The effect of minimum wage increases on firm productivity

Masters' thesis

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Abstract

This paper researches the effect of minimum wages on the hygiene quality of restaurants empirically. We use exogenous increases in the minimum wage to identify the effect. The hygiene effect for the entire sample is negative and insignificant but the 25% best scoring restaurants in terms of hygiene score show a significant deterioration in hygiene score due to minimum wage increases. The effect is small: a dollar increase in the minimum wage lowers the hygiene score by 5% of a standard deviation. The effect of minimum wages on hygiene is interesting because minimum wages are common and hygiene is an important quality aspect for consumers.

Contents

Introduction

This paper researches the effect of minimum wage increases on hygiene scores for restaurants in California between July 1995 and December 1998. Hygiene is an important part of product quality for restaurants and the food industry in general. Minimum wages are common in developed countries, but from the current literature it is not clear what the effect of changes in the minimum wage are on the hygiene scores of restaurants or the quality of goods[1] in general. Apart from being interesting its own, our research question provides us with useful information concerning the effect of wage increases on productivity as well as insights into the mechanisms that drive the effect of minimum wages on employment. Both the effect of wage changes on productivity and the effect of minimum wages on employment have been researched extensively. There is a positive correlation between wages and productivity (Hellerstein, Neumark, & Troske, 1999) but this does not imply causality and even if it would, it would not tell us anything about the direction[2]. The classical literature on the effect of wage changes on productivity focuses primarily on changes in the structure of pay instead of looking at the effect of overall changes in the level of pay (Lazear, 1996), there is an empirical behavioral literature on the productivity effects of wage changes though. Evidence from both field experiments (Gneezy & List, 2006) and quasi-experiments (Jayaraman, Ray, & Véricourt, 2016) shows that the short run productivity effect of an increase in wages is positive and the long run productivity effect is small if significant at all. Since the short run effects disappear very quickly, it is not profitable for employers to pay their employees more than the market wage (Gneezy & List, 2006). The behavioral literature looks at individual productivity whereas this paper researches firm's overall productivity. The difference between these two approaches is mostly determined by understaffing: restaurants may hire fewer labor hours for the same work. This may cause the overall firm productivity to go down even though productivity per labor hours is unaffected.

The empirical literature on the employment effects of minimum wages can be classified into two different types: national-level studies and case studies. The first uses all variation in minimum wages and employment on the national level and the latter typically uses heterogeneity between adjoining local areas over time.

National-level studies have varying results that have a propensity to be negative whereas case studies have less varying results and typically find no effect (Dube, Lester, & Reich, 2010) (Neumark & Wascher, 2007) (Card & Krueger, 2000) (Neumark & Wascher, 1992). Unlike this paper, both focus primarily on the employment effects of changes in the minimum wage. Instead of researching the employment effects of changes in the minimum wage, this paper will research a mechanism that determines the sign of the employment effect, namely the productivity effects of changes in the minimum wage. This mechanism especially interesting in light of the part of the empirical literature that does not find minimum wages to have any significant effect on employment. In this paper we use the data from another paper by Jin and Leslie (2009), we will discuss this to further detail in the data section. We use the minimum wage increases in our sample period to estimate the effect of minimum wage increases on restaurant hygiene. In order to do this we assume that minimum wage increases are exogenous, this means that we assume that the political forces that cause minimum wage increases have no effect on restaurant hygiene quality. We find that

[1] Which can be considered part of productivity

[2] It may be that high wages are caused by high productivity and not the other way around

minimum wages have no significant effect over the entire sample, but they do affect the best performing restaurants in terms of hygiene significantly: their hygiene score is negatively affected by the minimum wage increases. The effect is small though: a dollar increase in the minimum wage lowers the hygiene score by 5% of a standard deviation.

In the next section we will consider a theoretical framework that is useful to interpret the results of the empirical part of this paper; we will also briefly discuss the potential welfare effects of the policy intervention there. In the third section we will describe the data we use in this paper. In the fourth section we show and interpret the results of this paper's empirical endeavors. In the last section we will discuss the earlier findings and draw conclusions.

Theoretical framework

This section is meant to provide a way to think about the effect of minimum wages on the productivity of workers. Since this paper is very relevant to the literature on the employment effects of minimum wages, our theoretical framework will relate the productivity effects to the employment effects of minimum wages. This paper is not a theoretical but an empirical paper, therefore the models will be kept simple and limited. We will first discuss a very simplistic thought experiment, and then we will discuss a simple model.

Ridiculously high minimum wages: a thought experiment

Imagine the government of a fictional country called Experiland that somewhat naively believes that minimum wages have only benefits and no possible negative effects. For this reason the government decides to implement a ridiculously high minimum wage of $1000 per hour.[3] Since the productivity of all of Experilanders is several orders of magnitude lower than $1000 per hour, no employer is willing to hire anyone at this wage. Therefore the policy can have two possible effects: either Experiland will have a 100% unemployment rate or the rule set by the government will not be enforced due to its unenforceability. This thought experiment may explain why the employment effects found by previous researchers is often negative or zero and almost never positive. It is clear that a minimum wage of $1000 per hour will (if enforced) lead to devastating unemployment. Therefore we can conclude from the case of Experiland that minimum wage increases have negative employment effects if they are large enough. However, nobody proposes setting the minimum wage at $1000 per hour.[4] The next section of this paper will show that it is not clear ex ante that the employment effect will be negative if one considers smaller and more reasonable minimum wage increases.

