The Window Tax: A Case Study in Excess Burden

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Abstract

The window tax in Great Britain (1696–1851) provides a remarkable case of tax-induced distortions in resource allocation. Tax liabilities on dwelling units depended on the number of windows in the unit. As a consequence, people boarded up windows and built houses with very few windows, to the detriment of both health and aesthetics. Using data from local tax records on individual houses, the analysis in the paper finds compelling evidence of such tax-avoidance and goes on to make a rough calculation of the excess burden associated with the tax.

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"The adage 'free as air' has become obsolete by Act of Parliament"

Charles Dickens

Introduction

The window tax must rank among the very worst taxes in the history of Western Civilization. Imposed in 1696, the tax (a kind of predecessor of the modern property tax) was levied on dwellings with the tax liability based on the number of windows. The tax led to all kinds of efforts to reduce tax bills through such measures as the boarding up of windows and the construction of houses with very few windows (sometimes whole floors of houses were windowless). In spite of the pernicious health and aesthetic effects and of widespread protests, the tax persisted for over a century and a half: it was finally repealed in 1851.

Our purpose in this paper is threefold. First, we provide a brief history of the tax with a discussion of its rationale, its role in the British fiscal system, and its economic and political ramifications. Second, we have assembled what we think is a rather remarkable data set from microfilms of local tax records during this period that indicate the numbers of windows in individual dwellings. Drawing on these data, we are able to test some basic hypotheses concerning the effect of the tax on the number of windows and to calculate an admittedly rather rough measure of the excess burden associated with the window tax. And third, we have in mind a pedagogical objective in this paper. The concept of excess burden (or "deadweight loss") is for economists part of the meat and potatoes of tax analysis. But to the laity it is actually a rather arcane notion; public-finance economists often have some difficulty, for example, in making clear to groups of taxpayers the sometimes quite significant welfare costs that result from tax-induced distortions in resource allocation. The window tax has the virtue of providing a compelling and transparent example of how a tax can have serious adverse side effects on social welfare. In addition to its objectionable consequences for tax equity (stressed by Adam Smith among many others), it resulted in very obvious and costly misallocations of resources.

A Brief History of the Window Tax

The window tax was introduced in England in 1696 by William III. Burdened with expenses from the Revolution and the costs of re-coinage necessitated by the "miserable state" of existing coins which had been reduced by "clipping" (i.e., scraping off small portions of the high-grade silver coins), the King levied a new tax consisting originally of a flat rate of two shillings upon each house and an additional charge of 4s upon houses with between ten and twenty windows and 8s upon houses with more than 20 windows.1 The tax was levied upon the occupants of the dwelling, not the owner. Moreover, if flats (apartments) were rented separately, assessors charged the residents collectively. Thus, if a building contained two apartments, each with six windows, the building was taxed at a rate based on twelve windows. This made the tax

[1] There were 20 shillings (s) to the pound and 12 pence (d) to the shilling. A mixed sum of shillings and pence such as 2 shillings and 5 pence was written as "2s 5d." The average annual income during this period was a bit less than 20 pounds per year.

particularly burdensome on poor households living in tenement buildings with multiple units. Although the initial legislation specified a period of only three years for the tax, the window tax would last (in various forms) for over 150 years! As we noted above, it was not repealed until 1851.

Although the rate structure of the tax was revised numerous times over this lengthy period, there is one feature of this structure that is of special importance for our study. The tax did not consist of a series of smoothly rising marginal rates but instead included a series of "notches," points at which an additional window brought with it a large increase in tax liability. Consider, for example, the tax over the period 1747–1760. If the owner of a house (more properly a dwelling unit) with nine windows were to add a tenth, the tax on his unit would suddenly rise significantly. As this suggests, we might expect to find many more houses with nine, rather than ten, windows. We will make use of these notches in our later empirical study of the effects of the tax.

