"Insufficient for the Support of a Family":[1] Wages on the Public Works During the Great Irish Famine

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Abstract: This paper presents a model of the money wage paid on the public works during the Irish Famine. The administrators are assumed to minimise a cost function that includes the divergence from the target as well as the increase compared to the wage that current information is available on. Estimation reveals a lag of four weeks existed between price changes occurring and adjustment to the money wages. Most seriously, the administrators systematically failed to take full account of the extent of price changes.

INTRODUCTION

The provision of public works enjoys wide support as a policy to counter the risk of famine. In an important monograph on the public response to hunger, Drèze and Sen (1989) highlight the potential of public works "… to carry out large transfers to vulnerable households, while at the same time imparting a strong redistributive bias to the entitlement protection process". To prevent starvation the design of the policy is in principle straightforward: any destitute must be eligible to get a place on the works and be able to earn sufficient to cover subsistence. This paper examines the experience of the public works during the Great Irish Famine where the policy was a total failure. Its purpose is to highlight an issue that has not received the attention that it warrants, namely the adjustment of the money wage to take account of price fluctuations.[2]

During the period of the public works in Ireland payments were in cash

[1] This is a quotation from Trevelyan (1848, 62-3), the civil servant who directed the relief operation from the Treasury.

[2] Thus the issue is distinct from that whether disbursements should be in money or food (see Coate, 1989).

and no attempt was made by the government to influence the price of food – it was firmly committed to *laissez faire* quoting Adam Smith as the authority.[3] (The principal foodstuff of the poor at this time was maize imported from the United States; there had been a general crop failure in Europe and the Irish price of maize was determined internationally.)

The public works in Ireland were established on a scale that had few precedents: at their peak they employed three-quarters of a million people on over 5,000 sites scattered throughout the island. The numbers involved and their spatial dispersion made the issue of determining the money wage a considerable challenge; failure to ensure an adequate wage was largely responsible for the failure of the policy. Over the winter of 1846-7 the average wage was just over one shilling per day: according to Ó Gráda (1994), "Mere subsistence for a family of four or five …cost at least *2s.* or *3s.* a day, before making any allowance for clothes or lodging" (p.196).

Two points deserve to be highlighted here. First, there is the question of the mean level of the wage. Clearly, if this is below the subsistence level, then by definition excess mortality cannot be avoided. An effective public works programme to counter famine would set the money wage at the level that would just cover subsistence. This raises the second point. Price changes over the period of the public works were considerable as can be judged from Figure 1. For the money wage to be sufficient to cover subsistence in any particular week then its level would be such that at the prices *anticipated* to pertain during the week, the money wage would afford subsistence, that is, the real wage, would be held constant at the subsistence level. As is evident from Figure 1 the variation in the real wage, defined as the money wage divided by the Belfast market price of maize (as quoted in the *Northern Whig*), was actually considerable.

The difficulties faced by the British government are common to any public works system. For example, the Employment Guarantee Scheme (EGS) of Maharashtra (see Hirway and Terhal, 1994) played an instrumental role in the prevention of famine during the drought of 1970-3, when at the peak 5 million labourers were attending public works over a wide geographic area. (Drèze, 1990). The original intention was to limit the role of the food market by providing subsidised food in the state's 'Fair Price Shops' and so the

[3] According to Smith the interests of the inland corn dealer and the people were similar – the former maximised his profit when the latter adjusted their consumption, in the light of the information being given by prices, so that it equalled available supply. "The unlimited, unrestrained freedom of the corn trade, as it is the only effectual preventative of the miseries of a famine, so it is the best palliative of the inconveniences of dearth" (Smith, 1976, p. 527). The evidence of the corn trade, assembled by Bourke (1976, pp. 163-164), broadly supports this position: total grain exports from September, 1846 to June, 1847 were about a fifth of the levels of imports.

Figure 1: *Prices and the Real Wage on the Public Works*
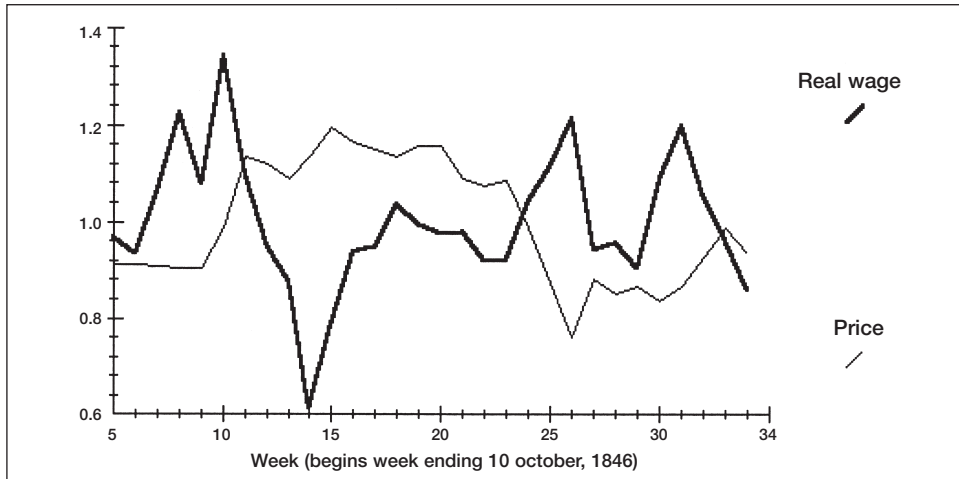
Sources: Prices relate to the Belfast market price of maize as recorded in the *Northern Whig*. For wages see Section III.

problem of wage adjustment could in theory have had been avoided.[4] In reality the market was the main source of grain for those employed; to attract supplies from the rest of India required a doubling of food prices. In response to this the wage rate on the EGS was increased by 20 per cent which was sufficient to stave off famine (Oughton, 1982).[5] The contrast with the Irish case could not have been more dramatic.

