 \le \tau < 1$ be the buyers' tipping rate, and let $w(\tau)$ and $p(\tau)$ be the equilibrium wage and restaurant price. Then, the index of *effective tipping rate* is defined by

$$\tau^e(\tau) \stackrel{\text{def}}{=} \left[1 + \frac{w(\tau) - w(0)}{\tau k p(\tau)}\right]\tau = \left[\frac{I(\tau) - w(0)}{I(\tau) - w(\tau)}\right]\tau \quad \text{for all } 0 \le \tau < 1. \tag{7}$$

Intuitively, given that a buyer leaves a fraction τ of the price as a tip, the purpose of the measure (7) is to quantify the actual tipping rate *received* by the waiter given that the tip causes the hourly wage and/or the price to drop. In the extreme case where hourly wages do not vary with the tipping rate, τ, the effective tipping rate, τ^e, equals the consumers' tipping rate τ because $w(\tau) = w(0)$ for any $\tau \ge 0$. However, if wages decline with the tipping rate, then $w(\tau) < w(0)$, and hence $\tau^e < \tau$, implying that the effective tipping rate is lower than the buyers' tipping rate.

Appendix A proves that the second definition in (7) is equivalent to the first. The second measure offers an alternative interpretation for the effective tipping rate. It is the ratio of the difference between total tip-inclusive hourly income and the wage rate that would prevail in the absence of tipping to the difference between total tip-inclusive hourly income and the wage when tipping prevails, all multiplied by the buyers' tipping rate τ. This ratio is smaller than one when the wage rate under no tipping, $w(0)$, is higher than when there is tipping, $w(\tau)$ for $\tau > 0$.

3. Price-Taking Restaurants with Unemployment

This section analyzes the effects of tipping on hourly wages and total worker compensation assuming price-taking (competitive) service providers.[4] Under this market structure, the two restaurants are assumed to take the meal's price $\bar{p}$ as given. Consequently, the hourly wage rates, w_1 and w_2, adjust so that the demand for labor is sufficient to produce the service level demanded at the market price $\bar{p}$. Given $\bar{p}$, the total quantity of service (1) and the resulting employment level with each restaurant are

$$Q = \frac{\alpha - (1+\tau)\bar{p}}{\beta} = q_1 + q_2; \quad \text{hence}$$
$$x_1 = 1 - x_2 = \frac{l_1}{n} = \frac{l_2}{n} = \frac{q_1}{kn} = \frac{q_2}{kn} = \frac{\alpha - (1+\tau)\bar{p}}{2k\beta n}, \tag{8}$$

where k is the productivity parameter defined in (6). Substituting x_1 and x_2 from (8) into (4), solving for the equilibrium wage rates, and then substituting into (2) yields

$$w_1 = w_2 = \frac{\delta[\alpha - (1+\tau)\bar{p}] - 2k^2\bar{p}\beta n\tau}{2k\beta n} \quad \text{and}$$
$$I_1 = I_2 = \frac{\delta[\alpha - (1+\tau)\bar{p}]}{2k\beta n}. \tag{9}$$

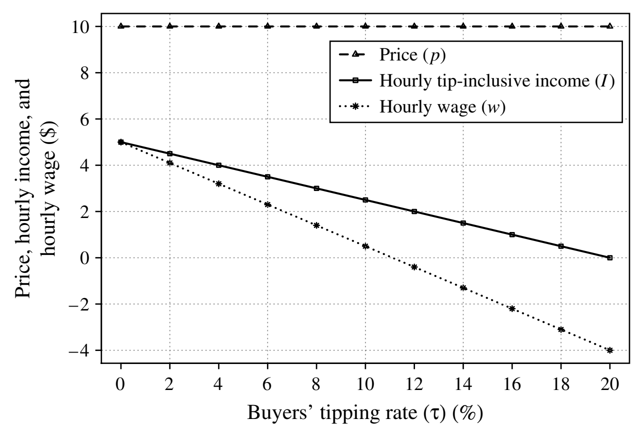
Appendix A derives the following results.

Result 1. In a competitive restaurant industry where restaurants are price takers, an increase in the tipping rate τ (a) decreases the equilibrium wage rate paid to workers in each restaurant i ($\partial w_i/\partial \tau < 0$) and (b) decreases workers' tip-inclusive hourly income ($\partial I_i/\partial \tau < 0$).

Note also that $\partial w_i/\partial n < 0$ and $\partial I_i/\partial n < 0$, which imply that a uniform (across worker type) increase in the labor force reduces wages and tip-inclusive incomes.

Figure 2 illustrates a simulation of Result 1 by plotting the equilibrium wage rates and incomes (9), assuming that restaurants charge a fixed competitive price of $\bar{p} = \$10$. Figure 2 shows that waiters' hourly wage declines monotonically when the tipping rate increases from 0% to 20%. This figure shows that the equilibrium hourly wage rate declines by approximately \$4 (from \$5 to \$1) when the tipping rate increases from 0% to 10%,

