

# Giffen behaviour in Irish famine markets: an empirical study

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Abstract: There has been much contention among economists as to whether the potato in Irish markets during the Famine period is an example of a ‘Giffen’ good, but no price and quantity data from Ireland’s famine period has previously been unearthed to enable this to be systematically tested. Analysing high frequency price and quantity data for potatoes, wheat, barley, oats, and bacon pigs, collected from Cork market reports between 1842-49, this paper presents initial results which indicate that whilst potatoes, wheat, barley, and oats display normal characteristics during this period, the Cork markets for bacon pigs display some characteristics associated with Giffen-style behaviour. Further econometric analysis of the famine bacon pig market may therefore shed light upon the ‘Giffen’ phenomenon as well as market behaviour during famines.

## 1. Introduction

When Alfred Marshall first outlined the Law of Demand in the 1895 edition of *Principles of Economics*, he was forced to cite one exception: Giffen goods. These were defined as a type of inferior good, larger quantities of which are consumed when prices rise, resulting in a demand curve with a positive gradient on a quantity price graph. Marshall ascribed this idea to Sir Robert Giffen, a Scottish statistician and economist, saying he first made the following observation about bread:

As Mr. Giffen has pointed out, a rise in the price of bread makes so large a drain on the resources of the poorer labouring families and raises so much the marginal utility of money to them, that they are forced to curtail their consumption of meat and the more expensive farinaceous foods: and, bread being still the cheapest food which they can get and will take, they consume more, and not less of it.<sup>1</sup>

The ‘Giffen’ effect Marshall described has since been modelled in the Slutsky equation by economists as a situation where an income effect, due to a price rise, outweighs the impact of a substitution effect upon the quantity demanded of the good. Despite a lack of empirical evidence in support of Marshall’s conjecture, a discussion of Giffen goods as an accepted phenomenon has featured in almost every major economics textbook published in the last fifty years and still remains ‘a source of inspiration’ to theoretical researchers in the twenty-first century, according to Wim Heijman and Pierre von Mouche.<sup>2</sup>

Some economists, including John Nachbar, have attempted to discredit the theory behind the existence of Giffen goods.<sup>3</sup> This has been supported by studies of Marshall’s original example by George Stigler in 1947 and Roger Koenker in 1977, which have argued that the demand curves for bread and flour in Britain were never upward sloping in the eighteenth and nineteenth centuries.<sup>4</sup> Since the 1960s, instead of bread, some economists began to cite the potato during the Irish famine of 1845-49 as the classic example of a Giffen good. The first citation was in Paul Samuelson’s *Economics*, albeit in a rather cavalier way, possibly confusing Sir Robert Giffen with Sir Francis Drake, who, in legend, brought the first potatoes to Britain in the sixteenth century:

When the 1845 Irish famine greatly raised the price of potatoes, families who consumed a lot of potatoes merely because they were too poor to consume much meat might have ended up consuming *more* rather than less of the high-*P* potatoes. Why? Because now they had to spend so much on potatoes, the necessity of life, as to make it quite impossible to afford any meat at all and hence were forced to become even more dependent than before on potatoes. In brief, the substitution-effect was here overcome by the perverse income-effect applicable to a

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<sup>1</sup> A. Marshall, *Principles of Economics* (London: Macmillan, 1895) pp. 208-209.

<sup>2</sup> W. Heijman and P. von Mouche (eds.), *New Insights into the Theory of Giffen Goods* (London: Springer, 2012) p. vii.

<sup>3</sup> J. H. Nachbar, ‘The Last Word on Giffen Goods?’, *Economic Theory* 11 (1998) pp. 403-412.

<sup>4</sup> G. J. Stigler, ‘Notes on the History of the Giffen Paradox’, *Journal of Political Economy* 55 (1947) pp. 152-156; R. Koenker, ‘Was Bread Giffen? The Demand for Food in England Circa 1790’, *Review of Economics and Statistics* 59 (1977) pp. 225-229.

peculiar “inferior” good such as the potato, which tends to *decrease* in the poor man’s budget when incomes rise. This *curiosum* is attributed to Sir Francis [sic.] Giffen, a Victorian economist.<sup>5</sup>

The Irish famine potato was subsequently cited as an example of a Giffen good in works by Edgar Browning, Heinz Kohler, Richard Leftwich, Donald McCloskey, Walter Nicholson and Liam Kennedy.<sup>6</sup> However, debate has since raged amongst academic economists on the issue of whether the Irish famine potato can be labelled a Giffen good in theoretical terms. Most notably, Gerald Dwyer and Cotton Lindsay have argued that the idea is flawed theoretically. They argue that the potato could not have been a Giffen good during the famine due to supply constraints: ‘there were not more but fewer potatoes available; the Irish people could not have eaten more as a group’, even after a price rise.<sup>7</sup> With quantities available falling, the rising price of potatoes meant that potatoes could not be Giffen goods. They concluded that ‘the place to look for a Giffen good is not a peasant economy engaged in subsistence farming’, where food prices are not determined exogenously, on the basis that their conception of the Giffen effect required an exogenous price increase to occur.<sup>8</sup> This position has since been supported by studies conducted by Nachbar, Terrence McDonough and Joseph Eisenhauer.<sup>9</sup> But this conclusion has been criticised in that it ignores other types of commodities in famine Ireland. Ulrich Kohli has replied to Dwyer and Lindsay with the argument that meat in famine conditions is more likely than potatoes to display Giffen behaviour, on theoretical grounds.<sup>10</sup>

However, none of these studies have attempted to collect or analyse empirical price and quantity data in order to test for Giffen behaviour for potatoes, or other goods, in the Irish famine. Cormac Ó Gráda has noted despairingly that Giffen goods ‘are like the Loch Ness Monster, occasionally reported, never observed’.<sup>11</sup> In other areas of the world, Yochanan Shachmurove and Janusz Szyrmer have searched for ‘Giffenity’ in post-Soviet transition economies, but they only used highly aggregated data and attempted to perform regression analyses on as few as six data points.<sup>12</sup> With a more robust statistical framework, Robert Jensen and Nolan Miller have used experimental data from artificially manipulating prices in

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<sup>5</sup> P. A. Samuelson, *Economics* (New York: McGraw Hill, 1964) p. 432.