Welfare effects of a minimum wage increase

We will discuss the welfare effects of a minimum wage change for three different interest groups: firms, consumers and workers. If we assume rationality, firms will have negative welfare effects (if the minimum wage is binding) because they are assumed to set wages in a profit maximizing way. Every deviation from the wage firms voluntarily set leads to lower profits by assumption.

[3] Note that the exact value of the minimum wage is not relevant here as long as it is way higher than most individuals' productivity

[4] To my knowledge

Consumers have more ambiguous welfare effects: on the one hand prices will ceteris paribus go up if the minimum wage increases. On the other hand consumers may get higher quality products and services if the minimum wage increases. If the quality effect is zero or negative (which is what this paper finds) the welfare effect for consumers is negative. Workers also have ambiguous welfare effects. They benefit from an increase in their hourly wage but they experience costs if they can work fewer hours[5]. The overall effect is determined by taking the sum of the wage effect and the employment effect. Advocates of minimum wages often claim to intend a welfare increase for the workers, however, it is also possible that the employment effect dominates the wage effect (e.g. Experiland). The total welfare effect is determined by adding up the welfare effects for firms, consumers and workers. This paper gives insight into the welfare effects of minimum wage increases for consumers because it estimates (part of) the effects of minimum wages on quality.

A simple model

The ambiguousness of the effect of minimum wage increases on employment can be explained trough three effects that together determine the sign of the net effect (Rebitzer & Taylor, 1995). In this section we will add a fourth effect (the worker selection effect) because it is not captured yet in the other three effects. The four effects we will consider are the cost effect, the market power effect, the wage dependent productivity effect and the worker selection effect.

The first effect (the cost effect) is negative. It is a simple argument based on the law of demand: if the minimum wage is increased, both marginal and average labor costs increase and an increase in costs will ceteris paribus lead to lower quantities (i.e. lower employment and/or fewer hours per employee). The second effect (the market power effect) has to do with market power (as the name suggests) on the demand side of the labor market. Since this paper uses data on restaurants and since restaurants barely have any market power on the labor market, we will not discuss this effect any further because it is not relevant for this papers' empirical setting. The third effect (the wage dependent productivity effect) is positive. It is an effect based on wage dependent worker productivity functions and it is often referred to as efficiency wages (Stiglitz, 1976). The intuition of the argument is that worker effort is enforced by the threat of firing workers who do not exert effort sufficiently. The threat of termination is not very effective if the alternative if the outside option of the worker in question is very comparable to his current job. Therefore firms increase the value of their workers job by offering a higher wage in order to have their employees exert more effort.

There is a fourth possible effect (the worker selection effect) that is positive as well. This effect is caused by the fact that employers may be able to be more selective in their hiring process if wages are higher. Therefore it is possible that individual workers do not become more productive but still the average worker becomes more productive because of selection. This paper does not use data on individual productivity; therefore the difference between this (fourth) effect and the previous (third) effect cannot be made empirically. Because we cannot differentiate between the third and fourth effect we will for our purposes consider them the same. Summing it all up we will consider two effects: the negative cost effect and the positive productivity effect. The second effect is decreasing in the dollar value of the minimum wage because there are diminishing marginal worker effort increases for every extra dollar of minimum wage increase. Since this does not apply to the

[5] Being fired is an extreme case of getting fewer hours

cost effect, the cost effect dominates the productivity effect if the minimum wage is increased by a lot (as was the case in our thought experiment about Experiland). Therefore we see an unemployment rate increase in the case of Experiland.

In mathematical terms this means that we can analyze the effect of minimum wages was follows:

$$Hours = W + a * Minwage + \varepsilon$$

$$Effort = X + b * Minwage + \epsilon$$

$$Hygiene = Y + c * Hours + d * Effort + \zeta$$

We estimate $Hygiene = Z + (a * c + b * d)Minwage + \eta$

Where ε, ϵ, ζ and η are error terms and W, X, Y and Z are constants. Hours indicates the number of hours a worker works, which is zero if he/she is unemployed. Effort is the effort level of a worker and hygiene is the hygiene quality that a restaurant. This paper estimates the value of (a*c + b*d) empirically. Where a*c can be seen as the effect of minimum wages on hygiene through the effect minimum wages have on the number of hours of labor used by restaurants and b*d can be seen as the effect of minimum wages on hygiene through the effect minimum wages have on the effort that restaurant workers exert (which determines their productivity). Unfortunately our empirical setting does not allow us to distinguish between a, b, c and d or even between a*c and b*d. In the next section we will discuss the data we use to estimate the effect of minimum wage increases on productivity.

Data

This paper uses the same data as Jin and Leslie (2009), which are data on the hygiene score as determined by a governmental inspection agency. In this paper we will consider the hygiene score to be one of the aspects of restaurant quality. The dataset also contains information on several restaurant characteristics. In this paper we will primarily use the following variables: the hygiene score, the time since the last inspection, the chain affiliation and the style of restaurants and the minimum wage in California (which changes over time). The data on minimum wages can be found on the website of the California state government, all other data come from Jin and Leslie (2009). Using data that have been used for another purpose may lead to some problems because the data may have been collected in a way that is not ideal for the specific research question of this paper. As we will see later on, we will encounter some bias because of other policy interventions. The policy interventions in question are changes in the rules regarding the hygiene score. This can be problematic because it is difficult to control for time related differences between individuals. Therefore we cut out the sample after July 1997, leaving us with a sample that only includes the period where no measurement changes or major policy interventions took place.