The window tax, incidentally, had an antecedent: the hearth tax. Imposed in 1662 by Charles II after the Restoration, the hearth tax consisted of a levy of 2s for every fire-hearth and stove in houses in England and Wales. The tax was very unpopular in part because of the intrusive character of the assessment process. The "chimney-men" (as the assessors and tax collectors were called) had to enter the house in order to count the number of hearths and stoves. There was great resentment against this invasion of the sanctity of the home. The window tax, in contrast, did not require access to the interior of the dwelling: the "window peepers" could count windows from the outside, thus simplifying the assessment procedure and obviating the need for an invasion of the interior.

Both of these taxes were intended to serve as a measure of wealth, i.e., an indicator of the owner's ability to pay. As pointed out in a report of a discussion in the House of Commons, "The window tax, when first laid on, was not intended as a window tax, but as a property tax, as a house was considered a safe criterion of the value of a man's property, and the windows were only assumed as the index of the value of houses" (HCDeb., 9 April 1850). But as Adam Smith pointed out in The Wealth of Nations, the number of windows could be a very poor measure of the value of a dwelling, inasmuch as "A house of ten pounds rent in the country may have more windows than a house of five hundred pounds rent in London; and though the inhabitant of the former is likely to be a much poorer man than that of the latter, yet so far as his contribution is regulated by the window-tax, he must contribute more to the support of the state" (p. 798).

Moreover, although the window tax removed the need for tax assessors to enter the house to count the number of hearths, the tax created some administrative problems of its own—not the least of which was the definition of a window for purposes of taxation. The law was vague, and it was never quite clear what constituted a window for tax purposes. In 1848, for example, Professor Scholefield of Cambridge paid tax on a hole in the wall of his coal cellar (HCDeb., 24 Feb., 1848). In the same year, Mr. Gregory Gragoe of Westminster paid tax for a trapdoor to his cellar (HCDeb., 24 Feb., 1848). An individual might even have to pay tax should a brick fall out of the wall if the hole admitted light into the house. Such an outcome could prove quite costly by forcing the resident to pay a higher rate on every window in his house. This issue was a source of

considerable unrest among taxpayers. Indeed, as late as 1850, there were continued requests to the Chancellor of the Exchequer for clarifications on the definition of a window.

The schedule and levels of tax rates were amended (in some cases raised dramatically) over the life of the tax.2 As mentioned earlier, the original rate structure in 1696 consisted of a flat tax rate of 2 shillings upon each house and an additional charge of 4 shillings on houses with between ten and twenty windows or 8 shillings upon houses with more than twenty windows. The reforms of 1747 separated the taxes on windows and the lump sum tax on each house. Beginning in 1747 no tax was paid on homes with nine or fewer windows; taxes were 6d per window on homes with 10–14 windows, 9d per window on homes with 15–19 windows, and 1s per window on homes with 20 or more windows. There were substantial changes in 1761. A tax rate of 1s per window was established for homes with eight or nine windows and rates were raised on homes with 10 or more windows. We look at the impact of the 1761 tax rate changes in a subsequent section of the paper.

Significant changes continued to be made before the tax was finally repealed. In 1784, Prime Minister William Pitt increased tax rates to compensate for lower taxes on tea. In response, "Owners in both town and country began to disfigure their houses ... by blocking up their windows" (HCDeb., 24 Feb., 1848). This was followed in 1797 by Pitt's Triple Assessment Act that tripled the rates to help pay for the Napoleonic Wars. The day following this new Act thousands of windows were blocked up, and "Lighten our darkness we beseech thee, O Pitt!" was written in chalk on the blocked-up spaces (HCDeb., 24 Feb., 1848). There were some reductions in the tax after 1820.

There were some exemptions under the window tax. Various factories and buildings were exempted from the tax: public offices, farm houses that cost less than 200 pounds per year, dairies, cheese rooms, malt houses, granaries, and coach makers. The rationale for these exemptions was either of two conditions: the windows provided air rather than light, or the trade required ample light so that workshops had to have glass windows. In addition, officials exempted some residences under various pretexts. Some exceptions were made for certain wealthy parties. And, in some instances, the presence of serious disease resulted in tax exemption. As stated in a decree in 1819, "In cases where the terror of contagion had forced the wretched inhabitants to restore the windows, and admit the light and air, the tax so incurred should be remitted" (HCDeb., 5 May, 1819). These exemptions were a source of considerable controversy amid claims of unfair treatment.

