Minimum Wages and Firm Profitability

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Web Appendix

Appendix A: Theoretical Models of Profitability and Minimum Wages

A1. Introduction

In order to obtain a long-run effect of the minimum wage on profitability we need to have some degree of imperfect competition in the product market. We therefore consider several industrial organization models. Aaronson and French (2007) consider in detail the effects on the minimum wage on prices and costs in a competitive and monopsonistic labor market model. However, in these models firms do not have positive price-cost margins so profits remain zero by assumption, regardless of the minimum wage.

We separate our analysis into the short-run and long-run, where we define the short run as the period where all variables are able to change (*including* capital, labor, prices, etc) but the number of firms is held fixed. In the long-run entry and exit can occur and the number of firms can change. Our analysis of exit and entry is directly applicable to the long-run results.

A2. Imperfect Competition in the Product market

Short-run effects with symmetric and asymmetric costs

Consider a two-stage game where firms pay a sunk entry cost (*K*) and, conditional on entering engage in competition with other firms (total number of firms in market is denoted *N*). The instruments of competition can be price or quantity.

We begin with the workhorse industrial organization model of an asymmetric Cournot model[1] where firms have heterogeneous marginal costs. Below we discuss alternative imperfect competition models that lead to similar qualitative results.

The non-cooperative Nash equilibrium in quantities gives a well-know expression for the price-cost margin:

$$\frac{p - c_i(q_i)}{p} = \frac{MS_i}{\eta} \tag{A1}$$

Where η is the (absolute value of the) price elasticity of product demand, p is output price, c_i is marginal cost of firm i, q_i is firm output and MS_i is the market share ($\mathrm{MS_i} = \frac{S_i}{\sum_i S_i}$) with S_i denoting firm sales. Note that equation (A1) nests the special cases of monopoly ($N = 1$). If we assume constant returns then marginal costs do not depend on output ($c_i = c_i'(q_i)$) so the price-cost margin can be characterised by the ratio of profit (Π) to sales (S):

$$\left(\frac{\Pi}{S}\right)_i = \frac{MS_i}{\eta} \tag{A2}$$

Firm *i*'s market share will depend on its marginal costs relative to the marginal costs of other firm's in the industry. If firm *i*'s marginal costs rise relative to those of other firms it will lose market share (see Tirole, 1989, Chapter 5 for example).

Consider the effect of an increase in the minimum wage. If we assume that demand is iso-elastic (we will relax this below) then the impact of the minimum wage on the firm's price-cost margins will be reflected in its market share. If a firm employs a greater proportion of minimum wage workers, it will face a larger increase in marginal costs and therefore a larger fall of its price-cost margins.

This is our key comparative static result: the introduction of a minimum wage will reduce the profitability of firms who are more "at risk" because they employ a higher share of minimum wage workers.

If we also relax the assumption the demand elasticity is constant, there will also likely be a fall in profitability. To see this clearly assume that firms are symmetric so that they all face identical marginal costs. In this case, the equilibrium condition of (A1) simplifies to

$$\frac{\Pi}{S} = \frac{1}{N}\frac{1}{\eta} \tag{A3}$$

[1] Cournot competition can be considered the reduced form of a two-stage game where firms set capacities in the first stage and then compete in prices in the first stage (Kreps and Scheinkman, 1983).

It is clear from equation (A3) that the impact of the minimum wage will on profitability ($\frac{\Pi}{S}$) will depend on its impact on the demand elasticity (η). In particular if demand becomes more elastic, profitability will fall. For most commonly used demand curves, a minimum wage will make the demand curve more elastic because price has risen. For example, consider the case of linear industry demand (Q) for where $Q = A - bp$, $b > 0$, $A > 0$. In this case, $\eta = b\frac{p}{Q}$. Following the introduction of a minimum wage prices will be higher and quantity sold lower unless demand is perfectly elastic. The elasticity of demand is therefore higher and profitability will fall. This will reinforce the effects on market share discussed in the more general model with asymmetric firms.[2]

Under differentiated products Bertrand equation (A3) should be interpreted as a firm-specific elasticity.