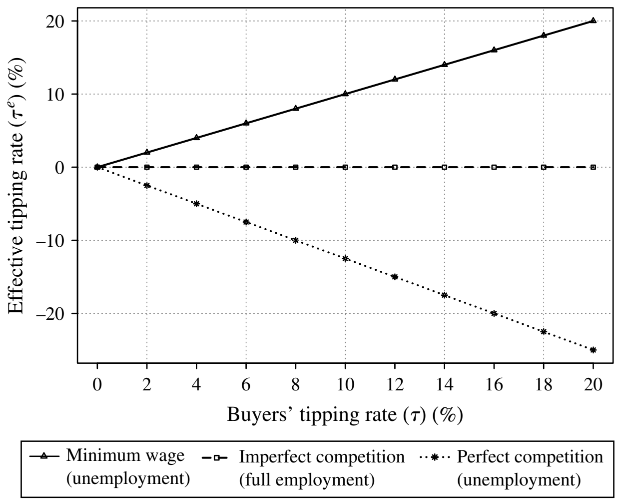
Figure 2 **The Effects of Tipping on Hourly Wage and Total Hourly Income in a Price-Taking (Competitive) Restaurant Market**



Note. This figure assumes a meal service price $\bar{p} = \$10$; labor productivity $k = 2$; demand parameters $\alpha = 12$, $\beta = 1$, and $\delta = 10$; and labor force normalized to equal $n = 1$.

[4] Competitive restaurant markets are often observed in cities and towns with concentrated restaurant areas (such as campuses) that offer and advertise fixed lunch menus. The labor market need not be perfectly competitive in the sense that restaurants may still be able to maintain some market power if there is no full employment.

Figure 3 Simulations of Effective Tipping Rates τ^e as Functions of Buyers' Tipping Rate τ Under Three Market Structures and Employment Configurations with Homogeneous Service and Heterogeneous Labor



and it becomes even negative at higher tipping rates. In this range, workers pay restaurant owners for the privilege to work and receive tips. Figure 2 also shows that the sharp decline in wage rates associated with higher tips offsets the waiters' revenue from tips and causes an overall decline in their total (tip-inclusive) hourly income. This happens because given a fixed price, an increase in the tipping rate increases the tip-inclusive price consumers pay, which reduces their demand for meals. Employment is then reduced by cutting wages to a level that also reduces workers' tip-inclusive income.

Substituting the equilibrium wage rate (9) into (7) yields the following result.

Result 2. In a price-taking (competitive) restaurant industry, the effective tipping rate is negative and is equal to

$$\tau^e(\tau) = \frac{-\delta\tau}{2k^2\beta n} < 0 \quad \text{for } \tau > 0. \tag{10}$$

Therefore, under this market structure, tipping makes waiters worse off in the sense that workers' total (tip-inclusive) hourly income declines with an increase in the buyers' tipping rate.

The effective tipping rate as a function of buyers' tipping rate (10) is simulated in Figure 3 as the (only) line with a negative slope.

4. Imperfectly Competitive Restaurant Industry with Unemployment

The meal price, p, is now endogenously determined by the downward-sloping demand function (1). In view of Figure 1, for this equilibrium to be consistent with some degree of unemployment ($l_1, l_2 < 0.5n$), this section assumes that the distance cost parameter is sufficiently large, so that $\delta > k(\alpha - k\beta n)$. This condition, derived in §6, ensures that a full-employment equilibrium with strictly positive worker's income does not exist.

The main feature of this model is the simultaneous determination of all endogenous variables in *two* markets: the service market and the labor market. Firms set wages that affect employment level and hence the service output level and the service price. Then, the size of the tip is determined as a fraction of the service price, which then determines waiters' tip-inclusive income and, therefore, the employment level, and so on. Formally, the price depends on the aggregate output level $q_1 + q_2$, which depends on the employment levels $l_1 = x_1 n$ and $l_2 = (1 - x_2)n$ according to (6). In addition, x_1 and x_2 are affected by the price because the waiters' decision of whether to accept employment also depends on the tips they receive, which is a percentage of price itself. This implies that we need to solve (1), (4), and (6) *simultaneously* to obtain p, q_1, and q_2, all expressed as functions of the restaurant-determined wage rates, w_1 and w_2. Therefore, the meal price and output level of each restaurant $i, j = 1, 2$ and $i \neq j$, as functions of wage rates, are

$$p(w_1, w_2) = \frac{\alpha\delta - k\beta n(w_1 + w_2)}{2k^2\beta n\tau + \delta(\tau + 1)} \quad \text{and}$$

$$q_i(w_1, w_2) = \frac{kn[k^2 n\beta\tau(w_i - w_j) + k\alpha\delta\tau + w_i\delta(\tau + 1)]}{\delta[2k^2 n\beta\tau + \delta(\tau + 1)]}. \tag{11}$$

Equation (11) implies that each restaurant can increase its output by paying a higher wage ($\partial q_i / \partial w_i > 0$). It is interesting to note that despite the unemployment, an increase in the wage paid by one restaurant would reduce employment with the competing restaurant because of an output shifting effect.[5]

Next, after substituting (11) into the profit functions $\pi_i = pq_i - w_i l_i$, noting that $l_i = q_i / k$, and thereby expressing profits as functions of w_1 and w_2 only, the unique Nash equilibrium hourly wage rates are given by

$$w_1 = w_2 = \frac{k\alpha\delta[\delta(1-\tau^2) - 2k^2 n\beta\tau^2]}{(\tau+1)[2k^4 n^2\beta^2\tau + k^2 n\beta\delta(5\tau+3) + 2\delta^2(\tau+1)]}. \tag{12}$$

Substituting (12) into (11), the equilibrium meal price is

$$p = \frac{\alpha\delta[k^2 n\beta(3\tau+1) + 2\delta(\tau+1)]}{(\tau+1)[2k^4 n^2\beta^2\tau + k^2 n\beta\delta(5\tau+3) + 2\delta^2(\tau+1)]}. \tag{13}$$

Recalling that the total hourly income is defined in (2), Appendix A derives the following results.