England and Scotland were both subject to the window tax, but Ireland was exempted because of its impoverished state. Some members of Parliament joked that "In advocating the extension of the window-tax to Ireland, the hon. Gentleman seemed to forget the fact that an English window and an Irish window were very different things. In England, the window was intended to let the light in; but in Ireland the use of a window was to let the smoke out" (HCDeb., 5 May, 1819).

[2] This section draws heavily on Glantz (2008). For useful histories of taxation in the U.K. covering this period, see Sinclair (1804), Dowell (1884), Kennedy (1913), Binney (1958), and Douglas (1999).

The Effects of the Window Tax

Our central concern in this paper is with the excess burden of the tax: its impact on social welfare over and above the burden of the tax payments themselves. We note in passing that much of the controversy over the tax involved its highly regressive incidence. The window tax was clearly very hard on the poor. We discussed earlier Adam Smith's criticism of the window tax on the basis of its high degree of regressivity, its failure as a measure of ability to pay. It is interesting (and perhaps a bit curious) that Smith had nothing to say about its distorting effects on resource allocation.[3]

These distorting effects were widespread and profound. Residents throughout England and Scotland boarded up windows to avoid the tax.[4] In 1848, Mr. Byers, the president of the Carpenters' Society in London, reported to Parliament that nearly every house on Compton Street in Soho had employed him to reduce the number of windows (HCDeb., 1848). In many houses, bricks took the place of previously existing windows. Moreover, newly constructed dwellings economized in drastic ways on the number of windows. There is a case of an apartment building in Edinburgh in which the entire second floor (containing bedrooms) had no windows at all.[5]

The most serious impact of the window tax was on human health. The protests against the tax and the studies of its effects document the health crisis created largely by the lack of fresh air and ventilation. A series of studies by physicians and others found that the unsanitary conditions resulting from the lack of proper ventilation encouraged the propagation of numerous serious diseases such as dysentery, gangrene, and typhus. In one instance in 1781, a typhus epidemic killed many citizens in Carlisle. Dr. John Heysham traced the origins of the outbreak to a house inhabited by six poor families (Guthrie 1867). He described the dwelling:

> In order to reduce the window tax, every window that even poverty could dispense with was built up, and all source of ventilation were thus removed. The smell in this house was overpowering, and offensive to an unbearable extent. There is no evidence that the fever was imported into this house, but it was propagated from it to other parts of town, and 52 of the inhabitants were killed (p. 409).

There were a series of petitions to Parliament resulting in the designation of commissioners and committees to study the problem in the first half of the nineteenth century. In 1846, medical officers petitioned Parliament for the abolition of the window tax, pronouncing it to be "most injurious to the health, welfare, property, and industry of the poor, and of the community at

[3] In Appendix G to his famous *Principles of Economics*, Alfred Marshall also discusses the window tax in a lengthy footnote. Like Smith, his concern is solely with the incidence of the tax (not with its effects on behavior). However, unlike Smith, Marshall speaks approvingly of the tax as a measure of ability-to-pay, arguing that the number of windows provides a reasonable index of "the scale and style of household expenditure in general" (p.802). In fact, he contends that "If the part of the tax assessed on houses were removed, and the deficit made up by taxes assessed on the furniture and indoor servants, the true incidence of the taxes would be nearly the same as now" (p.802). Both Smith and Marshall fail to address the quite striking effects of such taxes on efforts to avoid their payment.

[4] There are many references to the window tax in major pieces of English literature. In *Tom Jones* for example, one of Henry Fielding's characters exclaims that "Why now there is above forty Shillings for Window-lights, and yet we have stopped up all we could; we have almost blinded the house I am sure..." (p. 380).