<sup>6</sup> E. K. Browning, and J. M. Browning, *Microeconomic Theory and Applications* (Boston: Little, Brown, and Company, 1983) p. 82; H. Kohler, *Intermediate Microeconomics* (Glenview: Scott, Foresman & Company, 1982) p. 84; R. Leftwich, *The Price System and Resource Allocation* (Hinsdale: Dryden Press, 1982) p. 140; D. McCloskey, *The Applied Theory of Price* (New York: Macmillan, 1982) p. 75; W. Nicholson, *Microeconomic Theory* (Hinsdale: Dryden Press, 1978) p. 103; L. Kennedy, P. S. Ell., E. M. Crawford, and L. A. Clarkson, *Mapping the Great Irish Famine: A Survey of the Famine Decades* (Dublin: Four Courts Press, 1999) p. 67.

<sup>7</sup> G. P. Dwyer and C. M. Lindsay, ‘Robert Giffen and the Irish Potato’, *American Economic Review* 74 (1984) p. 188.

<sup>8</sup> *Ibid.*, pp. 190-191.

<sup>9</sup> T. McDonough and J. Eisenhauer, ‘Sir Robert Giffen and the Great Potato Famine: A Discussion of the Role of a Legend in Neoclassical Economics’, *Journal of Economic Issues* 3 (1995) pp. 750-756.

<sup>10</sup> U. Kohli, ‘Robert Giffen and the Irish Potato: Note’, *American Economic Review* 76 (1986) pp. 539-541.

<sup>11</sup> C. Ó Gráda, *The Great Irish Famine* (Cambridge: Cambridge University Press, 1995) p. 77.

<sup>12</sup> Y. Shachmurove and J. Szyrmer, ‘Giffen Goods in a Transition Economy: Subsistence Consumption in Russia’, *Frontiers in Finance and Economics* 8 (2011) 27-48.

western Chinese villages with rice vouchers, but the data was not harvested from a historical or natural situation.<sup>13</sup>

In contrast, this paper analyzes empirical market data from Cork newspaper market reports for five foodstuffs to explore whether these markets displayed Giffen-style behaviour. Much of the theoretical investigation of *Giffen goods* has focused on the concept of demand curves for individual market participants, which are impossible to investigate due to identification problems. For practical purposes this article, instead, looks at whether *Giffen-style behaviour*, the correlation of high prices and high sale quantities as well as low prices and low quantities over the annual harvest price cycle, can be identified in aggregate market data.

## 2. Material and Method

The empirical data for the present study, price and quantity sold data from the Cork markets, was collected from the *Constitution or Cork Advertiser* on a weekly basis from January 1842 to December 1849.<sup>14</sup> This newspaper provides market reports most consistently and completely; although many Irish newspapers of this period provide market prices for food, no other Irish newspaper has a robust run of price *and* quantity data for the same period. The market reports cover all the marketplaces in 1840s Cork and provide an overall picture of market behaviour in this city during the famine. In addition, the data is not subject to political bias as, although the paper's stance was pro-Union, the same reports also appeared sporadically in the pro-Repeal *Cork Southern Reporter*.

Potato prices are only consistently available for the 1845-49 period, but weekly average price and quantity data for wheat, barley, oats, and bacon pigs exist for the 1842-49 period, providing a dataset to investigate for Giffen behaviour in famine Ireland. However, analysis of this dataset brings some econometric problems in the form of identifying the demand curves of the market, as John Davies has described:

...at the econometric level there is the perennial difficulty of trying to distinguish between points on a single, positively sloping demand curve and points derived from a sequence of upwardly shifting, negatively sloped demand curves.<sup>15</sup>

A simple price quantity graph of the data, in its crude form, cannot represent a demand curve, because the data is a long time series and each point may be merely a point on a different demand curve which has moved due to other factors including changing income levels—extremely likely during the famine. Demand and supply curves are theoretical

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<sup>13</sup> R. T. Jensen and N. H. Miller 'Giffen Behavior and Subsistence Consumption', *American Economic Review* 98 (2008) pp. 1553-77.

<sup>14</sup> *Constitution or Cork Advertiser*, January 1842-December 1849.

<sup>15</sup> J. E. Davies, 'Giffen goods, the survival imperative, and the Irish potato culture', *Journal of Political Economy* 102 (1994) pp. 547-65.

representations of the potential for supply and demand and both may move in reality. The only places on them which can be identified from real data are their equilibriums.

However, looking at the data in terms of annual harvest cycles can minimize the impact of changing supply and income levels in the market. This is particularly true in an agricultural economy such as Cork's with its annual business cycle based around the annual harvest. The 1841 Irish census estimated that up to 81 per cent of County Cork households relied directly on agriculture in that year, with much of the other 19 per cent in manufacturing and trade involved in the food processing industry, suggesting that supply as well as incomes are predominantly fixed by the size of each year's harvest. Using the method of least squares, one can produce a coefficient or gradient for a straight line representation of the aggregate data that enables us to tell whether the market is displaying normal or abnormal characteristics, although it should be noted that the exact formula of the annual demand curve cannot robustly be determined using this method. In Britain and Ireland around this period, normal characteristics are that high market quantities and low prices, as well as low market volumes and high prices, correlate with each other in the annual harvest cycle, in conformity to the normal law of demand. If this correlation is not present, it suggests that the market is not behaving normally. The results of this method can be seen in Tables 1-5. As a visual check, in Figures 1-5, the data for each of the five commodities have been plotted on a scatter graph for the 1842-49 and 1845-49 periods in order to observe the shape of the clouds they produce, as well as the minimum and maximum possible demand and supply curves the clouds indicate. These show the extent of the equilibrium positions over this period.