Hygiene score

Since the hygiene score is the dependent variable in most of the regressions, it is important to understand how the score is influenced by other factors, therefore the hygiene score will be described thoroughly. We will first look at some citations from Jin and Leslie (2009) and then we will consider some descriptive statistics of the hygiene score. The first citation will describe how the hygiene score is determined, the second and the third citation explain why we see some shocks in the average score over time.

"The data cover every restaurant inspection conducted by Los Angeles County DHS inspectors between July 1995 and December 1998. The DHS implements a scoring system as an explicit attempt to reduce the impact on inspection outcomes of inspectors' subjectivity. Inspectors deduct pre-specified points for each violation that is detected. For example, a food temperature violation results in a 5-point deduction, evidence of cockroaches results in a 3-point deduction, and a functioning but unclean toilet results in a 2-point deduction." (Jin & Leslie, 2009)

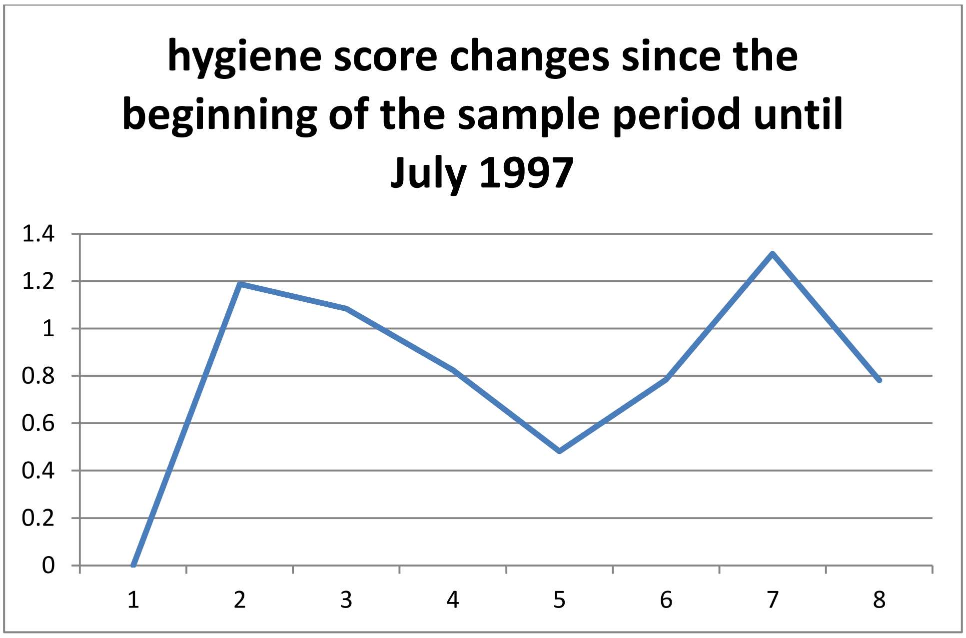
"There was a change in the score criteria that occurred during our sample. Prior to July 1, 1997, inspectors could deduct up to 25 additional points based on their overall subjective evaluation of the restaurant's hygiene. This component was abolished in July 1997, leaving only the pre-specified point deductions for each violation. We presume that the average effect of the change in criteria on observed scores is a nominal change in inspection scores with no real change in hygiene quality." (Jin & Leslie, 2009)

"An important policy change applies to the final year of our data which we exploit for some hypothesis tests. Beginning January 16, 1998, at the end of every inspection restaurants are issued with a grade card to be prominently displayed in the window, near the entrance, for customers to see.4 An A-grade is given for scores above 90, a B-grade for scores in the 80s, a C-grade for scores in the 70s, and for scores below 70 the numerical score is shown on the card." (Jin & Leslie, 2009)