[5] There are, of course, some instances in which residents by design had numerous windows as a means of displaying their wealth.

large" (HCDeb., 1850). Parliament came to realize and acknowledge the serious damage to public health resulting from the blocking of windows. This ultimately resulted in the repeal of the tax in 1851.

Conceptual Framework

A tax system creates a "notch" if a small change in behavior leads to a discrete change in both average and marginal tax rates. As we noted above, the window tax incorporated notches throughout much of its history. Consider, for example, the tax schedule over the 1747–57 period. As we showed above, a consumer who owned a home with nine or fewer windows paid no tax. But his neighbor whose home had ten windows would pay a tax of 6d for ***each of his windows***. Consequently, the marginal tax rate for the tenth window was 60d (which is equal to 5s) and the average tax rate was 6d. Notches are uncommon and have received relatively little attention in the literature on taxation.[6] "Kinks" are far more common. A tax system creates a kink if a small change in behavior leads to a discrete change in the marginal tax rate but just a very small change in the average rate. The United States federal individual income tax, for example, has several kinks. Earning an additional dollar could move a taxpayer into the next higher tax bracket, thus raising the marginal tax rate with (almost) no effect on the average tax rate.

Public finance economists often argue against notches on the grounds that they lead to large deadweight losses. The idea here is that a tax schedule with notches provides strong incentives for taxpayers to distort behavior and locate at a notch. We explore this argument as we develop a conceptual framework to think about the window tax.

Consider a simple form of the window tax that includes just one notch. Consumers pay no tax if they own z_0 or fewer windows but pay a tax of t pence per window if they own more than z_0 windows. There are three cases to consider. Case I includes consumers who would own fewer than z_0 windows in the absence of the tax. Case I consumers would continue to own the same number of windows after the window tax is put in place. Thus Case I consumers pay no tax and suffer no deadweight loss.

Case II consumers purchased more than z_0 windows before the tax and continue to purchase more than z_0 windows after the tax is imposed (though fewer windows than they did initially unless demand is perfectly inelastic). Figure 1 looks at the impact of the window tax on Case II consumers. It shows a Case II consumer's (compensated) demand for windows. This consumer purchases z_2 windows at the market price p but z_1 windows once the tax is imposed. The notch is irrelevant for Case II consumers. For them, the window tax is equivalent to a standard excise tax of t pence per window. They pay a total tax bill of A + B in Figure 1, suffer a welfare of A + B + C, and thus a deadweight loss of C.

Case III includes consumers who would buy more than z_0 windows if there were no tax but exactly z_0 once the tax is imposed. These consumers pay zero tax. The tax has, however,

[6] Slemrod (2010) provides an excellent overview of notches. Sallee and Slemrod (2009) look at notches in the context of subsidies for fuel efficient cars. Blinder and Rosen (1985) present simulation results that suggest the deadweight loss from notches may not be as large as some have feared.

distorted their decisions and so they suffer a deadweight loss. The Neary and Roberts (1980) work on rationing helps to clarify this point. In the context of this problem, Neary and Roberts would define the shadow price of a window as the price of a window that would lead a consumer to purchase z_0 windows in the absence of the ration. Thus in Figure 1, the shadow price of windows is p_0. Neary and Roberts show (again, in the context of this problem) that the deadweight loss from restricting consumption to a maximum of z_0 windows is the welfare loss associated with a price increase from the market price to the shadow price minus a lump sum payment of $(p_0-p)\, z_0$. The first term is A + B + C + D + E in Figure 1, the second term is A + D, and therefore the deadweight loss from avoiding the tax by restricting the purchase of windows to z_0 is B + C + E.

Which consumers fall into Case II (they choose to pay the tax) and which into Case III (they avoid the tax by restricting their consumption of windows)? Case II consumers suffer a loss of A + B + C; Case III consumers suffer a loss of B + C + E. Consumers will choose the option that minimizes their loss from the tax. And so we come to the following rule:

> Consumers will choose to pay the tax (Case II) if A + B + C < B + C + E. They will avoid the tax (Case III) if A + B + C > B + C + E. They will be indifferent if A + B + C = B + C + E.