### **3. Results**

It is possible to observe whether, on an aggregate basis, Cork markets are displaying normal or abnormal, and possibly Giffen, characteristics by whether the gradients of straight lines produced by the method of least squares are negative or positive for each commodity. Table 1 shows that the price and quantity data for potatoes sold in Cork from 1845/46 to 1848/49 have a negative correlation for every harvest cycle, indicating that this market displays normal behaviour over the course of each harvest year. There is therefore no evidence on this basis that the Cork famine potato, the "classic" example of a Giffen good, actually showed Giffen behaviour. This is partly due to a supply constraint; as prices rose there were no extra potato supplies available because of the blight so no way to produce a Giffen increase in quantity sold in the market. Figure 1 shows that the cloud of data points for Cork potatoes, as well as the maximum and minimum possible demand curves around the cloud, are all downwards sloping, confirming that this market displays normal behaviour over the market cycle.

There is also very little evidence in this data that barley, oats, and wheat, Marshall's original examples of Giffen goods, displayed this behaviour during the Famine. Table 2 shows a flat or negative relationship for wheat, for most periods under consideration, and although there is a flat trend line in 1845/46, Figure 2 confirms visually that the overall data for 1842-49 wheat indicates that there is a normal negative relationship between price and quantity. Looking at Marshall's other 'farinaceous' foods, oats and barley, Tables 3 and 4 also display negative or flat relationships between prices and quantities in this year, other than an anomalous positive result for barley over the 1845/46 harvest cycle, possibly the result of a supply shock halfway through that year for barley. This indicates that these three commodities also displayed normal market behaviour during the famine. No particular note is taken of the anomalous results in 1845/46 because of the likelihood of rapidly moving demand and supply curves in this year, when the probability of famine was first evident.

The only type of commodity that does not display normal behaviour with any consistency is bacon pigs for the period 1842-47, the data for which is shown in Table 5 and Figure 5, and which agrees with Kohli's supposition that meat markets may be the best place to look for Giffen goods. Table 5 shows a positive relationship between bacon pig prices and quantities sold on the market, between 1842 and 1847 in each harvest cycle, the opposite of what should have been expected for normal behaviour. Figure 6 displays the same data visually over time, with prices steadily rising in the period 1842-47, in spite of the seasonal weekly quantity sold peak increasing in size each year. Annual fluctuations show low prices in each cycle coincide with low quantities and annual highs in prices occur with large increases in quantities. Although this market returns to normal behaviour from 1847, it is the result of supply restrictions caused by the stocks of pigs running out: the *Constitution* noted, with surprise, that from January 1847 all the pigs and other items of food had disappeared from impoverished rural areas.<sup>16</sup> The overall conclusion from graphical analysis is therefore that whilst the markets for potatoes, wheat, oats, and barley all display market behaviour that is consistent with a normal demand curve, over their annual harvest cycles, there is some abnormal, and possibly Giffen behaviour occurring in the Cork market for bacon pigs in the 1842-47 period.

#### **4. Further analysis on the Bacon Pig Market**

The abnormal positive relationship between price and quantity in the annual cycles of the Cork bacon pig market leaves open the possibility that this market is displaying Giffen-style behaviour. Although bacon pig meat was not a subsistence food of the poor in the same fashion as the potato, it was the cheapest form of meat in famine Ireland and therefore an inferior good to more expensive meat consumed by wealthier classes of people. A good fitting this description is fully compatible with the modern conception of a Giffen good:

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<sup>16</sup> *Constitution or Cork Advertiser*, 5 January 1847.

Junko Doi, Kazumichi Iwasa and Koji Shimomura have shown that Giffen behaviour ‘is compatible with an arbitrarily high level of utility and low share of income spent on the inferior good’ and that, theoretically, it can be observed in classes of people with incomes well above subsistence levels.<sup>17</sup> Although no robust long run quantity data for bacon pig’s main superior substitutes, pork and beef, survive for Cork, qualitative evidence for quantity from the Cork markets suggest that beef was a normal good. Retail prices in Cork, shown in Figure 7, display a convergence of beef and bacon prices in the 1845-47 period, until bacon pig supplies collapse at the start of 1847. This is consistent with middle-income consumers, their incomes ‘crushed’ in real terms by rising food prices between 1845-47, being forced to trade down from beef to pork until prices of these goods on the market virtually equalized in mid-1846. Giffen-style increased demand for bacon pigs, despite their rising price, could have resulted from this.

Initial analysis of the bacon pig market appears to show that its abnormal characteristics can be correlated with the years in which real incomes fell in Ireland. Looking at the p-values of the ordinary least square regression of the bacon pig data for each harvest year (Table 5) which give a rough guide to how strong the positive relationship is for each time period, low p-values are associated with the year real incomes fell. Comparing the p-values with the agricultural wage index from the *Freeman’s Journal* adjusted for the changing cost of living (Figure 8), the years displaying high statistical significance for the positive relationship between prices and quantities– the harvests of 1842, 1844, 1845, and 1846– are the same years as when real incomes generally fell in Ireland. These results suggest that a real income effect can be linked to the abnormal and perhaps Giffen-style market behaviour in the bacon pig market, although further research is needed in this area to confirm the causation between these two factors and whether this is outweighing a substitution effect.