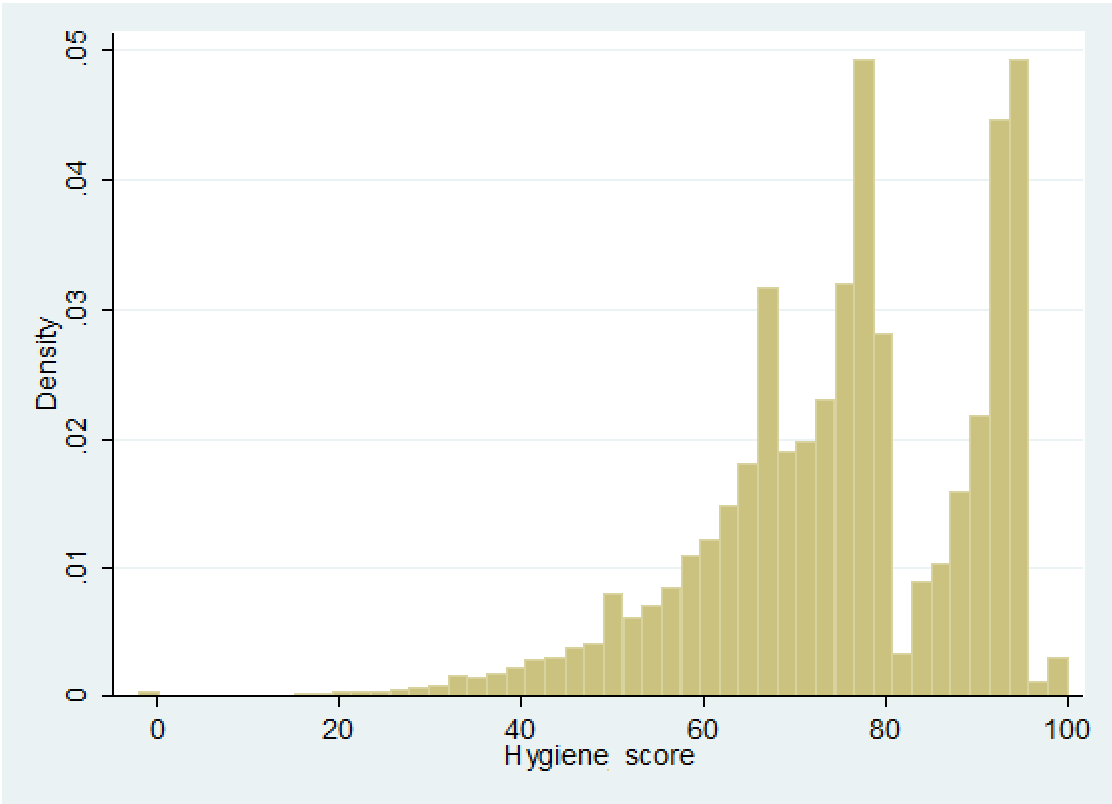
Table 1 descriptive statistics of the hygiene score

Observations	Mean	Std. Dev.
127,111	81.15344	14.14414

Graph 1 the cumulative change in hygiene score (in score points) since July 1995 and until July 1997 (y-axis: hygiene score as determined by Los Angeles County DHS inspectors, x-axis: sample quarters where 1 is Q3 1995 and 8 is Q2 1997)



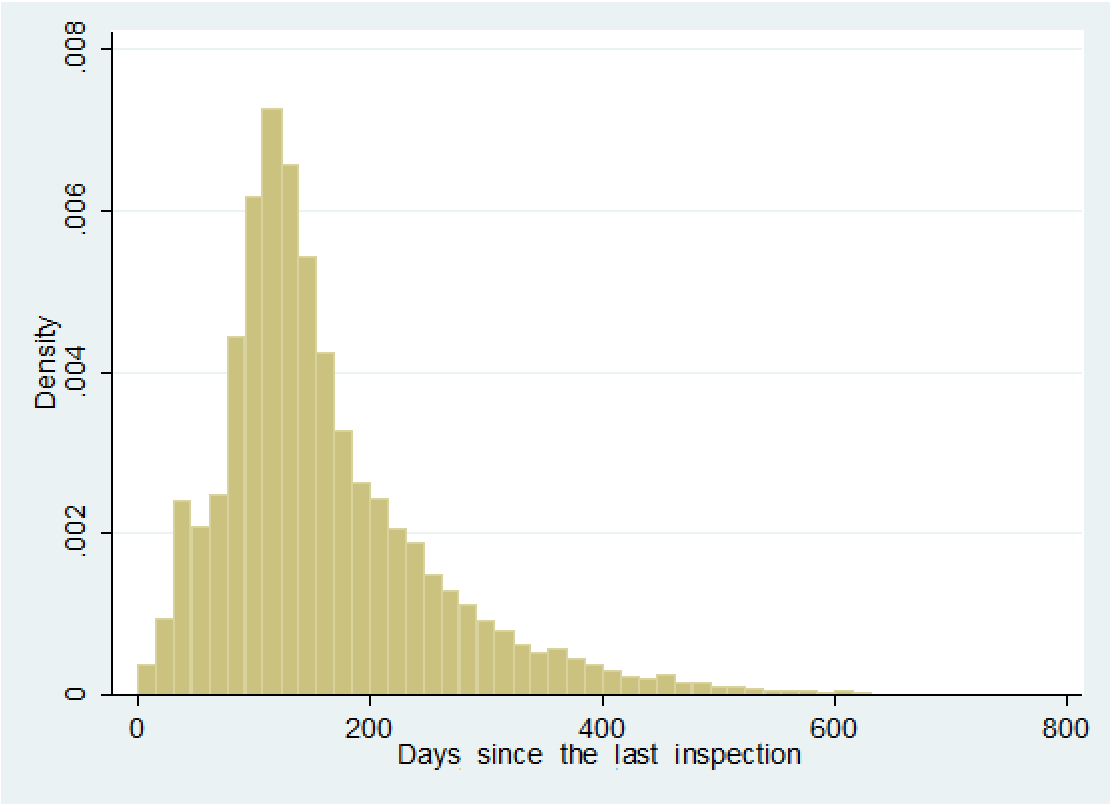
Histogram 1 hygiene score distribution



Time since last inspection

In this paper we will also consider the time since the last inspection. Since we have data on the date of every specific inspection, we can use the amount of days since the previous inspection for all observations except the first one of every restaurant in our sample. The average amount of days since the last inspection is 163 and the median is 139. The standard deviation is 96.