[5] An increase in the service level of one restaurant would cause a reduction in the service level of the competing restaurant to prevent the service price from falling too low.

Result 3. When some unemployment prevails, in an imperfectly competitive (oligopoly) restaurant industry, an increase in the tipping rate τ (a) decreases the equilibrium wage rates ($\partial w_i/\partial\tau<0$), (b) decreases the equilibrium meal price ($\partial p/\partial\tau<0$), and (c) increases the total workers' hourly income ($\partial I_i/\partial\tau>0$).

Note also that $\partial p/\partial n<0$ and $\partial I_i/\partial n<0$, which imply that a uniform increase in the labor force decreases the price of a meal and tip-inclusive incomes because of the increase in the supply of meals.

As it turns out, the amount of tips paid by consumers does not translate into an equivalent rise in waiters' income. The effective tipping rate is computed by substituting the equilibrium wage rate (12) and price (13) into (7) to obtain the effective tipping rate for the imperfectly-competitive restaurant industry,

$$\tau^e(\tau)=\frac{k^4n^2\beta^2\tau(\tau+1)}{(3k^2n\beta+2\delta)[k^2n\beta(3\tau+1)+2\delta(\tau+1)]}. \tag{14}$$

Appendix A derives the following result.

Result 4. When some unemployment prevails, in an imperfectly competitive restaurant industry, the effective tipping rate increases (slowly and at a decreasing rate) with buyers' tipping rate. Formally, $\tau^e(0)=0$, $\partial\tau^e/\partial\tau>0$, and $\partial^2\tau^e/\partial\tau^2<0$.

The effective tipping rate (14) as a function of buyers' tipping rate is not plotted in Figure 3 because it turns out to be very small (less than 1/10 of 1%). Therefore, buyers' tipping has a small effect on the effective tipping rate under this market structure.

5. Imperfectly Competitive Restaurant Industry with Minimum Wage and Unemployment

The U.S. federal government and many states allow restaurant owners to pay a significantly lower minimum wage to tipped employees, as long as the tip-inclusive hourly income is no less than the mandated minimum wage for nontipped employees. Appendix B describes the 2014 laws that establish minimum wage rates for tipped employees in selected jurisdictions.

Suppose both restaurants pay their waiters the mandated minimum wage, denoted by $\bar{w}$. In view of Figure 1, this equilibrium exhibits some unemployment ($l_1, l_2<0.5$) if the distance cost parameter is assumed to be sufficiently large, so that $\delta>2[k\alpha\tau+\bar{w}(\tau+1)-k^2n\beta\tau]/(\tau+1)$ and $\alpha\delta>2kn\beta\bar{w}$. Solving (1), (4), and (6) simultaneously for p, q_1, and q_2, all expressed as functions of the minimum wage $\bar{w}$, yields the market-clearing price and the total (tip-inclusive) hourly income:

$$p=\frac{\alpha\delta-2kn\beta\bar{w}}{2k^2n\beta\tau+\delta(\tau+1)}\quad\text{and}$$
$$I_1=I_2=w+k\tau p=\frac{\delta[k\alpha\tau+\bar{w}(\tau+1)]}{2k^2n\beta\tau+\delta(\tau+1)}. \tag{15}$$

Appendix A derives the following results.

Result 5. In an imperfectly competitive restaurant industry where all restaurants pay minimum wage, an increase in the tipping rate τ (a) decreases the equilibrium restaurants' price ($\partial p/\partial\tau<0$) and (b) increases total workers' hourly income ($\partial I_i/\partial\tau>0$).

Note also that $\partial p/\partial n<0$ and $\partial I_i/\partial n<0$. This means that a uniform increase in the labor force decreases the price of a meal and tip-inclusive incomes.

To compute the effective tipping rate under minimum wage, substituting $w(\tau)=w(0)$ for any $\tau>0$ into (7) yields the following result.

Result 6. If both restaurants pay minimum wage, the effective tipping rate equals consumers' tipping rate. Formally, $\tau^e(\tau)=\tau$.

The effective tipping rate τ^e as a function of buyers' tipping rate τ is illustrated in Figure 3 as the line with a slope of 1. This shows that tippers are 100% successful in delivering the tips to waiters as an additional income.

6. Full Employment

It follows from Definition 1 and the bottom part of Figure 1 that $x_1=x_2=\hat{x}$ under full employment, where $\hat{x}$ is defined in (5). To obtain full employment as an equilibrium result, the transportation cost parameter δ should be sufficiently low to induce all potential workers, including those located close the center (see Figure 1), to accept employment with one of the restaurants that are located at the corners. Formally, this section assumes that $\delta<k(\alpha-k\beta n)$ and $\alpha>k\beta n$.

Next, the restaurants' output levels are given by $q_1=k\hat{x}n$ and $q_2=k(1-\hat{x})n$. Therefore, under full employment, aggregate industry output is constant and is given by $Q=q_1+q_2=kn$, which is independent of the wage rates, w_1 and w_2. Using (1) and (5), the division of total industry output between the two restaurants as functions of the wage rates and the resulting market price are

$$q_1=kn\frac{w_1-w_2+\delta}{2\delta},\qquad q_2=kn\left(1-\frac{w_1-w_2+\delta}{2\delta}\right),$$
$$\text{and}\quad p=\frac{\alpha-\beta kn}{1+\tau}. \tag{16}$$

Note that under full employment, the price does not vary with the wage rates because aggregate industry output is constant at the full-employment level.