Further quantitative analysis can be carried out to distinguish the demand curve from the supply curve in the data for the bacon pig market. Although both have been extracted from the cloud of equilibrium point data graphically and by the least squares method, confusion between the two remains because price and quantity may be simultaneously determined by the interaction of supply and demand. The change in the quantity of pigs sold could be caused by supply effects such as variation in the available supply of food for the pigs,  $F$ , predominantly potato ‘peelings and waste’, which became scarce in the famine period.<sup>18</sup>  $F$  can be represented by the quantity of potatoes on the market, an exogenous variable, which affects the supply of pigs but not directly the price and can be used as an instrumental variable. Supply and demand can therefore be represented by the straight lines:

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<sup>17</sup> J. Doi, K. Iwasa, and K. Shimomura, ‘Giffen behaviour independent of the wealth level’, *Economic Theory* 41 (2009) p. 247.

<sup>18</sup> P. M. A. Bourke, ‘The Use of the Potato Crop in Pre-Famine Ireland’, *JSSISI* XXI (1968) pp. 84-85.



$$Q_s = \alpha_0 + \alpha_1 P + \alpha_2 F + \varepsilon_s \quad \text{and}$$

$$Q_d = \beta_0 + \beta_1 P + \varepsilon_d \quad \text{respectively.}$$

At equilibrium, quantity supplied,  $Q_s$  = quantity demanded,  $Q_d$ . Solving the resulting equation, the price and quantity at equilibrium can be represented by straight line equations (of the form  $y = mx + c$ ) on graphs of price and quantity against  $F$ :

$$P^* = \frac{-\alpha_2}{(\alpha_1 - \beta_1)} F + \frac{\beta_0 + \varepsilon_d - \varepsilon_s}{(\alpha_1 - \beta_1)}$$

$$Q^* = \frac{-\beta_1 \alpha_2}{(\alpha_1 - \beta_1)} F + \beta_0 + \frac{\beta_1 (\beta_0 + \varepsilon_d - \varepsilon_s)}{(\alpha_1 - \beta_1)}$$

The ratio of the gradient on the quantity graph to gradient on price graph gives the gradient of the average demand curve.

$$\frac{\frac{-\beta_1 \alpha_2}{(\alpha_1 - \beta_1)}}{\frac{-\alpha_2}{(\alpha_1 - \beta_1)}} = \beta_1.$$

Carrying out an analysis of monthly data from the Cork using this method, both annually and for the entire 1842-47 period, the gradients on the quantity against  $F$  graph and price against  $F$  are both negative for all these results. Therefore the demand curves are represented by lines with gradients  $\beta_1$  which are positive, confirming that they display Giffen-style behaviour on this basis. The Giffen effect weakens in the 1847 period onwards, and disappears for 1848 and 1849, due to a supply constraint caused by a shortage of pigs after very high sale volumes in 1846 and 1847. However in 1847, as well as in periods of less extreme distress, the Giffen demand effect appears to outweigh any supply effects of a lack of pigs available for sale on the Cork market.

## 5. Discussion

These initial results from the Cork market data suggest that the place to look for Giffen behaviour in famine Ireland is not in subsistence-level households consuming potatoes but amongst the wealthier classes consuming meat when they suffer adverse income effects, which may outweigh any substitution effect, creating a Giffen-style demand pattern. This concurs with Kohli's suggestion that meat is more likely than potatoes or bread to display Giffen behaviour in famine Ireland and Doi, Iwasa and Shimomura's conclusion that Giffen

behaviour theoretically can be observed in classes of people with incomes well above subsistence levels.<sup>19</sup>

There is no evidence in the data collected from Cork for potatoes, wheat, oats, and barley to suggest that these goods displayed any behaviour other than a normal demand relationship between prices and quantities over the annual harvest cycle of the crops. The Irish famine potato—the current widely discussed textbook example of a Giffen good—in fact showed the most normal demand relationship with price for any good used in this study. Indeed, in Ireland, to suggest that the poorest peasants after losing their entire potato crops to blight with their real incomes falling to almost zero, would have had enough money to push up the price of even basic subsistence crops, such as potatoes or farinaceous foods, is a fallacy. Moreover, these goods all suffered from short-term supply constraints, making it more unlikely for a Giffen-style phenomenon to be observed for these goods.

Instead, it is more probable that Giffen-style behaviour was exhibited by the aggregate market for bacon pigs. It appears to have redistributed food from the poor to the wealthier classes. The data for the quantity of bacon pigs sold in Cork (Figure 6), totalled per annum, show sales in 1846 increased almost 100 per cent to 64,114, from just 33,063 in 1845, itself a record high, indicating extreme inducement to sell. The negative relationship between  $F$  and the supply of pigs suggests that pigs were sold and quantities rose when food for pigs was short. This agrees with contemporary descriptions. In 1840s Ireland, when the potato crop was diminished in size, the peasants could have had recourse to their pigs, ‘fed upon anything’ without ‘expense’, selling them to pay the rent or buy cheaper food. A contemporary description of agricultural Ireland records that in normal times ‘the pig that “pays the rent”’ was ‘seldom or never brought up for “home consumption”’ and was sold in times of distress.<sup>20</sup> When 75 per cent of the potato crop failed in late-1846, peasants, with few scraps left to feed the pigs and facing financial ruin, with their landlords chasing rent arrears in the face of sharply rising interest rates on their mortgages during these same months, were forced to sell their pigs to pay the rent, creating a large quantity on the market in 1846. They ran out of pigs by the start of 1847, with market volumes of bacon pigs and other foods falling to very low levels that year, as the *Constitution* noted in its market reports.<sup>21</sup> But one would expect such a high initial supply to reduce bacon pig prices and thus inhibit sales. Instead, it appears that that bacon pig prices rose in 1846 as for previous years since 1842, and together with the instrumental variable analysis giving a positive gradient for the demand line, this suggests that a Giffen-style effect was stronger in increasing sales than the variations in the supply of food for the pigs. Thus we see the more important effect was an abnormal demand curve as the middle classes traded down to bacon, from other meats

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<sup>19</sup> See Kohli, ‘Robert Giffen and the Irish Potato: Note’, pp. 539-541; Doi et al., ‘Giffen behaviour independent of the wealth level’, pp. 247-267.