Histogram 2 distribution of the days since the last inspection



Minimum wage

We do not look at the hygiene score alone; we also look at the minimum wage and the chain and style of the restaurant. The minimum wage is the simplest: we use the dollar value of the minimum wage in California. The minimum wage has been increased three times in our sample period (see also table 2).

Table 2 the minimum wage in California over time in our sample

effective date	new minimum wage	old minimum wage	amount of increase	percentage of increase over previous wage
March 1, 1998	$5.75	$5.15	$0.60	11.65 percent
September 1, 1997	$5.15	$5.00	$0.15	3.00 percent
March 1, 1997	$5.00	$4.75	$0.25	5.26 percent
October 1, 1996	$4.75	$4.25	$0.50	11.76 percent

Restaurant style

In this paper we use the restaurant style to determine how much a restaurant is affected by the minimum wage. We specify two groups, the treatment group consists of restaurants that have no specified style or have specified to be family restaurants; the control group consists of all other styles (bar, cafeteria, delivery and fast food). We expect the control group (from now on called the cheap group), which serves cheaper food, to be more affected by the minimum wage because their cost function is determined for a larger extend by the minimum wage (almost all their employees are paid the minimum wage). The treatment group (from now on called the expensive group) however employs quite some workers who are not paid the minimum wage. E.g. cooks in a classical restaurant are rarely paid the minimum wage whereas kitchen workers at McDonalds are often paid the minimum wage, therefore McDonalds' costs are influenced more by the minimum wage than a classical restaurant's are.

Table 4 descriptive statistics of the restaurant style

Variable	Mean	Min	Max
no style specified	86.21%	0	1
bar	0.55%	0	1
cafeteria	2.39%	0	1
delivery	0.55%	0	1
family	2.55%	0	1
fast food	7.73%	0	1

Chain affiliation

Our fixed effects estimation requires parallel trends between the control group and the treatment group. We know however from the literature that chain restaurants have a different trend than non-chain restaurants in our sample period due to the score card intervention (Jin & Leslie, 2009). Therefore we must use the chain affiliation of restaurants as a control variable if restaurants in either the treatment group or the control group are more often affiliated with a chain. If we regress being an expensive style restaurant on being in a chain we find that there is a strong and significant negative correlation between being in a chain and being an expensive style restaurant. About 69% of cheap restaurants have a chain affiliation while only about 3% of expensive style restaurants have a chain affiliation.

Table 3 descriptive statistics of the restaurant chain affiliation

Variable	Mean	Min	Max
no chain	87.86%	0	1
burger king	0.58%	0	1
carl's jr	0.63%	0	1
el pollo loco	0.62%	0	1
jack in the box	0.71%	0	1
kentucky fried chicken	0.69%	0	1
mc donalds	1.28%	0	1
pizza hut	0.77%	0	1
starbuck's coffee	0.36%	0	1
subway	1.03%	0	1
taco bell	0.77%	0	1
missing	4.70%	0	1

Results

In this paper we use multiple regression specifications to estimate the effect of the minimum wage on worker productivity. We will look at five specifications in total; the five specifications will build up to what we consider the most suitable specification. In the last section we already decided to drop the part of the sample after July 1997 because the measurement changes and policy interventions are not helpful in isolating a causal effect. In this section we start out by looking at the entire sample again (including the post July 1997 part). We do this in order to illustrate the relevance of dropping the part of the data after July 1997. As we will find out, including this part of the data will require us to use so many controls that they may cause overfitting[6].

Including the post July 1997 data

Our first estimation looks as follows:

Specification 1: $Hygiene\ score = C + \beta 1\ ExpensiveStyle_i * Minwage_t + \alpha_i + \gamma_t + \varepsilon_{it}$

Where C is a constant, $\beta 1$ is the coefficient we are interested in, $ExpensiveStyle_i$ is a dummy variable that equals one if a restaurant is of the expensive style and zero otherwise, $Minwage_t$ indicates the dollar value of the minimum wage, α_i is a restaurant fixed effect[7], γ_t is a time fixed effect and ε_{it} is the error term. This regression gives a significant positive value of 1.598 for $\beta 1$, this

[6] That is if we are unwilling to accept the potential bias caused by the measurement changes and the policy intervention.

[7] In our estimations we use two kinds of fixed effects: restaurant fixed effects and time fixed effects. Restaurant fixed effects are estimated using the restaurant ID number and time fixed effects are estimated for every quarter.

would mean that a minimum wage increase has a negative effect on productivity[8]. However, the causal interpretation of $\beta 1$ depends on the assumption that the time trend does not differ for the expensive types and the cheap types. This assumption is highly unlikely to be true since Jin & Leslie (2009) show that chain restaurants increase their hygiene score slower in response to the score card intervention than non-chain restaurants do. Since cheap types are much more likely to have a chain affiliation than expensive types, we cannot expect the time trend of cheap types and expensive types to be the same. If the time trends are not the same for cheap types and expensive types, it will lead to a biased estimate of $\beta 1$. Luckily we can control for time trend differences due to chain affiliation pretty easily using the following regression specification:

Specification 2: $Hygiene\ score = C + \beta 2\ ExpensiveStyle_i * Minwage_t + \delta\ Chain_i * Quarter_t + \alpha_i + \gamma_t + \varepsilon_{it}$