This paper seeks to answer three questions concerning the public works during the Irish famine. Given that there were over 5,000 separate schemes, what was the administrative system whereby money wages were altered? How accurately did the decision makers anticipate the price level? What do the data indicate were the policy objectives lying behind the variations in the money wage?

The first question is addressed in Section II where the administrative structure of the Board of Works is examined and the extent of local control over the wage rate is discussed. After the construction of the wage data employed in the paper is outlined in Section III, the wage adjustment process is examined empirically in Section IV where two alternative models are considered. This is followed by some conclusions. First though an overview of the historical background is presented in the next section.

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[4] There were 30,000 of these. The actual distribution of subsidised foodgrains was estimated at between 2 and 4 kg per capita, far short of the official allocation of 12 kg (Drèze, 1990). The result was that most grain was bought in the market, where prices increased from Rs. 1.73 in June, 1972 to 3.34 one year later (Oughton, 1982).

[5] Interestingly this required legislation.

I THE CHALLENGE FACED BY THE BOARD OF WORKS

According to Cormac Ó Gráda the consensus among historians today concerning the programme of relief during the Great Irish Famine mirrors that of contemporary observers, namely that it was "too little, too slow, too conditional, and cut off too soon" (1999, p. 49). Given the demographic toll, estimated as at least one million dead and a similar number of emigrants, 1845-51 (Mokyr, 1980, Boyle and Ó Gráda, 1986), against a population returned as 8.2 million by the 1841 census, it is difficult to contest this assessment. On the other hand, this must not lead to underestimation of the scale of the problem facing the British government in 1846.

It has been estimated by Solar (1989) that Irish food production fell from an average of 32.1 billion kcal/day in the period 1840-45 to 15.7 billion in 1846-50. This fall of more than half was almost entirely accounted for by the fall in potato output. The shock would have been greatest in 1846/1847 given the extent of potato cultivation together with the collapse in its yield. Not only was output drastically reduced by the blight, the mode of production was changed utterly. Prior to the blight an extremely labour intensive form of tillage production had been pursued and in 1845 almost two-thirds of Irish agricultural production consisted of tillage items (according to Ó Gráda's, 1984, estimate); by itself the potato comprised one-fifth of net agricultural output.

To understand the nature of the shock the fungus imparted to the rural economy requires an appreciation of the operation of the land and labour markets. The owners of the land and the tillers of the soil formed mutually exclusive classes in pre-Famine Ireland. Despite this, access to land was virtually universal. Commercial and many family farmers held tenancies from landlords, often under lease.[6] The labouring classes acquired land through a wide variety of subtenancy agreements (examined in McGregor, 1981). The most common was a trade of land for labour: a farmer would allow a labourer to crop a field (which would change over the years with the rotation scheme) in return for an agreed number of day's labour. The rent and the wage rate were nominal and no money was exchanged until after harvest. Naturally this system required the labourer (or cottier) to have a year's subsistence and so although the economy was poor, capital was widely distributed but in a vulnerable form.[7] Labourers producing their subsistence was a characteristic shared by the other forms of subtenancy such as con-acre, where the right to

[6] Although insecurity of tenure was a popular contemporary refrain, the empirical evidence for it is somewhat limited (Mokyr, 1985).

[7] Irish per capita income in 1845 was probably less than half of Britain's (Mokyr, 1985, p. 11).

access was for eleven months and was often gained through auctions, and free-cropping, where the labourer manured the ground and no rent was paid.

Labourers and cottiers, together with their dependants, numbered about 4.7 million and according to Ó Gráda's (1989) estimate consumed almost half of the net potato output. Consequently the loss of the 1846 crop was borne disproportionately by the poorest in society, since the crop constituted the bulk of their assets. Labourers, now without subsistence, demanded money wages instead of access to a farmer's land. In response to this situation farmers expanded livestock production sharply and cut back on tillage.

The situation in the Irish agricultural labour market addressed by the British government in the winter of 1846-47 is depicted in Figure 2.[8] Winter was a seasonal trough in labour demand that lasted about three months and followed the harvest peak (Bourke, 1993, p. 48); the demand schedule reflects both this and the impact of the blight on commercial farmers. With the devastation of the potato crop in 1846 rural employment collapsed: "The farmers, scarcely without an exception, have discharged the whole of their servants, both male and female – Numbers of both sexes have offered to remain and work with farmers for their 'food' alone, without any wages – but even this the farmers say they cannot afford".[9] That farmers could not afford to pay labourers just food alone suggests a market wage below subsistence.