<sup>20</sup> S. C. Hall, *Ireland: Its Scenery, Character etc.* (London: How & Parsons, 1843) Volume III, p. 451.

<sup>21</sup> *Constitution or Cork Advertiser*, 5 January 1847.

such as beef, which they were less able to afford because their incomes were reduced in real terms by rising food prices.

Therefore a further conclusion of this study is that Giffen mechanisms may have resulted in the greater middle class demand for inferior meats encouraging the poorer classes to sell their emergency capital and food reserves in circumstances in which the money exchanged rapidly lost its real value. More research is needed on the market microeconomics whereby the wealthier classes, who only lost part of their incomes and could still afford to buy food, out-competed the peasantry for the available food supplies, and unwittingly forced them to starve or migrate. The collapse of the pig population to very low levels in 1847, caused by a Giffen-style surge in demand by wealthier sections of Irish society, may have indirectly made the famine worse as pigs were no longer available to convert food inedible by humans, such as potato peelings and foraged vegetation, into calories edible by humans. If this is a general characteristic of famines, further research in this area may inform not only economic theory but famine studies too.

The age of the data set from Cork, and the uncertainty over the exact method of its recording, together with the approximation of using straight lines to represent sometimes rapidly moving curves should encourage some caution over the results in this paper. But this is the best case study so far available for a region in famine Ireland and it shows that the bacon pig market displays abnormal demand behaviour, with some relation to a negative real income effect, in these years. The persistence of these results under analysis and the potential for understanding the mechanism behind famines in societies with large populations of impoverished food producers makes investigation into the Cork bacon pig market worthy of note and a fertile area for further econometric analysis.

Table 1: Cork Market potato price (d/21 lbs) against quantity supplied (cart loads), gradient of Method of Least Squares Curve method, annually.

| Year    | Ordinary Least Squares Coefficient | Correlation Type |
|---------|------------------------------------|------------------|
| 1845/46 | -0.0141                            | Negative         |
| 1846/47 | -0.0363                            | Negative         |
| 1847/48 | -0.0606                            | Negative         |
| 1848/49 | -0.0351                            | Negative         |

Table 2: Cork Market wheat price (s/20 stone) against quantity supplied (barrels), gradient of Method of Least Squares Curve method, annually.

| Year    | Ordinary Least Squares Coefficient | Correlation Type |
|---------|------------------------------------|------------------|
| 1842/43 | -0.0007                            | Negative         |
| 1843/44 | -0.0009                            | Negative         |
| 1844/45 | -0.0002                            | Negative         |
| 1845/46 | 0.0000                             | Insignificant    |
| 1846/47 | -0.0002                            | Negative         |
| 1847/48 | -0.0005                            | Negative         |
| 1848/49 | -0.0004                            | Negative         |

Table 3: Cork Market barley price (s/14 stone) against quantity supplied (barrels), gradient of Method of Least Squares Curve method, annually.

| Year    | Ordinary Least Squares Coefficient | Correlation Type |
|---------|------------------------------------|------------------|
| 1842/43 | -0.0001                            | Negative         |
| 1843/44 | -0.0002                            | Negative         |
| 1844/45 | -0.0002                            | Negative         |
| 1845/46 | 0.0000                             | Insignificant    |
| 1846/47 | -0.0005                            | Negative         |
| 1847/48 | 0.0000                             | Insignificant    |
| 1848/49 | -0.0001                            | Negative         |

Table 4: Cork Market oats price (s/16 stone) against quantity supplied (barrels), gradient of Method of Least Squares Curve method, annually.

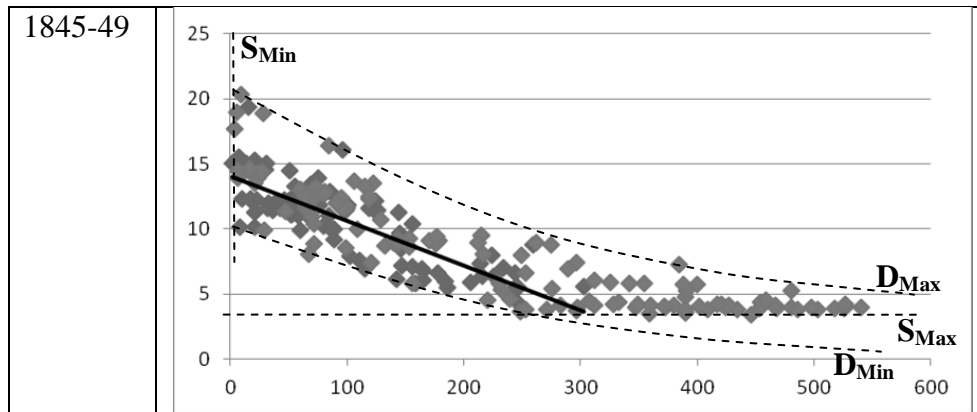
| Year    | Ordinary Least Squares Coefficient | Correlation Type |
|---------|------------------------------------|------------------|
| 1842/43 | -0.0003                            | Negative         |
| 1843/44 | -0.0006                            | Negative         |
| 1844/45 | 0.0000                             | Insignificant    |
| 1845/46 | 0.0003                             | Positive         |
| 1846/47 | -0.0021                            | Negative         |
| 1847/48 | 0.0000                             | Insignificant    |
| 1848/49 | -0.0001                            | Negative         |

Table 5: Cork Market bacon pigs price (s/cwt) against quantity supplied (units), gradient of Method of Least Squares Curve method, annually.