Where $Chain_i$ is a dummy variable that equals one if a restaurant is chain affiliated and zero otherwise. δ is estimated separately for every value of $Quarter_t$[9],therefore $Quarter_t$ can be seen as a time fixed effect. All other variables are the same as they were in the previous specification. $\beta 2$'s value is -.081 which is not significantly different from zero. This specification controls for the observed difference in time trends between the expensive and the cheap types. There is still a problem with this specification though, since restaurants' chain affiliation and restaurants' style are highly correlated and since the fixed effects soak up a big fraction of the variation in the hygiene score, there may not be enough variation left to be explained by our variable of interest. In other words: $\beta 2$ may simply be near zero because of near perfect multicollinearity with the other variables. To test this we regress our variable of interest on all other independent variables:

Specification 3: $ExpensiveStyle_i * Minwage_t = C + \delta\ Chain_i * Quarter_t + \alpha_i + \gamma_t + \varepsilon_{it}$

This regression has an R-squared of 0.9944 which strongly supports that the multicollinearity story therefore $\beta 2$ cannot be interpreted causally.

Excluding the post July 1997 data

In order to overcome the problem mentioned before, we can restrict our sample to the period where the score card intervention was not implemented yet, this means that we'd lose 4 out of 14 quarters. If we restrict our sample this way and run regression specification 2 we find a $\beta 2$ of .577 that is not significant at a 5% level. However, another change in regulations in implemented within our sample. In July 1997 (Quarter 9 and after) inspectors lose their right to deduct an additional 25 points based on their personal opinion because the regulator wants scores to be more objective. It is likely however that chain restaurants, which score better on average, are not equally affected by this change in rules compared to non-chain restaurants. To control for this, we can restrict our sample to the first 8 quarters (losing another 2). If we do this we find a $\beta 2$ of -.489 which is not significant. Since parallel trends between cheap and expensive types is a reasonable assumption over the first 8 quarters (i.e. without policy changes), we could interpret the last mentioned effect

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[8] Since cheap types are more affected by the minimum wage, a positive coefficient for the expensive types must be interpreted as a negative coefficient for the cheap types. Therefore the interpretation of a positive coefficient is a negative effect of a minimum wage increase on productivity.

[9] This is done since we do not expect a linear trend but a specific effect around the implementation of the hygiene score card intervention

causally. However, the effect is not significant and it does not tell us anything about the overall effect of minimum wages on productivity but it only tells us something about the difference between cheap and expensive types.

From now on all results discussed will be limited to the first eight quarters of our sample. If we restrict our sample we to the period in which no policy intervention took place, we no longer have to differentiate between cheap and expensive types and/or chain and non-chain restaurants. We could use a fuzzy regression discontinuity design (specification 4):

Specification 4: $Hygiene\ score = C + \beta 2\ Minwage_t + \alpha_i + \gamma_t + \varepsilon_{it}$

Since the time fixed effects are very small and have little predictive power we may better estimate the time trend linearly. Later on we will see that the effects found are small, therefore it is important to use no more degrees of freedom than strictly necessary.

Specification 5: $Hygiene\ score = C + \beta 2\ Minwage_t + \alpha_i + \gamma\ Day_t + \varepsilon_{it}$

The R squared of this specification (specification 5) is higher than the last (specification 4), probably because we use days instead of quarters[10]. This suggests that it is not problematic to control for the small increase over time in a linear way (instead of fixed effects). $\beta 2$ equals -0.50 which has a P-value of 13% level, this can be interpreted as a 0.6 point decrease in the hygiene score for every dollar increase in the minimum wage. However, as QQ-plot 1 shows, the residuals are not normally distributed. This may cause inference to be inaccurate[11]. A possible solution would be to use quantile regression, however, similar results can be achieved using normal regression if the regression is run four separate times[12] (once for every quartile of the data). The results can be found in table 4. In table 4 we can see that the effect is driven to a large extent by the 4th quartile.

The big effect in the fourth quartile and the near zero effects in all other quartiles can be explained by understaffing: restaurants hire fewer workers and since it requires a lot of effort to get a high hygiene outcome, understaffing has a large effect on restaurants that have high hygiene performance. However, when restaurants are already doing a poor job in terms of hygiene, it probably does not require much time and effort to maintain the same level of hygiene. Therefore cleanest restaurants suffer the most from the raise in the minimum wage.