Figure 2: *The Irish Rural Labour Market 1846/7*
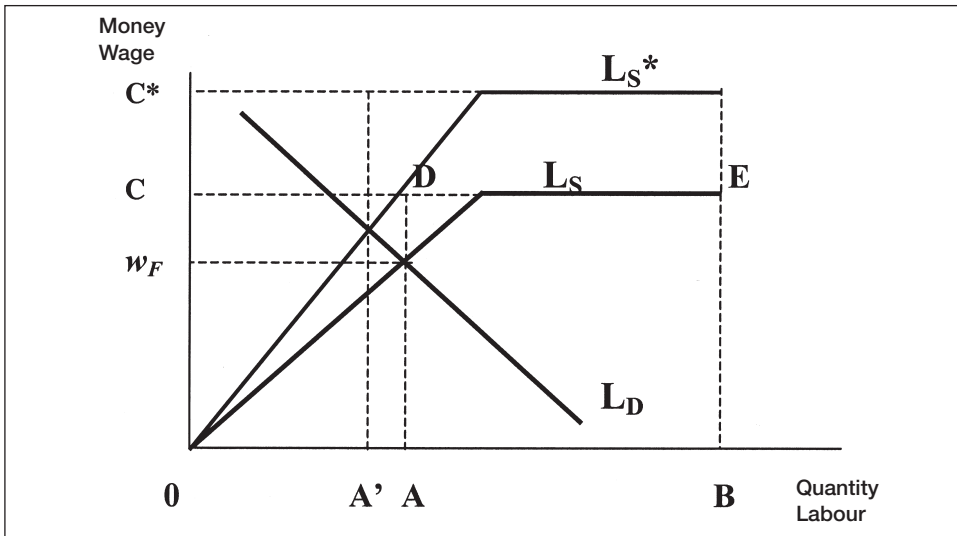
The labour supply schedule in Figure 2 is drawn on the basis that survival dominated the considerations of the poor. To appreciate the consequences of this consider two labourers, J who has assets that will yield 1 shilling per week and K who has none. Subsistence, C, costs 2 shillings per week (these figures assume household composition is the same and that assets constitute the only difference between J and K). As things stand both J and K will starve. To survive in a competitive labour market, they will have to secure employment. The major difference is that J can accept (and would be rational to do so) a wage of 1 shilling while K cannot accept a wage below 2 shillings.[10]

The labour supply schedule will reflect the distribution of resources so the linear section through the origin in Figure 2 assumes that assets are uniformly distributed below the subsistence level. The schedule goes through the origin since a labourer with assets that will yield 1 shilling 11 pence per week will accept employment at a wage of 1 penny. Once the wage is at subsistence the schedule becomes infinitely elastic as the large number of cottiers and labourers rendered destitute by the blight are now physically able to work at the going wage. The equilibrium wage in the absence of intervention is at w_F, which is below subsistence. At this wage OA are in employment and AB are in what Sen (1981) refers to as the starvation set.

The numbers of destitute swamped the contemporary welfare system that was based upon the Poor Law. Each locality had its workhouse, where the destitute had to reside to be eligible for relief; workhouse capacity at the onset of the Famine though was only 100,000. The government response was to provide public works (see Black, (1960) for background) with the intention that employment would be restricted to those in distress. The policy was successful in dealing with the modest failure in 1845 but was overwhelmed by the level of demand in the aftermath of the 1846 crop failure. By March 1847, almost three-quarters of a million people were employed under the Labour Rate Act even though its inability to prevent widespread starvation had been appreciated by inspecting officers in January (Great Britain, 1847 Vol. 52, pp. 7-8).

The major reason for the failure of the public works was the low wage they paid. This was candidly admitted by Trevelyan, the Treasury Under Secretary who controlled the government relief effort: "The wages, paid regularly in money, were higher than any which had ever been given for agricultural labour in Ireland, but at the existing prices of food they were insufficient for the support of a family, melancholy proof of which was afforded by daily

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[10] This assumes that K supports the rest of his household. What K cannot do is to significantly reduce his nutrition for then his labour power falls and no-one will employ him – it is assumed that the wage is set in terms of efficiency units.

instances of starvation" (1848, pp. 62-3). The average wage paid according to Ó Gráda (1994, p. 196) was less than half required for the support of a family.

Figure 2 illustrates the dilemma faced by the government in 1846. The wage on the public works that would prevent starvation is at C and the level of employment AB. But such a wage would attract those currently employed at the market wage of w_F. The conclusion is bleak: under the circumstances that pertained in the winter of 1846-1847 no wage existed that would screen between the destitute and those capable of surviving in the labour market. The latter had some assets and thus could undercut those who had none; any attempt by them to gain access onto the works would inevitably create the impression that the wage was too high.[11]

II WAGE POLICY ON THE PUBLIC WORKS

This section examines the wage policy of the Board of Works and in particular how it coped with two major challenges: the first of these was the determination of the level of the real wage; the second was the response to the sharp fluctuations in the price of maize revealed in Figure 1. In terms of Figure 2 an increase in price causes the labour supply schedule to rotate anticlockwise to $L_S{}^*$. The result is that the wage required to prevent starvation increases to C^* and there are increases in both the famine money wage (though a fall in the real wage) and the starvation set, which increases by AA'.

The wage policy on the relief works was confused in theory but frequently flexible in practice. The initial policy with respect to the daily wage offered on the public works was put forward in a Treasury Minute of 31 August 1846 that instructed it should be $2d$. below that prevailing for labour in the locality (Great Britain, 1847, Vol. 50. pp. 67-70).[12] In effect the wage was to be used as a screening device (see Besley and Coate, 1992). The problem of course was that at a wage of $w_F - 2$ no-one in the starvation set is physically fit to labour. Moreover, given the extent of price changes, the informational demands of the policy were considerable.