This result differs from Aaronson and French (2006) who consider a model of monopolistic competition. This generates an equilibrium condition like (A3). The minimum wage has no effect on price cost margins in their model because they assume that the elasticity of demand is constant. This guarantees no effect of the minimum wage on price-cost margins as all costs are passed through completely to the consumer. Additionally, the "large number of firms"

[2] We cannot rule out the possibility that the aggregate demand curve may become more elastic as wages rise even if the labor market is perfectly competitive. Micro-economic theory places few restrictions on industry demand curve aggregated from consumer preferences (e.g. see Varian, 1984, chapter 3.16). Thus, it is still ultimately an empirical issue whether profitability rises or falls after the minimum wage.

assumption underlying monopolistic competition rules out strategic interactions that generate the market share effects in equation (A3)

Long-run effects

After the minimum wage is imposed, absolute profits in the industry will be lower. This will mean that there is less of an incentive to enter the industry. Consequently, we might expect to see fewer firms in the industry (from exit and/or less entry) in the long run. The short run fall in profits for the incumbent firms in the industry will therefore be greater than the long-run change as *N* will fall (e.g. see equation (A3)).

An important caveat to this is that the number of firms in the industry may not fall due to an "integer" effect. Since there will always be an integer number of firms in the industry all firms will usually earn some economic profit. Firms will enter and pay the sunk cost up until the point that a marginal firm entering the industry would not make a profit net of the sunk cost. For example, consider a symmetric duopoly in long-run equilibrium. If a third firm entered the industry a firm's profits (net of the sunk cost, *K*) would be negative i.e. $\Pi^{*(3)} - K \leq 0 \leq \Pi^{*(2)} - K$, where $\Pi^{*(3)}$ is equilibrium profits with three firms and $\Pi^{*(2)}$ equilibrium profits with two firms.

Now, except in the special case when profits in the market exactly covers the sunk cost ($\Pi^{*(3)} - K < 0$ and $\Pi^{*(2)} - K = 0$) the minimum wage could reduce $\Pi^{*(2)}$, but not by so much that $\Pi^{*(2)} - K < 0$ and one firm was forced to exit the industry. Consequently, for small increases

in the minimum wage firms could have lower profits without a change in the equilibrium number of firms.

This caveat aside, in a dynamic setting we would expect that a minimum wage would increase exit and reduce the entry rate.

A3. Perfect Competition in the Product Market

Now consider the case of perfectly competitive product markets. Comparative statics of prices and factor demands following a minimum wage increase have been comprehensively analyzed by Aaronson and French (2007). Here, we will briefly contrast the usual case of perfect competition in the labor market with some alternative models. It worth emphasizing two preliminary points. First, as we discussed above that these are in the short-run as in the long run firms earn zero profits by assumption. Second, the short-run effect of the introduction of a minimum wage will be *larger* in the competitive model than in the monopsony model.

Perfect competition in the labor market

If labor markets are perfectly competitive, the short run effects of the minimum wage on profits are composed of two components (see Ashenfelter and Smith, 1979, and the main text). First, there is fall in profits due to the increased wage for the current number of workers paid below the minimum wage. This fall in profits is offset by a second effect to the degree that firms can substitute minimum wage workers for other factors of production (including non minimum wage

workers). In the limiting case of perfect substitutability of minimum wage workers there will be *no effect* on profits.

Of course these are only short-run effects as there can be no economic profits under perfect competition and in equilibrium industry prices will rise and quantity will fall (so there will either be fewer firms or the average firm size will shrink).

Imperfect Competition in the labor market

There have been a variety of models proposed in recent years where firms have some power to set wages because of efficiency wages, monopsony, search or other reasons. In these models, over a certain range of values a binding minimum wage can increase employment.

Considering profits, we would expect the negative short-run effects of a minimum wage on profitability to be muted in such models. This is because, unlike the competitive model the first order effect on profits is zero as an increase in the wage has a beneficial effect on profits through making it easier to recruit, retain and/or motivate workers. There will be a second effect because the firm is being shifted away from its optimal level of the wage so overall we would still expect a decline in profits. However, this is likely to be much less severe than in the competitive model.

To see this consider a simple representation of the monopsony model. We model the firm's wage setting power in a reduced form way (following Card and Krueger, 1995) and assume that the

production function, $F(W,L)$, is increasing in the wage as well as labor, L. The firm chooses wages and labor to maximize profits

$$\Pi = \max_{W,L} pF(W,L) - WL$$

Which lead to the standard first order condition:

$$p\frac{\partial F(W,L)}{\partial L} = W^*$$

where an asterix denotes the optimized value. We also have an additional non-standard condition from optimizing wages of:

$$p\frac{\partial F(W,L)}{\partial W} = L^* \tag{A4}$$

If we consider the effect of a small increase in wages on profits in the neighbourhood of the optimized level of wages and employment (W^*, L^*) this is given by:

$$\frac{d\Pi}{dW} = p\frac{\partial F(W^*,L^*)}{\partial W} - L^*$$

Note that this is equal to zero by the first order condition with respect to wages, equation (A4).