Regressions key: \* p < 0.10, \*\* p < 0.05, and \*\*\* p < 0.01.

| Year    | Ordinary Least Squares Coefficient | Correlation Type | P-values   |
|---------|------------------------------------|------------------|------------|
| 1842/43 | 0.0015                             | Positive         | 0.01509**  |
| 1843/44 | 0.0013                             | Positive         | 0.14126    |
| 1844/45 | 0.0016                             | Positive         | 0.00447*** |
| 1845/46 | 0.0015                             | Positive         | 0.00604*** |
| 1846/47 | 0.0001                             | Positive         | 0.05702*   |
| 1847/48 | -0.0021                            | Negative         | 0.17177    |
| 1848/49 | -0.0021                            | Negative         | 0.52697    |

Figure 1: Cork Market potato price (d/21 lbs) against quantity supplied (cart loads), 1845-49 period. Data for 1842-44 unavailable.



$S_{Min}$   $S_{Max}$  = Possible Minimum and Maximum Supply curves  
 $D_{Min}$   $D_{Max}$  = Possible Minimum and Maximum Demand curves

Figure 2: Cork Market wheat price (s/20 stone) against quantity supplied (barrels), 1842-49 and 1845-49 periods.

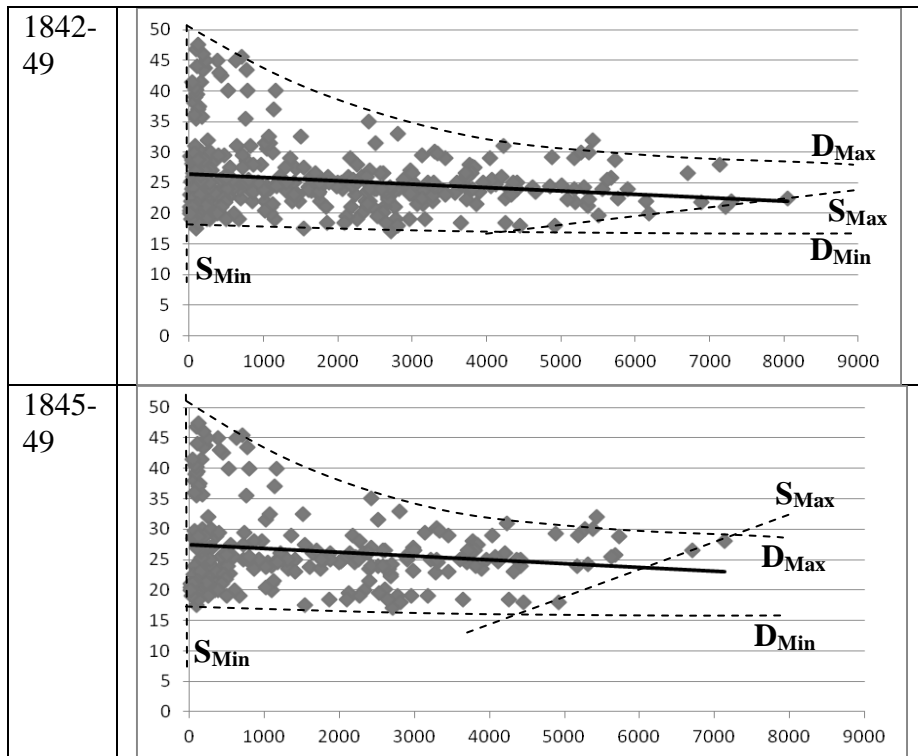


Figure 3: Cork Market barley price (s/16 stone) against quantity supplied (barrels), 1842-49 and 1845-49 periods.

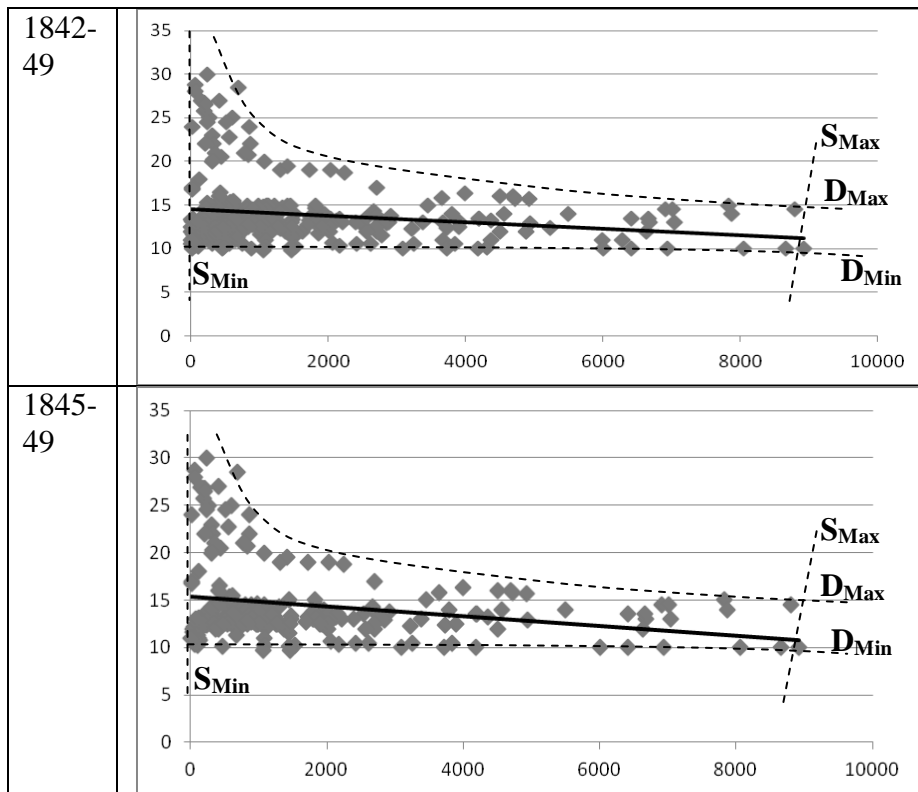


Figure 4: Cork Market oats price (s/14 stone) against quantity supplied (barrels), 1842-49 and 1845-49 periods.