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[11] The informational demands of policy making given contemporary technology should not be underestimated. There were over 5,000 different public works schemes in Ireland during the winter of 1846/7. The information required for close supervision exceeded the capacity to generate and process it. To put this in perspective, while the crop returns used by Bourke (1959) and Mokyr (1981) to estimate the Pre-Famine potato acreage were collected by the constabulary, they played no role in the relief scheme because they were not processed contemporaneously. Sir Randolph Routh, admitted that all his attempts to secure the extent and yield of food crops in Ireland, had been unsuccessful (Bourke, 1993, p. 179).

[12] For those more youthful than the author, $12d$. or old pence equals one shilling equals 5 (new) pence.

However, the Treasury Minute also directed that task work should be used "to the utmost extent". The two systems were fundamentally different. The former system could be and was set centrally: in September the Board of Works reduced the wage to 8*d*. per day "in consequence of instructions on that head from the Treasury and the Board" (Great Britain, 1847, Vol. 50, p. 74). As can be imagined, the reduction was not popular. A mob confronted the inspecting officer for Mayo and asked how a man could support a large family on 8*d*. a day. The officer, wisely, "did not, of course, mention the poor-house" but instead asserted that the relief committee would probably distribute meal to such families (ibid. p. 81). When this letter was written the Belfast price of Indian meal was just over £9 per ton: by mid October it was £15. Yet the relief committee of Corran on the later date wrote to the Prime Minister complaining that the 8*d*. per day on the public works was a "miserably low rate" (ibid. pp. 150-151). The Treasury Minute on this did not deny the wage but said it was restricted to those "unable or unwilling to work by task".

The task-work system effectively decentralised the wage policy. The Board instructed its officers that "the sum to be paid for each portion of work, should be sufficient to enable an ordinary labourer to earn from 10*d*. to 1*s*. per day, and a good labourer, who exerted himself, from 1*s*. 4*d*. to 1*s*. 6*d*. per day" (ibid. p. 140). Unfortunately the good labourer who was capable of sustained physical exertion was not the prime target of the relief effort.

The task work system required that operations involved in road construction be measured and the rate of payment set for a gang of men. The incentive structure was clear and produced a rational response. The system was discontinued in Meath because "fitter men would not take into their gangs any weak men or persons who had suffered from destitution, and who were, consequently, the very parties who required relief most" (Great Britain, 1852, 6, q2387; see also q3832).

Conditions on the ground at the 5,000 sites operated by the Board of Works were frequently appalling but also highly variable as evidenced by the dispersion of average wages at a county level over the entire period that the public works operated: the mean was 6.48 shillings per week but the standard deviation was a disturbing 1.82. Thus the concept of a 'wage policy' operating during this period must not be interpreted rigidly.

Inspecting officers provided the principal management link between the Commissioners of the Board of Works and the sites. There were 50 of these, drawn from the army and navy. Ó Gráda (1999) provides an insightful comparison of two of them with responsibilities in Clare: a similar reality could evoke radically different perceptions and responses (1852, 6, q2179; q1516). Since physical geography varied considerably, task work rates could be adjusted to take into consideration both the level of prices and the capabilities

of the workforce: "instead of fitting the wages to the task, we were obliged to fix a rate of wages, such as would give even to starving people a sufficient sum to subsist upon; the whole conditions of every part of the machinery were reversed". Such was the assessment of Thomas Larcom, deputy commissioner of the Board of Works (Great Britain, 1852, 6, q2176).[13]

The pressure that the Board worked under was huge, evidenced by the 2,500 letters received on 12 December (the maximum for a single day – see Griffiths (1970)). The administrative result can be appreciated by reading the report of its auditors who said that "the extent, the complexity, and the irregularity" of the accounts was hard to convey.[14] An engineer prepared an estimate of the cost of any work and the amount was remitted after approval by the Commissioners. Clearly they, and behind them the Treasury, could exert considerable influence on the level of total relief expenditure, but only limited influence on how it was disbursed in practice.

The influence of local officials was important as can be seen in several matters, such as bad weather payments (see Great Britain, 1847, Vol. 52, pp. 24-25) and the number of members permitted on the works per family (it had been Trevelyan's intention that only one member per family was to be employed.)[15] The sheer scale of the undertaking would have increased the discretionary power of the local officials.[16] Whatever the local variation in conditions, the total inadequacy of the overall result is beyond question. The liabilities of Irish counties for the public works were reviewed by a select committee investigating their aggregation into a consolidated annuity. In its report, published in 1852, it recommended that county liabilities for the bulk of the works carried out during the Famine be cancelled due to their unproductive nature.[17] Coroner's reports give some impression of what the reality was for those dependent on the public works.[18] The frequency of such

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[13] This humane interpretation must though be put against the harsh statement contained in circular no. 55 of the Board: if a labourer "determines not to use any exertion, and in consequence his earning does not exceed sixpence or eightpence per day, the fault lies with *himself,* and not with the contract price" (Great Britain, 1847, Vol. 52, p. 75). The physical deterioration of the destitute did not change this responsibility.

[14] Great Britain, 1852, 6, Appendix UU; see also q's17-46, q's330-8 and q1021.

[15] Great Britain, 1847, Vol. 50, p. 480; 1852, 6, q4041; ibid. q1099; see also q3436, q3819.

[16] The imprecise nature of wage setting on the public works is illustrated by the disturbances that occurred in December at the Ballea site. The engineer in charge decided to give 8*d*. per day "subsistence money" until the measurements for regulating task-work could be completed. Originally he had set it at 10*d*. but "the men in many districts relaxed so much in their exertions as not to earn 6d. a day" so he reduced it to 8*d*., fomenting a riot (Great Britain, 1847, Vol. 50 pp. 480-483).