Long-run effects

In this setting, there are no long-run effects on profits.

Considering exit, unlike the model with imperfect competition firm size is not tied down.

In the competitive model, prices will be higher and output lower. In our constant returns set-up a zero profit equilibrium can be restored either by all firms becoming smaller or by some firms exiting.

A4. Summary

In models of imperfect product market competition, we would generally expect to observe negative effects on the profitability of firms where the minimum wage bites, even after firms have adjusted all factors of production. In such models, some of the increase in costs is borne by shareholders rather than just consumers and unemployed low-wage workers as in the standard competitive model.

It is worth emphasizing that employment will still fall in these models. So oligopoly could explain only why employment responses could be more muted than one would expect from a competitive model. Of course, employment changes can be positive if firms with market power in the product market also have market power in the labor market.

The final section (A4) showed a very simple model that assumes no change in sales or jobs following a minimum wage hike. This model does surprisingly well in rationalizing the results.

Additional References

Aaronson, Daniel and French, Eric (2006) "Product Market Evidence on the Employment Effects of the Minimum Wage" Federal Reserve Bank of Chicago Working Paper No. 21

Kreps, David and Scheinkman, J. (1983) "Quantity Precommitment and Bertrand competition yield Cournot outcomes" Bell Journal of Economics, 14, 326-227

Tirole, Jean (1989) The Theory of Industrial Organization, Cambridge: MIT Press

Varian, Hal (1986) Microeconomic Analysis, Second Edition New York: Norton

Appendix B: Data

FAME Data

The FAME (Financial Analysis Made Easy) dataset contains information on firm company accounts of publicly listed and private firms in the UK economy. It is supplied under licence as part of the AMADEUS database from BVD (Bureau Van Dijk). Our sample begins with data on all firms in the six financial years from April 1st 1996 to March 31st 2002 including those who had entered and exited. We select firms who report on the 31st March. We drop firms with missing data on our key variables (profits, wages, sales, employment, industry, and region). We use information on consolidated accounts at the lowest level that exists (i.e. we use subsidiary level information if this exists). We drop information for all observations where the profit-sales ratio is greater than 1 in absolute value.

In the main results, we condition on the cohort of firms who were alive on March 31st 1999 when the minimum wage introduced and had an average wage between £4000-£20,000. We also present results where we examine the impact of including firms who entered after this date (and exited before this date) including a dummy variables for entrant and exiting firms (and interactions of these dummies with the NMW policy period).

Profits/Sales: Gross profits (prior to deductions for tax, interest and dividends) over turnover (sales).

Average Wages: Total remuneration divided by total number of employees

Capital / Sales: Tangible assets over turnover (sales).

Sales / Employment: Total turnover (sales) over the number of employees.

Labor Force Survey

The Labor Force Survey (LFS) is a large-scale household interview-based survey of individuals in the UK that has been carried out on varying bases since 1975.[3] Around 60,000 households have been interviewed per survey since 1984. Annual proportions calculated relative to firm reporting year rather than calendar year (i.e. April 1998 – March 1999).

Union membership: Defined at the three-digit UKSIC industry level, annual values 1993-2002.

Part-Time Work: Proportion of employed workforce classified as part-time, annual values 1993-2002. Defined at the three-digit industry level.

Female Workforce: Female workers as a proportion of total employed workforce, annual values 1993-2002. Defined at the three-digit industry level.

[3] Between 1975 and 1983, the survey was conducted every two years. From 1984 until 1991, it was conducted annually. Since 1992, the Labor Force Survey has been conducted every three months in a five-quarter rolling panel format.

Graduate Qualifications: Proportion of graduate qualified workers per region and two-digit industry cell.

Region: Government Office Region of Workplace ("gorwk"). These include Tyne and Wear, Rest of the North East, Greater Manchester, Merseyside, Rest of the North West, South Yorkshire, West Yorkshire, Rest of Yorkshire and Humberside, West Midlands and Met Country, Rest of West Midlands, Eastern, Inner London, Outer London, South East, South West, Wales, Rest of Scotland, Northern Ireland.