Under full employment, the profit functions are defined by

$$\pi_1(w_1,w_2)=pq_1-w_1l_1$$
$$=\frac{\alpha-\beta kn}{1+\tau}\cdot kn\frac{w_1-w_2+\delta}{2\delta}$$
$$-w_1n\frac{w_1-w_2+\delta}{2\delta}, \tag{17}$$

$$\pi_2(w_1, w_2) = pq_2 - w_2 l_2 = \frac{\alpha-\beta kn}{1+\tau}\cdot kn\left(1-\frac{w_1-w_2+\delta}{2\delta}\right) - w_2 n\left(1-\frac{w_1-w_2+\delta}{2\delta}\right), \quad (18)$$

where q_1, q_2, $l_1 = q_1/k$, and $l_2 = q_2/k$ are substituted from (16).

Restaurant 1 chooses its wage rate w_1 to maximize $\pi_1(w_1, w_2)$, and restaurant 2 chooses w_2 to maximize $\pi_2(w_1, w_2)$. The unique Nash equilibrium wages and the resulting total hourly compensation are then given by

$$w_1 = w_2 = \frac{k\alpha - \beta nk^2 - \delta(1+\tau)}{1+\tau} \quad \text{and} \quad I_1 = I_2 = k\alpha - k^2 n\beta - \delta. \quad (19)$$

Equation (19) reveals that workers' tip-inclusive income I_i is independent of the tipping rate τ. Differentiating (19) with respect to τ yields $\partial w_i/\partial\tau = k(\beta nk - \alpha)/(1+\tau)^2 < 0$ because $k < \alpha/(\beta n)$. Next, (16) implies the equilibrium tip-inclusive buyer's price is independent of the tipping rate because $(1+\tau)p = \alpha - \beta kn$. Hence, the price received by the restaurants declines with an increase in the tipping rate. The above computations prove the following results.

Result 7. Under full employment, an increase in the tipping rate τ (a) decreases the equilibrium wage rates ($\partial w_i/\partial\tau < 0$), (b) decreases the equilibrium price ($\partial p/\partial\tau < 0$), and (c) has no effect on total worker hourly compensation ($\partial I_i/\partial\tau = 0$).

Result 7 reveals that tipping is "neutral" under full employment in the sense that it does not alter workers' total hourly income. The reason for this is that the increase in the tipping rate is exactly offset by a reduction in workers' wages, w_i, and the price p from which the tip is computed. Note also that the service price p, wage rates w_i, and tip-inclusive incomes I_i all decline with a uniform increase in the labor force, n.

Finally, to compute the effective tipping rate, substitute the equilibrium wages (19) and price (16) into (7) to obtain the following result.

Result 8. Under full employment, the effective tipping rate is zero regardless of how much tips buyers leave. Formally, $\tau^e(\tau) = 0$ for all $\tau \geq 0$.

The effective tipping rate τ^e as a function of buyers' tipping rate τ is plotted in Figure 3 as the horizontal line at $\tau^e = 0$.

7. Differentiated Services and Homogeneous Labor

The analysis has so far modeled the service as homogeneous, whereas labor was assumed to be heterogeneous according to a worker's location or preference for working in each restaurant. This section turns the model the other way around by differentiating the service according to consumers' location or preference for each restaurant and by treating labor as homogeneous.

Let p_1 and p_2 denote the endogenously determined prices charged by restaurant 1 and restaurant 2, respectively. Let v denote the basic value that consumers attach to a meal service, and let δ denote the transportation cost per unit of distance. Consumers are indexed by y and are uniformly distributed on $[0, 1]$ with unit density. The utility of a potential restaurant customer residing at y ($y \in [0, 1]$) is given by

$$U_y = \begin{cases} v-(1+\tau)p_1-\delta y & \text{if restaurant 1 chosen,} \\ v-(1+\tau)p_2-\delta(1-y) & \text{if restaurant 2 chosen,} \\ \hat{v} & \text{otherwise.} \end{cases} \quad (20)$$

With no loss of generality, the reservation utility is normalized to equal zero; $\hat{v} = 0$.

From (20), we can define the thresholds y_1 and y_2 so that all consumers indexed on $[0, y_1]$ choose restaurant 1 and all consumers indexed on $[y_2, 1]$ choose restaurant 2, as illustrated in Figure 4.

The second modification of the model is the treatment of labor as a homogeneous input. This is accomplished by assuming an aggregate upward-sloping inverse labor supply curve given by

$$I = w + \tau kp = \alpha + \beta(l_1 + l_2) \quad \text{or} \quad w = \alpha + \beta(l_1 + l_2) - \tau kp, \quad (21)$$

where $\alpha > 0$ and $\beta > 0$, and $I = \max\{I_1, I_2\}$ because homogeneous workers always choose to work at the restaurant that pays the highest tip-inclusive hourly income. The equilibria analyzed in this section always yield equal restaurant prices ($p = p_1 = p_2$), equal wage rates ($w = w_1 = w_2$), and hence equal income ($I = I_1 = I_2$). Also, $v > \alpha/k$ must be assumed in order to make the restaurant market profitable. This condition implies that the basic value of a meal exceeds its labor cost.