[17] Great Britain, 1852, 6, lv. The assessment of the works is given p. xviii-xxii.

[18] See for example the report on Catherine Sheehan in the *Cork Examiner*, 8/1/1847.

accounts provides a graphic but limited measure of the general inadequacy of the wage on the public works to sustain a family.

The public works degenerated into little more than disbursing cash relief payments to those prepared to be exposed to the vagaries of the weather. In terms of Figure 2 this meant that, because the wage did not have to cover much physical effort, it could fall below C. Just who determined how far is not self evident. The influence of the commissioners themselves can be judged by the suggestion made by their chairman to Trevelyan on 6 February 1847: Jones suggested that all labourers on the works be paid 10d. per day "in order to do away with the premium held out by our supposed system of task-work" (Great Britain, 1847, Vol. 52, p. 83). Three points should be highlighted here. First, that this was written three weeks after the peak in Indian meal prices when prices were double the level at which 8d. was considered adequate. Second, the failure of the task-work system was appreciated. Finally, whatever Jones' desire was, the average wage over the entire period was about 13d.

This section posed two questions concerning the wage policy of the Board of Works: what target did they have for its real level and how was the nominal level adjusted to in response to price changes? There were two wage systems in operation. The first of these was a fixed nominal one that gave the impression of centralised control. The second was the task work system where local officers could exert more influence. In reality the two merged into an inchoate combination as the works descended into chaos. The key central control was not over wage policy but rather the level of expenditure.[19] The declared policies of the Board of Works provide a poor guide to the actual outcome but do suggest a framework for empirical analysis that is developed below. First, though, the data are reviewed.

III THE WAGE DATA

The employment figures are taken from the Return showing the Number of Persons Relieved by Labour from 10 October 1846 to 26 June 1847, in each County in Ireland, which were prepared by the Office of Public Works in February, 1851, and published in the following year. They are the revised figures and thus avoid some of the errors committed during the immense pressure of the early Famine period. Since the expenditure figures relate to

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[19] It is a sad reflection on the commissioners that their most decisive intervention was in closing the works when the relief policy had been changed to one of gratuitous food distribution: within thirteen weeks the works had effectively come to an end, despite the new policy being inoperative.The hiatus between the two policies has been severely criticised by historians (see Donnelly (1989), Daly (1986) and Kinealy (1994)).

counties the employment in cities and towns has been aggregated into their counties though the level of this was quite minor.

The above return also gives the 'Sums certified to the several Grand Juries for Repayment'. Since only half the expenditure had to be repaid, multiplying this column by two gives total expenditure on relief works at the county level over the period. The average wage at a county level over the entire period is then just this divided by the aggregate county employment over the period (note that the data do not permit the computation of county weekly wages).

The calculation of weekly average earnings for Ireland as a whole is complicated by changes in the way the Board of Works presented the information. Between the week ending 6 March and 10 July, 1847, a weekly return appears in the Parliamentary Papers (1847, Vol. 54). Total expenditure is broken down into labour costs and superintendence. The proportion of the former in the total varied between 0.914 and 0.761 up to 29 May (thereafter, there were some lower entries but by then employment was under 50,000 and the works were running down). The calculation of average earnings for this period is thus straightforward.

For each week in January and February the monthly report of the Board of Works gives a 'Return of the Sums actually paid in Wages' on 'Employment of the labouring poor, 9 and 10 Vic. C. 107'. In November, only total expenditure for this act is given so the figure was multiplied by 0.9 to estimate wages disbursed. The December figures relate to total expenditure under the various acts that supported public employment. Total expenditure under the Labour Rate Act was estimated by multiplying this by 0.95, the proportion in January. The wage total was estimated by multiplying the result by 0.9 as in November.

IV WAGES ON THE PUBLIC WORKS: AN EMPIRICAL ANALYSIS

This section is concerned with two questions: what was the real level of relief targeted by the Board of Works? How was the nominal wage adjusted to this target as prices changed?[20] The disaster could have been caused by adequate adjustment of nominal wages to too low a target or an adequate target that was not achieved by failures in the adjustment of nominal wages

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[20] The term 'relief payment' is somewhat cumbersome and so 'wage' will be retained. Strictly speaking the figures derived by the process outlined in the previous section relate to average earnings rather than wages. However, since any disparity between the two would be restricted to the consequences of the weather (which is captured in the empirical work by dummy variables), the more popular term is employed.

to price changes. It is helpful first to develop a model to provide a framework for the empirical analysis.

Let C be subsistence target held by the Board of Works, which will be considered as a composite decision maker. The target is measured in physical units, such as kilos of maize. Given that prices varied considerably during the Famine, the challenge was to determine the weekly money wage, W_t^*, such that a labourer employed on the public works could secure C at minimum cost to the government. If the price of the wage good in week t was expected to be P_t^e then to avoid famine it is necessary that at the beginning of week t

$$W_t^* = CP_t^e \tag{1}$$

or in logs

$$w_t^* = c + p_t^e. \tag{2}$$

Clearly the information concerning the wage prevailing at each site was not contemporaneous. Say that the inspecting officer visited each site every m weeks and it was on this occasion that the wage rate was adjusted. Such changes may have been subject to expenditure constraints imposed by the Board of Works, itself under close Treasury scrutiny.