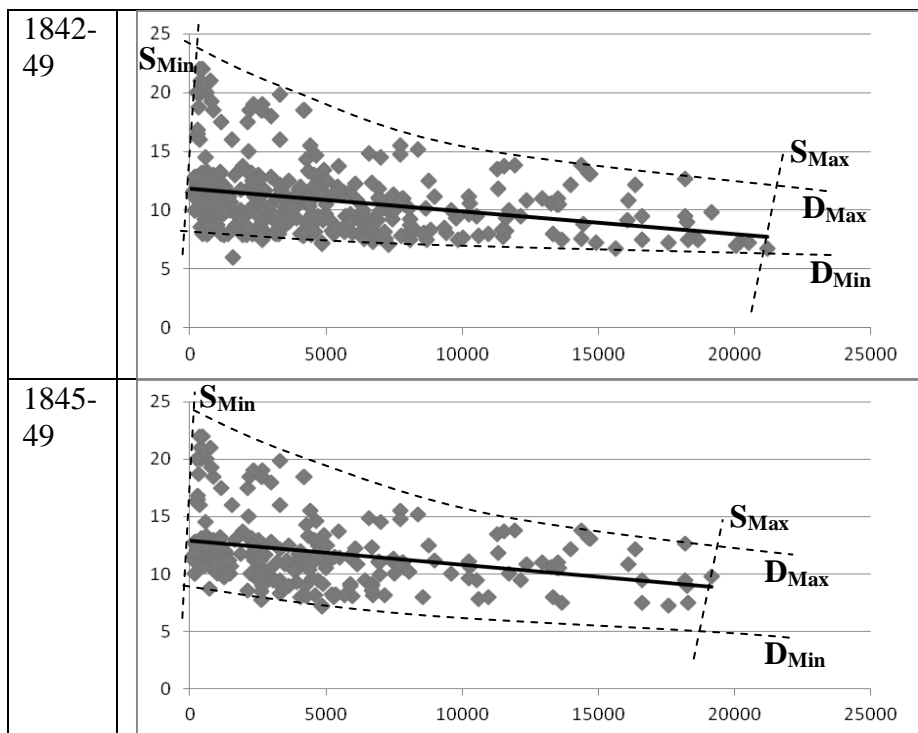


Figure 5: Cork Market bacon pigs price (s/cwt) against quantity supplied (units),

1842-49 and 1845-49 periods.

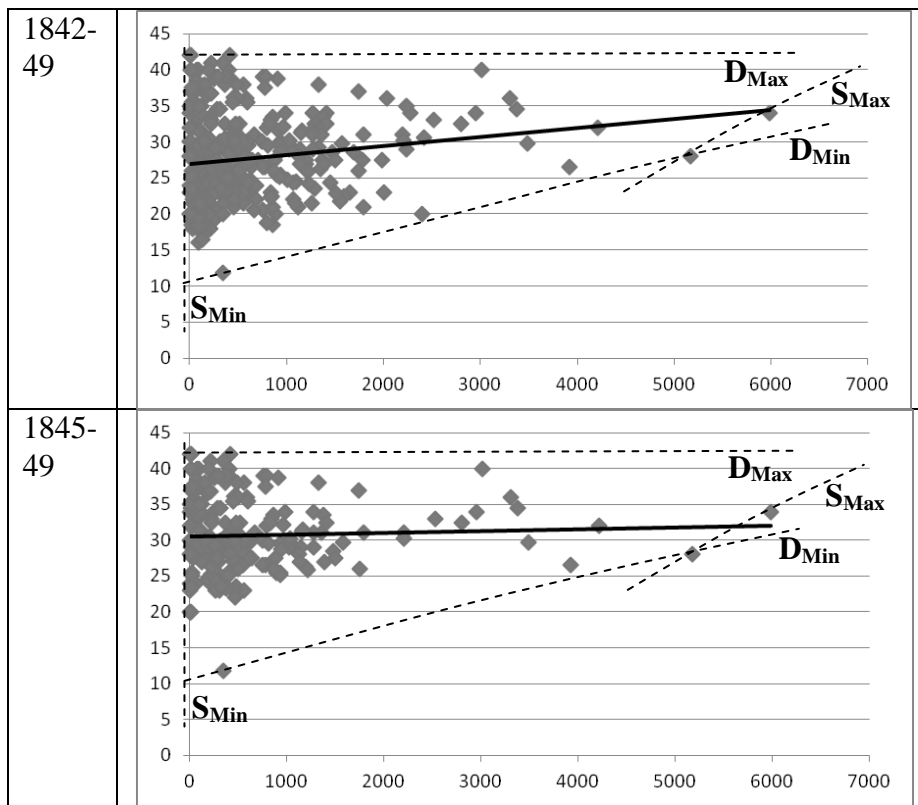


Figure 6: Bacon Pig price s/cwt (left hand scale) and quantity of bacon pigs sold (right hand scale) for Cork Markets 1842-49. An overall view of the data.