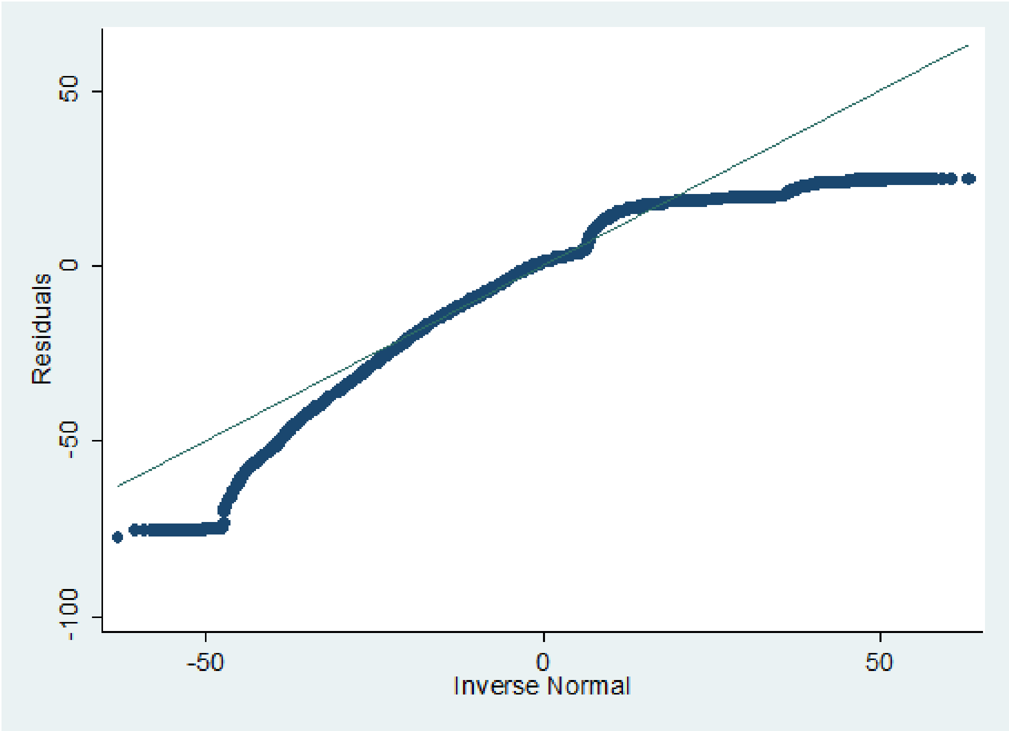
Table 4 results regression in quartiles

Quartile	Coefficient
1st	0.343
2nd	0.204
3rd	0.099
4th	-0. 639***

*** means significant at the 1% level

[10] We cannot use day fixed effects because there are only very few inspection per day. Daily fixed effects will over fit the data.
[11] In this case possibly spuriously insignificant
[12] Quantile regression is not possible to me due to computational limitations and data limitations

QQ-plot 1 residuals specification 5 over the full sample in the first 8 quarters



There is an issue with the interpretation of the results though: restaurants that enter or exit the market are unlikely to be a random selection. Therefore the results may be biased it is unclear in which direction the bias works since inexperienced entrants may bias the effect of the minimum wage downward and incapable restaurant owners who leave the market may bias the effect upwards. However, since we have not data on entry/exit we cannot control for this directly. Instead we remove all restaurants with only one data point (i.e. one inspection) out of our sample, and then we rerun our regressions. We iteratively repeat this process for two to five data points. The results remain the same (that is insignificant near zero results for the first three quartiles and an effect around -0.64 for the fourth quartile) this suggests that the bias caused by entry/exit is negligible. Do note that even the significant effect is very small, a one dollar increase in the minimum wage will cause a 0.64 point decrease in the hygiene score of the best performing restaurants. The standard deviation in the hygiene score is 14 points so a 0.64 point decrease is hardly noticeable, especially since the minimum wage increased by respectively 50, 25, 15 and 60 cents. Therefore we can estimate the total productivity effect of all for increases in the minimum wage to be around a one point decrease in the hygiene score of the best scoring 25% of the restaurants.

Are inspections random?

In our dataset, every observation corresponds to an inspection. This may cause unequal weighting of certain restaurants. This may especially be problematic if the inspection frequency depends on the hygiene score because this may cause our results to be biased[13]. In table 5 we compare hygiene

[13] This is only problematic if the score dependency changes with the intervention we are interested in (i.e. the minimum wage)

score summary statistics (where every inspection is an observation) to the summary statistics of the mean hygiene score (where every restaurant is an observation[14]) of every restaurant[15].

Table 5 hygiene score summary statistics compared to the summary statistics of the mean hygiene score of every restaurant (for the first 8 quarters)

score		(mean) score	
	Percentiles		Percentiles
1%	33	1%	41.5
5%	48	5%	52.67
10%	56	10%	58.4
25%	66	25%	67.6
50%	77	50%	76.6
75%	90	75%	86
90%	94	90%	93
95%	94	95%	94
99%	95	99%	95
Obs	67,139	Obs	21,031
Mean	75.30	Mean	75.75
Std. Dev.	15.11	Std. Dev.	12.97
Variance	228.29	Variance	168.29
Skewness	-0.762	Skewness	-0.617
Kurtosis	3.776	Kurtosis	3.470

Table 5 shows that the differences are small and probably not problematic. We also regress the previous inspection's hygiene score (t0) on the days since the last inspection. If we do this we find a highly significant[16] positive correlation between the time since the last inspection and the last hygiene score. If we (iteratively or not) add a time control and restaurant fixed effects the effect remains positive and highly significant,[17] the effect is not big though. The coefficient is 0.22 when a time control and restaurant fixed effects are added. This means that better performing restaurants are visited slightly less often.[18] This makes sense from the perspective of the regulator: restaurants that do well require less monitoring. Since the effect is very small, it is not problematic for our other results.