7.1. Partially Served Service Market

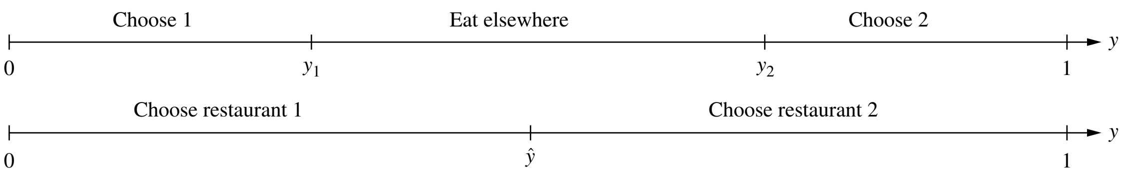
In view of Figure 4 and consumers' utility function (20), a fraction $(y_2 - y_1)$ of the customers is not served when the transportation (distance) cost parameter δ is sufficiently high, so potential customers who reside in the middle of the linear city would not find it beneficial to travel to any restaurant. Formally, this subsection assumes that

$$\delta > \frac{2(1+\tau)(k^2 v - k\alpha - \beta)}{k^2(\tau+2)}. \quad (22)$$

From consumers' utility function (20), the fractions (and number) of consumers who purchase from restaurant 1 and restaurant 2 are determined from $0 = \hat{v} = v - (1+\tau)p_1 - \delta y_1$ and $0 = \hat{v} = v - (1+\tau)p_2 - \delta(1-y_2)$, respectively. Therefore,

$$y_1 = \frac{v-(1+\tau)p_1}{\delta} \quad \text{and} \quad (1-y_2) = \frac{v-(1+\tau)p_2}{\delta}. \quad (23)$$

Figure 4 **Consumers' Choice of Restaurants**



Note. Top: partially served market; bottom: fully served market.

Recall that output and labor are related via $y_1 = kl_1$ and $(1-y_2) = kl_2$. Restaurant 1 chooses its price p_1 to maximize profit given by $\pi_1 = p_1 y_1 - wl_1 = p_1 y_1 - wy_1/k$, taking the market-determined competitive wage rate w as given. Similarly, restaurant 2 chooses p_2 to maximize $\pi_2 = p_2(1-y_2) - wl_2 = p_2(1-y_2) - w(1-y_2)/k$. Substituting y_1 and y_2 from (23) into the two profit functions, the unique Nash–Bertrand equilibrium restaurant prices as functions of the endogenously determined competitive wage rate and the resulting labor demand by each restaurant are

$$p_1 = p_2 = p(w) = \frac{kv + (1+\tau)w}{2k(1+\tau)}; \quad \text{hence}$$
$$l_1 = \frac{y_1}{k} = l_2 = \frac{1-y_2}{k} = \frac{kv-(1+\tau)w}{2k^2\delta}, \tag{24}$$

where the labor demand functions are computed by substituting $p(w)$ into (23). Substituting (24) for $p(w)$, l_1, and l_2 in (21) yields the equilibrium wage rate

$$w = \frac{k[2(1+\tau)\beta v + 2(1+\tau)k\alpha\delta - k^2 v\delta\tau]}{(1+\tau)[k^2\delta(\tau+2) + 2\beta(1+\tau)]}. \tag{25}$$

From (21) and (24), the resulting equilibrium price and workers' tip-inclusive hourly income are, respectively,

$$p = \frac{k^2 v\delta + k\alpha\delta(1+\tau) + 2(1+\tau)\beta v}{(1+\tau)[k^2\delta(\tau+2) + 2\beta(1+\tau)]} \quad \text{and}$$
$$I = \frac{k[k\alpha\delta(\tau+2) + 2v\beta(1+\tau)]}{k^2\delta(\tau+2) + 2\beta(1+\tau)}. \tag{26}$$

Appendix A derives the following results.

Result 9. In a differentiated duopoly service industry with homogeneous labor, where the service market is only partially served, an increase in the tipping rate τ (a) decreases the equilibrium wage rates ($\partial w_i/\partial\tau < 0$), (b) decreases the equilibrium meal price ($\partial p/\partial\tau < 0$), and (c) increases the worker's tip-inclusive hourly income ($\partial I/\partial\tau > 0$).

Result 9 verifies that Result 3 also holds for the reverse model, where the service market is differentiated and the labor market is homogeneous.

Next, substituting the equilibrium wage rate (25) and price (26) into (7) yields the effective tipping rate for the differentiated restaurant industry,

$$\tau^e(\tau) = \frac{k\beta\delta\tau(1+\tau)(kv-\alpha)}{[k^2 v\delta + (k\alpha\delta + 2v\beta)(1+\tau)](k^2\delta+\beta)}. \tag{27}$$

Appendix A derives the following result.

Result 10. Under a differentiated service market with homogeneous labor, the effective tipping rate increases at an increasing rate with the tipping rate. Formally, $\tau^e(0) = 0$, $\partial\tau^e/\partial\tau > 0$, and $\partial^2\tau^e/\partial\tau^2 > 0$.

Note that although the effective tipping rate rises at an increasing rate with the buyers' tipping rate, the magnitude of the effective rate could still be small at low buyers' tipping rates.