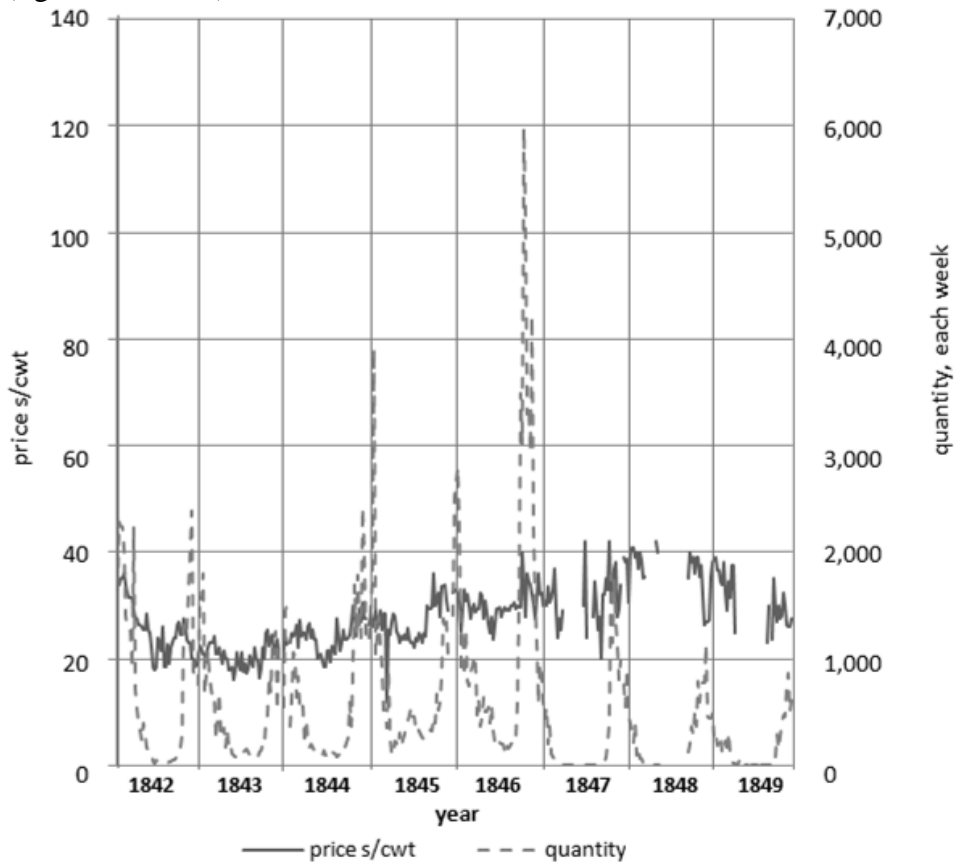
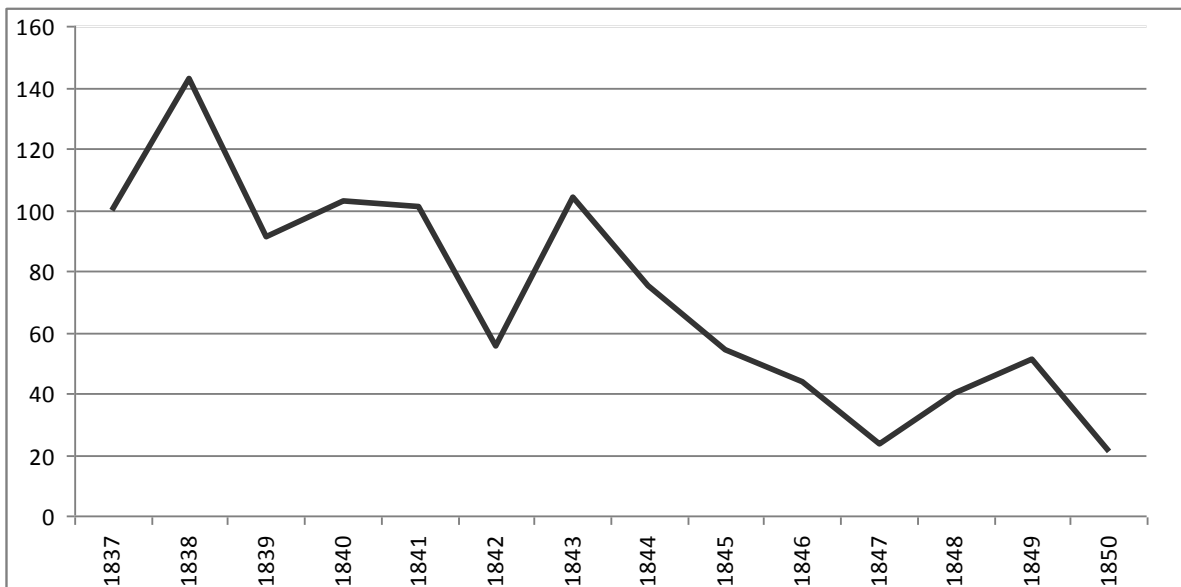


Figure 7: Retail price of beef (d/lb, top line) and bacon (d/lb, bottom line) in the Cork markets 1845-47.



Figure 8: Purchasing power of real wages, from the *Freeman's Journal* agricultural wage statistics adjusted for living costs, both indexed to 1837=100.<sup>22</sup> Large falls in Irish real wages are evident in 1842, 1844, 1845 and 1846, the same years that strong Giffen-style behaviour is reported in the Cork bacon pig market.



<sup>22</sup> F. Geary and T. Stark, 'Trends in real wages during the industrial revolution: a view from across the Irish Sea', *Economic History Review* (2004) pp. 362-395; F. A. D'Arcy, 'Wages of Labourers in the Dublin Building Industry, 1667-1918', *Saothar* 14 (1989) pp. 23-24; *Freeman's Journal*, 24 January 1837, 18 September 1839, 7 February 1840, 18 July 1842, 8 January 1846, 7 February 1840, 20 May 1846, 26 June 1846, 6 May 1847, 16 June 1847, 5 January 1850, 2 May 1850.