[14] Where means of the inspection scores are taken for all restaurants that have more than one inspection within our sample
[15] Using averages we know for sure that every restaurant is counted once (instead of every inspection)
[16] At the 0.1% level
[17] Also at the 0.1% level
[18] About one day later for every five points increase in the hygiene score

Discussion and conclusion

From the previous sections it follows that the causal effect of minimum wage increases on restaurant productivity is negative but very small. For the bulk of restaurants the effect is so small that we cannot confidently determine its sign, for the best performing restaurants though the effect is negative and highly significant. The effect for the best performing 25% of restaurants is still small: it is 0.64 points of a hygiene point per dollar increase in the minimum wage. This is approximately 5% of a standard deviation. The conclusion of this paper is that there is a tradeoff between firm productivity and minimum wages but that it is not a big tradeoff: raising the minimum wage from $4.25 to $5.75 has some negative productivity effects but they are small. The effect can be expected to be bigger for higher minimum wages based on theoretical grounds. The productivity effect of a minimum wage change consist of three parts: the productivity effect of individual workers[19], the productivity effects due to worker selection[20] and the productivity effects caused by a change in man hours[21]. This paper shows that the sum of these three effects is slightly negative, but other research is needed to find the sign and significance of the three parts of this effect. The employment effect of minimum wage changes, which are related to the productivity effects, are not researched in this paper.

[19] Worker may become more or less productive due to the change in the minimum wage
[20] Higher wages enable employers to be selective
[21] Restaurants may use more or less labor because of the minimum wage change

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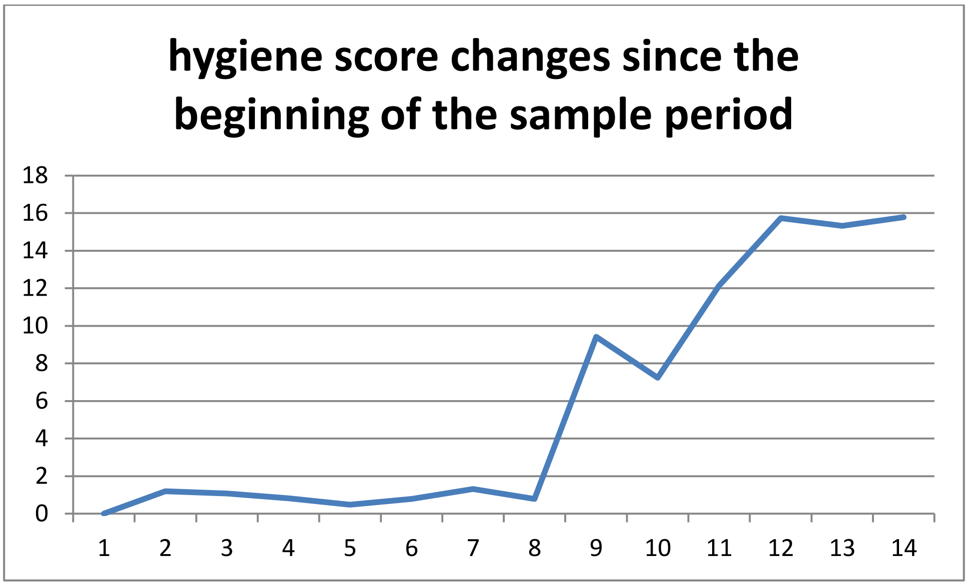
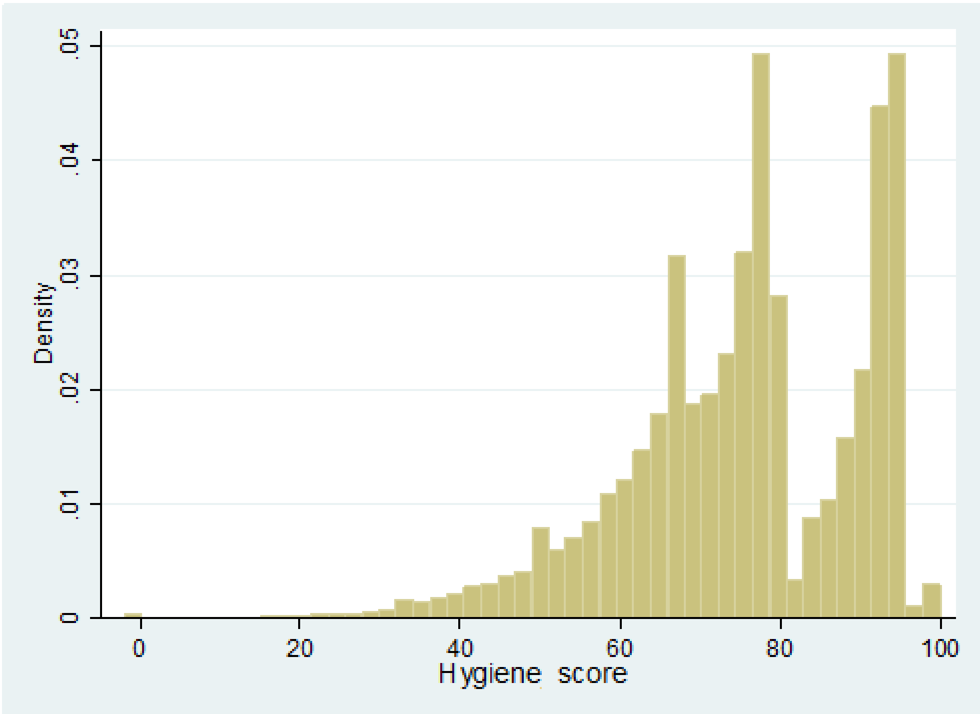
Appendix

Graph 1.2 same axes as graph 1 but this time considering the period after July 1997 as well



Histogram 1.2 same axes as histogram 1 but this time considering the period after July 1997 as well



Histogram 2.2 same axes as histogram 2 but this time considering the period after July 1997 as well