The information set of the decision maker consists of $w_{t\text{-}m}$, the target c and the expected price p_t^e that is based on past prices. Given this information, the current wage would be adjusted towards the target. The long run equilibrium, defined by prices being constant at p^*, would simply be $w^* = c + p^*$. A modified error correction form (MECF) provides a useful framework for the adjustment process:

$$w_t - w_{t-m} = \Delta w_t = \theta_1(p_t^e - p_{t-m}) + \theta_2(w_{t-m} - c - p_{t-m}) + \varepsilon_t$$

$$= \theta_2(w_{t-m} - c - p_t^e) + (\theta_1 + \theta_2)(p_t^e - p_{t-m}) + \varepsilon_t \tag{3}$$

The first line of the model suggests two determinants of change in the wage level: the term $(w_{t-m} - c - p_{t-m})$ represents the extent to which the real wage m periods ago diverged from the target, c. The coefficient θ_2 captures the extent to which this divergence is removed by the change in the current wage rate. The second factor that causes a change in the wage rate is the anticipated change in prices compared to m periods ago. The extent of this depends on the impact coefficient, θ_1. Equation (3) differs from the standard error correction form due to the determinant of the target variable being an expected price:

rather than the past value of this appearing in the model the actual value is, reflecting the information set of the decision maker. The speed of adjustment depends on the magnitudes θ_1 and θ_2 though for the associated autoregressive distributed lag model to be stationary requires $0 > \theta_2 > -2$. If $-1 > \theta_2 > -2$ then the autocorrelation coefficient is negative and the series "jagged".

Potential expenditure constraints upon the Board of Works are captured in Equation (3) by the magnitudes of θ_1 and θ_2: given the importance of such constraints in the situation being considered it is worthwhile developing this point. Assume the decision maker minimised a cost function (see Pagan, 1985, for further discussion) that was made up of $w_t - w_t{}^*$ to take account of the shortfall anticipated in the current period but also $w_t - w_{t-m}$ which takes account of the potential increase in expenditure associated with any wage change. The two components of the cost function are allowed to interact so the adjustment procedure can overshoot the target. The cost function then is:

$$A = 0.5(w_t - w_t{}^*)^2 - \lambda(w_t - w_t{}^*)(w_t - w_{t-m}) + 0.5\theta(w_t - w_{t-m})^2 \tag{4}$$

Minimising A yields: $w_t = \beta w_t{}^* + (1 - \beta)w_{t-m}$ where $\beta = \dfrac{1 - \lambda}{1 - 2\lambda + \theta}$ and the

denominator is positive by the second order conditions. Note that the magnitude of β indicates the intensity of the expenditure constraint; if β equals zero then the expenditure constraint completely dominates; as β increases from zero then the expenditure constraint becomes less important and the current shortfall becomes more so. Now if $\beta > 1$ then overshooting occurs since this implies $\lambda > \theta$ and so an increase in w_{t-m} leads to a fall in w_t, if $w_t{}^*$ is held constant. In such circumstances the expenditure constraint effectively is inoperative.

The above model will be referred to as the constrained expenditure model (CEM). Its relation to the MECF can be seen by substituting (2) into the solution and rearranging which gives:

$$\Delta w_t = -\beta (w_{t-m} - c - p_t{}^e) \tag{5}$$

Thus the CEM can be derived as a restriction on the MECF, namely when $\theta_1 + \theta_2 = 0$ (see the second line of (3)).

Before discussing estimation it is necessary to consider the formation of price expectations. Price expectations are assumed to be a simple linear function of past prices (see Alogoskoufis and Smith (1995), for an extended discussion of the modelling of expectations), that is:

$$p_t^e = \sum_{i=1}^{k} \gamma_i \, p_{t-i} = \sum_{i=1}^{k-1} \delta_i \, \Delta p_{t-i} + \delta_k \; p_{t-k}. \tag{6}$$

If prices were stable for a period then the differences would be zero and so it would be anticipated that $\delta_k = 1$. Since the magnitude of k will influence the extent of hypothesis testing its empirical determination will be considered immediately after a discussion of the characteristics of the data as indicated by the statistics presented in Table 1.

Table 1: *Characteristics of the Wage, Price and Employment Series*

	$\Delta(w\text{-}p)$	w	p	e
Mean	−0.004	1.852	2.796	12.625
Standard deviation	0.145	0.144	0.125	0.785
Coefficient of variation	34.686	0.078	0.045	0.062
Mean of untransformed series		6.44	16.51	380283
Autocorrelation at lag (critical value 0.36)				
1	−0.09	0.53	0.85	0.80
2	−0.02	0.16	0.71	0.67
3	−0.10	−0.12	0.58	0.51
4	−0.49	−0.28	0.47	0.38
5	0.18	−0.10	0.29	0.28

Note: All variables are expressed in natural logs.

A casual examination of Figure 1 might suggest that prices determined the level of the real wage, an impression confirmed by the significant negative correlation between the two series. This would be consistent with an almost constant money wage and so the real wage would vary inversely and directly with prices. However, the wage rate varied considerably and the standard deviation of its weekly proportionate change was 0.135 compared to 0.065 for that of prices.[21] Thus the level of the money wage was much more volatile than that of prices which suggests that overshooting might have occurred. Table 1 shows that the similar standard deviation for the real wage was 0.145. This indicates a small, but positive correlation between wages and prices, so some limited adjustment process existed.[22]

[21] This was approximated by the first difference in logs.
[22] $var(\Delta[w - p]) = var(\Delta w) + var(\Delta p) - 2cov\ ar(\Delta w, \Delta p)$.