7.2. Fully Served Service Market

Suppose now that the transportation cost parameter is low so that the entire market is served. Formally, suppose that condition (22) is reversed. The lower part of Figure 4 shows that the consumer indexed by $\hat{y}$ is indifferent between visiting restaurants 1 and 2. Hence, the consumers' utility function (20) implies that $\hat{y}$ is determined from $v-(1+\tau)p_1 - \delta\hat{y} = v-(1+\tau)p_2 - \delta(1-\hat{y})$, or

$$\hat{y} = \frac{(1+\tau)(p_2-p_1)+\delta}{2\delta}. \tag{28}$$

Therefore, the demands for labor are $l_1 = \hat{y}/k$ and $l_2 = (1-\hat{y}_2)/k$. Thus, restaurant 1 chooses p_1 to maximize $\pi_1 = p_1\hat{y} - wl_1 = p_1\hat{y} - w\hat{y}/k$, and restaurant 2 chooses p_2 to maximize $\pi_2 = p_2(1-\hat{y}) - wl_2 = p_2(1-\hat{y}) - w(1-\hat{y})/k$, where $\hat{y}$ is given in (28). The Nash–Bertrand equilibrium prices as functions of the wage rate are then

$$p_1 = p_2 = p(w) = \frac{k\delta + (1+\tau)w}{k(1+\tau)}. \tag{29}$$

Next, in a symmetric equilibrium, the lower part of Figure 4 implies that $\hat{y} = 1/2$; hence, $l_1 = \hat{y}/k = 1/(2k) = (1-\hat{y})/k = l_2$. Substituting these into (21) yields

$$I = \frac{\beta}{k} + \alpha; \quad \text{hence,} \quad w = \frac{(k\alpha+\beta)(1+\tau) - k\delta\tau}{k(1+\tau)^2}$$
$$\text{and} \quad p = \frac{k^2\delta + (k\alpha+\beta)(1+\tau)}{k({}^{2}1+\tau)^2}, \tag{30}$$

where p was computed by substituting for w in (29). Appendix A derives the following results.

Result 11. In a differentiated service industry with homogeneous labor, where the service market is fully served, an increase in the tipping rate τ (a) decreases the equilibrium wage rate ($\partial w/\partial\tau < 0$), (b) decreases the equilibrium price ($\partial p/\partial\tau < 0$), and (c) does not have any effect on the total workers' hourly income ($\partial I_i/\partial\tau = 0$); hence, (d) the effective tipping rate is $\tau^e(\tau) = 0$ for any buyers' tipping rate $\tau \geq 0$.

Table 1 **The Effects of Tipping on Hourly Wages, Total Hourly Income, and Employment by Market Structure and Employment Conditions**

Homogeneous service with heterogeneous labor							
Labor market	Service market	Employment	$\Delta w/\Delta\tau$	$\Delta p/\Delta\tau$	$\Delta I/\Delta\tau$	$\Delta l/\Delta\tau$	τ^e
Duopsony	Competitive ($\bar{p}$)	Partial	<0	$=0$	<0	<0	<0
Duopsony	Duopoly	Partial	<0	<0	small >0	small >0	≈ 0
Min. wage ($\bar{w}$)	Duopoly	Partial	$=0$	<0	large >0	large >0	$=\tau$
Duopsony	Duopoly	Full	<0	<0	$=0$	$=0$	$=0$
Differentiated services with homogeneous labor							
Labor market	Service market	Coverage	$\Delta w/\Delta\tau$	$\Delta p/\Delta\tau$	$\Delta I/\Delta\tau$	$\Delta l/\Delta\tau$	τ^e
Competitive	Duopoly	Partial	<0	<0	small >0	small >0	≈ 0
Competitive	Duopoly	Full	<0	<0	$=0$	$=0$	$=0$

The last result was computed by substituting the equilibrium wage rate and price given in (30) into (7). Result 11(d) verifies that Result 8 also holds for the reverse model where the service market is differentiated and the labor market is homogeneous. In both cases, production of service cannot be increased, either because of full employment or because of full service market coverage, so the increase in the tipping rate is exactly offset by a reduction in the wage rate and the price from which the tip is derived.

8. Summary and Discussion

Harvey (2006) analyzes cases in which social norms lead to collusion and anticompetitive behavior among market participants. This paper analyzes how an increase in buyers' tipping rate affects service workers' hourly wage and total tip-inclusive hourly income. Table 1 summarizes the results according to the different market structures and employment conditions analyzed in this paper.

Table 1 shows the *changes* in the equilibrium wage rate (Δw), price received by restaurant owners (Δp), waiters' tip-inclusive hourly income (ΔI), and a restaurant's hiring level (Δl), all resulting from a change in the tipping rate ($\Delta\tau$). The last column displays the effective tipping rate (τ^e) according to Definition 2. Note that employment increases ($\Delta l \geq 0$) if and only if total hourly income increases ($\Delta I \geq 0$) because higher total hourly income increases the number of workers who are willing to work at one of the restaurants.

Table 1 shows that tipping is totally ineffective under full employment or full market coverage, because under full employment, restaurants reduce their wages, and in addition, the market price received by the restaurants falls to maintain a fixed output level. In contrast, tipping is mostly effective if all restaurants pay minimum wage because tipping cannot reduce hourly wages, and hence all the gains from tips are transferred directly to service workers.

Under duopoly competition either in the labor market or in the service market, the effective tipping rate could be significantly lower than the buyers' tipping rate; that is, tips generate a very small transfer from customers to workers because restaurants reduce both hourly wages and price so that income does not increase very much with the tipping rate.

Perhaps the most striking result is obtained in the extreme case where the service market is competitive in which service providers view the market price as given. Under this market structure, tipping makes workers worse off because wage rates fall faster than the additional income generated from higher tips. The downward sloping curves in Figure 2 are consistent with anecdotal evidence that in some instances workers' wages became negative, meaning that workers had to pay their employers for the privilege of being able to work and collect tips from customers (Segrave 1998, p. 15).