Care Homes Data

The UK care homes data was collected in surveys conducted in 1992 (prior to the general election in that year) and 1993 for homes on the South Coast of England; in 1998 (before the introduction of the NMW) and in 1999 (after the introduction of the NMW in April) for all homes across the country. Finally, there was some more data collected in 2000 and 2001 for South Coast homes only. The data is in the form of an unbalanced panel so that the same homes are followed over time. The sector was chosen because it is characterized by a large concentration of non-unionized, low wage employees working in small firms with an average employment level of fifteen to twenty. There was also product market regulation in this sector insofar that an important fraction of home residents had their care paid for by the government through the Department of Social Security (DSS).[4] The Department of Social Security paid a capped price for beds, which were not increased when the minimum was introduced. As a result, many homes had a limited scope to increase prices in response to the minimum thereby leaving

[4] The average percentage of such residents was 52.7% before the minimum wage introduction and 57.6% after. We always condition on this variable in the regressions.

more room for employment or profitability effects to manifest themselves. A more comprehensive account of features of the data is given in Machin, Manning and Rahman (2003).

Business Registration and De-registration Database

The UK Department of Trade and Industry (DTI) publish data on births and deaths of companies at the three-digit level on a consistent basis from 1994 (see http://stats.berr.gov.uk/ed/vat/). These are based on Value Added Tax (VAT) Registration numbers that every incorporated firm in Britain is legally obliged to have. (This is the same as the aggregated FAME date).

We used this data to calculate for each three-digit sector the proportion of firms who entered in a year (entry rate). Entry rates calculated as the number of new VAT (Value-Added Tax) registrations as a proportion of the beginning of year stock. Exit rate calculated as the number of VAT deregistrations over the beginning-of-year stock. Net entry calculated as entry rate minus exit rate. We also calculated the net entry rate as the difference between the entry and exit rates.

We then matched information form the LFS at the same level of aggregation to calculate the proportion of workers in each industry paid below the minimum wage in the pre-policy period.

TABLE B1:
CHARACTERISTICS OF TREATMENT AND COMPARISON GROUPS

	Treatment Group T=1	Comparison Group T=0	All
Average Wage (£000s)	10.53	17.38	15.76
Profit/Sales	0.108	0.064	0.074
Capital/Sales	0.297	0.237	0.248
Wagebill/Sales	0.289	0.261	0.268
Employment (mean)	2,704	1,004	1,407
Employment (median)	273	170	187
Productivity (=Sales/Employee) (£000s)	71.4	110.2	101.0
Exit Rate	0.050	0.053	0.051
Proportion part-time employees	0.295	0.158	0.190
Proportion female employees	0.535	0.378	0.415
Proportion union members	0.186	0.213	0.207
Proportion Firms in:			
Manufacturing	0.165	0.372	0.323
Wholesale	0.081	0.172	0.150
Retail	0.098	0.038	0.052
Hospitality	0.163	0.015	0.050
Business Services	0.133	0.083	0.095
Number of Observations	974	3,138	4,112

NOTES:- T= 0: Comparison group; T = 1: Treatment Group; Part-time and female employees based on Labor Force Survey (LFS) and calculated as proportion of total workers per two-digit industry by regional cell. *Low Wage Firm* - treatment group is defined as firms with an average wage equal to or below £12,000 per annum in the pseudo pre-policy financial year up to March 31st 1996; the comparison group is defined as firms with average wages between £12,000 and £20,000. Sample for exit represents 1999 cohort of firms, with total N = 1,066 (N=319 for treatment group and N=747 for comparison group).

TABLE B2: FIRM ENTRY AND EXIT RATES BY THREE-DIGIT INDUSTRY, 1996-2001 (DTI VAT REGISTRATIONS AND DEREGISTRATIONS).

	(1) All Industries	(2) Low Wage industries (below median Lowpay)	(3) High Wage Industries (above median Lowpay)
Entry Rate	0.089	0.087	0.091
Exit Rate	0.082	0.083	0.081
Net Entry	0.007	0.003	0.011
Lowpay	0.126	0.051	0.201
Union	0.287	0.350	0.189
Female	0.343	0.274	0.411
Part-time	0.143	0.076	0.209
No. of Industries	170	85	85
No. of Observations	1,020	510	510

NOTES: Entry rates calculated as the number of new VAT (Value-Added Tax) registrations as a proportion of the beginning of year stock. Exit rate calculated as the number of VAT deregistrations over the beginning-of-year stock. Net entry calculated as entry rate minus the exit rate. The variables lowpay, union, female, part-time are all sourced from the UK Labor Force survey (LFS). The "Lowpay" variable is defined as the proportion of workers with hourly wage below £3.60 in the pre-minimum wage period (1994-1998). "Below Median Lowpay" indicates all those industries where the proportion of lowpay workers ranges from 0 to 0.092. "Above Median Lowpay" indicates all of those industries where the proportion of lowpay industries ranges from 0.095 to 0.557.