If it is assumed that $\Delta(w - p)$ is normally distributed (Jarque-Bera tests fail to reject this) then its standard deviation indicates that roughly one-third of the weekly proportionate changes were beyond ±15 per cent. Given that the wage was already below subsistence, such variation inevitably contributed to additional mortality (see Ravallion, (1987), for a sophisticated analysis of the link between prices and mortality).

A pattern of adjustment may be discerned from the structure of autocorrelation in the series. The lags are much more pronounced for prices than for wages; for prices the first four lags are significant and so a change that occurred one month ago will positively affect the current level, as will the changes in the intervening period. Thus k in Equation (6) is set to 4. With wages it is only changes one week ago that are significant so an increase that occurred a fortnight ago does not affect the current level of the wage. What is especially interesting is that for the real wage only changes that occur a month previously affect the current level and that changes in the intervening period have no effect. This suggests that the adjustment process was slow.

Although the data employed are time series, in the face of the relatively small number of observations (26) and the fact that the data are weekly it was not considered meaningful to test for stationarity or cointegration. This should be borne in mind in the discussion of the regression results below.

The final column of Table 1 relates to the level of employment, e. It is evident from Figure 3 that there is little relationship between e and the real wage. The correlation between e and the real wage is actually negative (–0.19) while that with w is positive (0.21); neither are significant at the 5 per cent level. Thus the wage had no influence on the level of employment, frustrating the Treasury's original intention to use it as a screening device. Instead employment was determined administratively with the significance of lags up to four weeks indicating the speed of adjustment.

The first stage in the testing procedure is the determination of the length of the lag, m, between the wage and its adjustment. This is achieved through the estimation of:

$$w_t - w_{t-m} = \alpha_0 + \alpha_1 \Delta p_{t-1} + \alpha_2 \Delta p_{t-2} + \alpha_3 \Delta p_{t-3} + \alpha_4 p_{t-4} \qquad (7)$$

$$+ \alpha_5 w_{t-m} + \alpha_6 MIDDEC + \varepsilon_t$$

where *MIDDEC* is the dummy variable taking account of outliers in the fortnight ending 19 December, 1846. The outcome of allowing m to vary between one and four weeks was that only the cases where *m = 3* or *4* were statistically satisfactory. The latter was chosen on the basis of its $\bar{R}^2$ (0.88 compared to 0.87); in addition it facilitated more hypothesis testing. The result is presented in Table 2. A lag of four weeks before the wage is adjusted to take

Figure 3: *Employment and Wage on the Public Works*
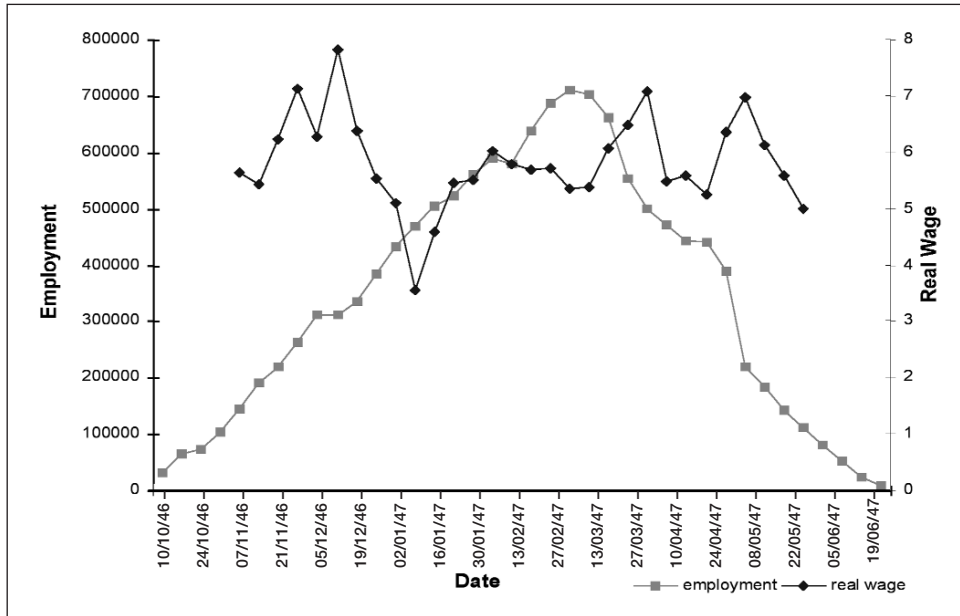
Sources: Prices relate to the Belfast market price of maize as recorded in the *Northern Whig.* For wages and employment see Section III.

account of price changes is considerable in famine circumstances, whatever the administrative pressures associated with employing three-quarters of a million men. Before testing the restrictions implied by the two models it clarifies matters to reduce the price differences to a single term $p_{t-1} - p_{t-4}$ since this is permitted by the data.[23]

The relationship between the parameters of the estimated Equation (7) and the two models that have been developed above are spelt out in Table 3.

The estimated coefficient of w_{t-m} is –1.31 which is significantly less than –1 according to the result of a Wald test presented in Table 4. With respect to the CEM this implies that overshooting of the target occurred; for the MECF it indicates that the wage series is negatively correlated; both interpretations account for the variability in the real wage series.