The theoretical conclusions derived in this paper call for empirical investigations to verify or nullify the theoretical results of how changes in tipping rates affect wages, total hourly compensation, and employment. I am not aware of such empirical investigations, perhaps because empirical investigations of these questions are difficult to conduct because of the length of the time series required to capture the gradual change in tipping rates over many years, during which there may be many changes in the demographic composition of tipped workers.[6] On the theory side, to simplify, the paper concentrated on two opposite extreme market structures: homogeneous service and heterogeneous labor and differentiated services with homogeneous labor. A natural extension would be to model both markets as differentiated.

[6] There are, however, several papers that investigate how raising the minimum wages for tipped employees affects total tip-inclusive hourly wages; see Wessels (1997), Anderson and Bodvarsson (2005), Even and Macpherson (2014), and their references. These cross-sectional investigations are possible because minimum wages for tipped workers may vary across different states (see Appendix B). Azar (2012) provides a theoretical investigation on the effects of changing the minimum wage of tipped workers.

As for policy implications, the results show that tips are not perfect substitutes for higher wages in most market structures and make workers worse off in a competitive price-taking restaurant industry. This result is in line with the empirical finding of Even and Macpherson (2014), who find that a reduction in the tip credit increases weekly earnings. Therefore, disregarding the effects on employment levels and focusing on the wage dimension only, service workers may be better off in a world with no tipping.

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Appendix A. Algebraic Derivations

Equivalence of the Two Measures in (7). Using the definition of tip-inclusive income (2), the first measure can be written as

$$\frac{\tau k p(\tau)+w(\tau)-w(0)}{\tau k p(\tau)}\tau = \frac{I(\tau)-w(0)}{w(\tau)+\tau k p(\tau)-w(\tau)}\tau = \frac{I(\tau)-w(0)}{I(\tau)-w(\tau)}\tau. \quad \text{(A1)}$$

Derivation of Result 1. Differentiating (9) with respect to the tipping rate yields

$$0>\frac{\partial w_i}{\partial\tau}=-\frac{\bar{p}(2k^2n\beta+\delta)}{2kn\beta} \quad \text{and} \quad 0>\frac{\partial I_i}{\partial\tau}=-\frac{\bar{p}\delta}{2kn\beta}. \quad \text{(A2)}$$

Derivation of Result 3. Let d denote the denominator of (12) and (13). Differentiating the equilibrium hourly wage (12) yields

$$0>d^2\frac{\partial w_i}{\partial\tau} = -2k\alpha\delta\big[2k^6n^3\beta^3\tau^2+k^4n^2\beta^2\delta(9\tau^2+8\tau+1) +4k^2n\beta\delta^2(\tau+1)(2\tau+1)+2\delta^3(\tau+1)^2\big]. \quad \text{(A3)}$$

Differentiating the equilibrium meal price (13) yields

$$0>d^2\frac{\partial p}{\partial\tau} = -\alpha\delta\big[2k^6n^3\beta^3(3\tau^2+2\tau+1) +k^4n^2\beta^2\delta(19\tau^2+18\tau+3) +8k^2n\beta\delta^2(\tau+1)(2\tau+1)+4\delta^3(\tau+1)^2\big]. \quad \text{(A4)}$$

Finally, using (12) and (13),

$$0<\frac{\partial I_i}{\partial\tau} = \frac{\partial(w_i+k\tau p)}{\partial\tau} = \frac{k^5n^2\alpha\beta^2\delta^2}{[2k^4n^2\beta^2\tau+k^2n\beta\delta(5\tau+3)+2\delta^2(\tau+1)]^2}. \quad \text{(A5)}$$

Derivation of Result 4. Twice differentiating (14) with respect to τ yields

$$0<\frac{\partial\tau^e}{\partial\tau}=\frac{k^4n^2\beta^2[k^2n\beta(3\tau^2+2\tau+1)+2\delta(\tau^2+2\tau+1)]}{(3k^2n\beta+2\delta)[k^2n\beta(3\tau+1)+2\delta(\tau+1)]^2}, \quad \text{(A6)}$$

$$0>\frac{\partial^2\tau^e}{\partial\tau^2}=\frac{-4k^6n^3\beta^3(k^2n\beta+2\delta)}{(3k^2n\beta+2\delta)[k^2n\beta(3\tau+1)+2\delta(\tau+1)]^3}. \quad \text{(A7)}$$

Derivation of Result 5: Differentiating (15) with respect to the tipping rates yields

$$0>\frac{\partial p}{\partial\tau}=\frac{(2kn\beta\bar{w}-\alpha\delta)(2k^2n\beta+\delta)}{[2k^2n\beta\tau+\delta(\tau+1)]^2} \quad \text{and} \quad 0<\frac{\partial I_i}{\partial\tau}=\frac{k\delta(\alpha\delta-2kn\beta\bar{w})}{[2k^2n\beta\tau+\delta(\tau+1)]^2}. \quad \text{(A8)}$$

Derivation of Result 9. Differentiating (25) with respect to τ yields

$$0>\frac{\partial w}{\partial\tau} = \big\{k[k^4v\delta^2(\tau^2-2)-(2k^3\alpha\delta^2+4k\alpha\beta\delta+4v\beta^2)(1+\tau)^2 -4k^2v\beta\delta(1+\tau)]\big\} \cdot\big\{(1+\tau)^2[k^2\delta(\tau+2)+2\beta(1+\tau)]^2\big\}^{-1}. \quad \text{(A9)}$$