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[23] A joint test on all three price differences being zero is rejected at the 5 per cent level (the test statistic is 10.92 and is distributed χ^2 with 3 df). Imposing equality on the coefficients of the differences gives a Wald test statistic of 0.73 which is distributed as χ^2 with 2 df so the restriction is not rejected.

Table 2: *The Determinants of the Change in Money Wages*

	$w_t\text{-}w_{t-4}$	$w_t\text{-}w_{t-4}$
Δp_{t-1}	0.65*	
	(2.44)	
Δp_{t-2}	0.38	
	(1.42)	
Δp_{t-3}	0.69*	
	(2.53)	
$p_{t-1} - p_{t-4}$		0.56**
		(3.72)
p_{t-4}	0.86**	0.86**
	(5.41)	(5.56)
w_{t-4}	−1.31**	−1.31**
	(9.52)	(9.87)
MIDDEC	0.25**	0.25**
	(5.21)	(5.43)
Constant	−0.0003	0.009
	(0.00)	(0.02)
N	26	26
$\bar{R}^2$	0.88	0.89
Serial 1	0.95	1.45
Serial 4	8.44	9.32
RESET	0.00	0.06
HET	0.62	0.37
NORM	0.53	0.17

**/* Indicates the coefficient is significant at the (1% / 5%) level.

Estimation by Ordinary Least Squares. HET is a test for heteroscedasticity (residual squared upon predicted dependent variable squared) and is χ^2 with 1 df under H_o. RESET is Ramsay's test of functional form (again on predicted squared) and is F (1,31-k) under H_o. NORM is the Jarque-Bera test, χ^2 with 2 df under H_o. Figures in parentheses are the absolute values of the t ratios.

Table 3: *The Relationship between Equation (7) and Model Parameters*

Model	α_0	α_4	α_5
MECF	$-c\theta_2$	$\theta_1(\delta_4 - 1) - \theta_2$	θ_2
CEM	$c\beta$	$\beta\delta_4$	$-\beta$

Table 4: *Tests of Restrictions on Equation (7)*

Hypothesis	$\alpha_5 = -1$	$\alpha_4 = 1, \alpha_5 = -1$	$\alpha_4 + \alpha_5 = 0$
Wald statistic	5.422	9.495	8.110
Probability value	0.020	0.009	0.004

If consistency of expectations is assumed, that is, $\delta_k = 1$ is held as a maintained hypothesis, then Table 3 shows that the wage and price coefficients should sum to zero. Table 4 indicates that this restriction is emphatically rejected, as is the case when the two coefficients have an absolute value of unity (which is the limit for convergence to exclude overshooting). The results from Table 4 thus show that both the ECM and MECF will only fail to be rejected by the data if $\delta_4 \neq 1$. Under such circumstances the parameters of the MECF are no longer identified so any further analysis is thus confined to the ECM.

$\delta_4 \neq 1$ may be interpreted as indicating that price expectations were incorrectly formed in which case the coefficient of p_{t-4} in Equation (7) is $\alpha_4 = \beta\delta_4$ and so $\hat{\delta}_4 = 0.86/1.31 = 0.66$, which is somewhat under unity. The results in the final column of Table 2 then imply that $\hat{p}_t^e = 0.43_{t-1} + 0.23p_{t-4}$. Compared to actual prices, this is virtually a flat line: anticipated prices have a mean (standard deviation) of 6.39 (0.49) compared to 16.79 (2.11) for actual prices. Thus the adjustments of money wages were being made upon erroneous price expectations. Such an interpretation is of course consistent with the suggestion made by Jones noted in Section II that the weekly wage should be *10d* in February 1847 despite the major price increases. It is extraordinary that the extent of price changes was not appreciated with the ready availability of market reports in contemporary newspapers.

What do the results imply for the target level of consumption? Since the estimate of α_0 is insignificant and $\hat{\beta} \neq 0$ then $\hat{c} = 0$ and so $\hat{C} = 1.0$. This must be put against a sample mean of *0.39* for the real wage. Thus the wage paid on the public works would on average cover less than half of subsistence. Such an implied shortfall is of a similar magnitude to that suggested by Ó Gráda (1994, p. 196). It is now possible to answer the two questions raised at the beginning of this section: the target that the Board of Works aimed for was correct; it failed to achieve it due to the failure to anticipate prices adequately.

V CONCLUSIONS

The Great Irish Famine has a central place in Irish political, social and economic history. However, the challenges that faced the implementation of the public works policy of that time deserve to be examined also as an assessment of a particular counter-famine policy. A number of conclusions can be drawn from such an exercise.

First, in famine conditions, the wage cannot be used as a device to screen out those that are not destitute. An attempt to do so during the Irish Famine was soon abandoned and replaced by administrative controls. Unfortunately,

this robs the policy of a major advantage claimed by its supporters that is especially relevant given the limited supply of reliable administrative services in many developing countries.

Second, to effectively counter famine the target wage on the public works clearly has to be at the subsistence level. The analysis of the wage data during the Irish Famine reveals that the commissioners pitched the target at the correct level but failed to achieve it because prices were incorrectly anticipated. Given the violent movement in prices this might be thought understandable though the fact that the variation in money wages was greater together with the evident failure of the works makes this inexcusable. This issue of the adjustment of money wages to price changes is important and also general: in famine situations public works will generally be geographically dispersed so it is desirable that any wage adjustment should reflect local conditions. The question is whether reliable administrative systems to fulfil this function exist or can be assembled rapidly. This was not the case in mid-nineteenth century Ireland.

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