Differentiating (26) with respect to τ yields

$$0>\frac{\partial p}{\partial\tau} = \big\{k^4v\delta^2(2\tau+3)+(k^3\alpha\delta^2+2k\alpha\beta\delta+4v\beta^2)(1+\tau)^2 +2k^2v\beta\delta(1+\tau)(\tau+3)\big\} \cdot\big\{-(1+\tau)^2[k^2\delta(\tau+2)+2\beta(1+\tau)]^2\big\}^{-1} \quad \text{(A10)}$$

and

$$0<\frac{\partial I}{\partial\tau}=\frac{2k^2\beta\delta(kv-\alpha)}{[k^2\delta(\tau+2)+2\beta(1+\tau)]^2}. \quad \text{(A11)}$$

Derivation of Result 10. Substituting $\tau=0$ into (27) yields $\tau^e(0)=0$. Next, differentiating (27) with respect to τ yields

$$0<\frac{\partial\tau^e}{\partial\tau}=\frac{k\beta\delta(kv-\alpha)[k^2v\delta(2\tau+1)+(k\alpha\delta+2v\beta)(1+\tau)^2]}{[k^2v\delta+(k\alpha\delta+2v\beta)(1+\tau)]^2(k^2\delta+\beta)} \quad \text{(A12)}$$

and

$$0<\frac{\partial^2\tau^e}{\partial\tau^2}=\frac{2k^3v\beta\delta^2(kv-\alpha)(k^2v\delta+k\alpha\delta+2v\beta)}{[k^2v\delta+(k\alpha\delta+2v\beta)(1+\tau)]^3(k^2\delta+\beta)}. \quad \text{(A13)}$$

Derivation of Result 11: Differentiating (30) with respect to τ yields

$$0>\frac{\partial w}{\partial\tau}=\frac{k^2(1-\tau)+(k\alpha+\beta)(1+\tau)}{-k(1+\tau)^3}, \quad 0>\frac{\partial p}{\partial\tau}=\frac{2k^2\delta+(k\alpha+\beta)(1+\tau)}{-k^2(1+\tau)^3}, \quad \text{and} \quad 0=\frac{\partial I}{\partial\tau}. \quad \text{(A14)}$$

Appendix B. Some Facts on Minimum Wage for Tipped Employees

The federal government and several states allow employers of tipped employees to pay significantly lower minimum wages provided that employees end up receiving tip-inclusive income not lower than the minimum wage for nontipped employees. Table B.1 displays a sample of such minimum wages in 2014. The column on the right displays the minimum monthly income from tips that would allow employers to classify their workers as tipped employees. Table B.1 shows that the federal government allows employers to pay \$2.13 per hour to workers who receive more than \$30 per month in tips instead of paying \$7.25.

Note that (a) Alaska, California, Guam, Minnesota, Montana, Nevada, Oregon, and Washington State do not

Table B.1 Rules for Minimum Wage for Tipped Employees in 2014

Jurisdiction's law	Minimum wage ($)	Tipped employees	Definition
Federal	7.25	$2.13	≥ $30/month
Alabama	0.00	$0.00	Irrelevant
Alaska	7.75	$7.75	Irrelevant
Arizona	7.90	$4.90	Not specified
Washington, DC	9.50	$2.77	Not specified
Massachusetts	8.00	$2.63	≥ $20/month
New Hampshire	7.25	45%	≥ $30/month

Source. U.S. Department of Labor (2014) Table of minimum hourly wages for tipped employees, by state. Accessed August 22, 2014, http://www.dol.gov/whd/state/tipped.htm.

allow lower minimum wages for tipped employees, and (b) employers cannot pay lower wages than the minimum prescribed by federal law.

References

Anderson J, Bodvarsson Ö (2005) Do higher tipped minimum wages boost server pay? *Appl. Econom. Lett.* 12(7):391–393.

Azar O (2004) What sustains social norms and how they evolve? The case of tipping. *J. Econom. Behav. Organ.* 54(1):49–64.

Azar O (2007a) Do people tip strategically, to improve future service? theory and evidence. *Canad. J. Econom.* 40(2):515–527.

Azar O (2007b) The social norm of tipping: A review. *J. Appl. Soc. Psych.* 37(2):380–402.

Azar O (2011) Business strategy and the social norm of tipping. *J. Econom. Psych.* 32(3):515–525.

Azar O (2012) The effect of the minimum wage for tipped workers on firm strategy, employees and social welfare. *Labour Econom.* 19(5):748–755.

Dublanica S (2010) *Keep the Change: A Clueless Tipper's Quest to Become the Guru of the Gratuity* (HarperCollins, New York).

Even WE, Macpherson DA (2014) The effect of the tipped minimum wage on employees in the U.S. restaurant industry. *Southern Econom. J.* 80(3):633–655.

Harvey D (2006) Anticompetitive social norms as antitrust violations. *Calif. Law Rev.* 94(3):769–791.

Kahneman D, Knetsch J, Thaler R (1986) Fairness as a constraint on profit seeking: Entitlements in the market. *Amer. Econom. Rev.* 76(4):728–741.

Lynn M, McCall M (2000) Gratitude and gratuity: A meta-analysis of research on the service-tipping relationship. *J. Socio-Econom.* 29(2):203–214.

Lynn M, Jabbour P, Kim WG (2012) Who uses tips as a reward for service and when? An examination of potential moderators of the service-tipping relationship. *J. Econom. Psych.* 33(1):90–103.

Schwartz Z (1997) The economics of tipping: Tips, profits, and market's demand-supply equilibrium. *Tourism Econom.* 3(3):265–279.

Segrave K (1998) *Tipping: An American Social History of Gratuities* (McFarland & Company, Jefferson, NC).

Wessels W (1997) Minimum wages and tipped servers. *Econom. Inquiry* 35(2):334–349.