Subtracting B + C from both sides shows that the key here is the relative magnitudes of areas A and E in Figure 1. The intuition behind this result is as follows. A consumer could choose to pay the tax and therefore purchase an additional z_1-z_0 windows. The benefit from paying the tax is the difference between willingness to pay for windows and the price of a window (including the tax) integrated over z_1-z_0 windows. But in order to be able to purchase these z_1-z_0 windows the consumer must pay the tax on the first z_0 windows, area A. So the decision on whether or not to pay the tax turns on whether the benefit from purchasing additional windows (area E) is greater than , less than, or equal to the cost (area A).

This analysis suggests a test of the hypothesis that the window tax distorted people's decisions. Some people may decide that the cost of purchasing taxed windows is too great and will therefore buy exactly z_0 windows, i.e., they will become part of Case III. That is, if the window tax distorted decisions, then we should find "too many" people at the notches.[7] We present such a test in the next section of the paper.

Did the Window Tax Distort Decisions?

To explore the quantitative impact of the window tax on actual behavior, we have assembled a data set from local tax records in 18th and 19th century Britain that indicates the number of

[7] More specifically, the test we have outlined here is a test of a sufficient condition that the tax distorted decisions. It is possible that if the notches were set very low that everyone purchased more windows than the number of untaxed windows and thus no one falls in Case III. The tax, in this example, would still distort decisions since the tax would have the same impact as a standard excise tax.

windows per household over the period 1747 to 1830. We provide in the appendix a description of the data set and just how we went about pulling it together.

We focus initially on the observations in our data set from 1747 to 1757. As we discussed above, the window tax was unchanged over this period and included three notches. A homeowner in this period paid[8]

- no tax if the house had fewer than 10 windows,
- a tax of 6d per window if the house had 10–14 windows,
- a tax of 9d per window if the home had 15–19 windows, or
- a tax of 1s per window if the home had 20 or more windows.

Thus the marginal and average tax rate jumped sharply when a consumer purchased the 10^{th}, 15^{th}, or 20^{th} window.

We have tax data on a total of 493 homes in this period. Most of the observations in our data set are from Ludlow, a market town in Shropshire. Ludlow is close to the border with Wales. It had a population of roughly 4,000 people at the start of the nineteenth century; its current population is 10,500. We have data for just a single year for roughly 40 percent of the houses in our sample and two or more observations for the remaining 60 percent. We have treated our data as a cross section. In those cases where the number of windows changed over the 11-year period, we used the last observation available. We want to capture the effect of the tax and using the last observation for each home gives us the greatest opportunity to observe a homeowner's response to the window tax.

1747–57 is a particularly useful sample period for our purposes. As Glantz (2008) explains, the administration of the window tax proved to be an ongoing, difficult problem.[9] It apparently was very common for homeowners to camouflage or board up windows until the tax collector was gone. Homeowners and local surveyors often avoided the window tax by taking advantage of loopholes and ambiguities in the tax code. The tax was imposed on every window in inhabited houses. All industrial or retail buildings and homes of low income families were exempt. Homeowners frequently attempted to disguise regular living quarters by storing a few sacks of grain in a room. Bribery and corruption among assessors was common.

As a result, tax collections were often much lower than expected. Parliament revised the window tax in 1747 to deal with these problems. The revisions included heavy fines for attempts to evade the tax. As part of the 1747 act, "The practice of blocking up windows in order to evade assessment and subsequently reopening them, was prohibited under a penalty of 20s for every window reopened without due notice given to the tax surveyor."[10] These penalties were steep; a fine of 20s is 20–40 times as large as the tax on windows itself. The 1747 revisions also included a number of provisions that significantly improved the administration of the tax.

[8] In addition, each homeowner paid a fixed duty of 2s. This house tax was separated from the window tax in 1747.

[9] This section draws heavily on Glantz (2008).

[10] Glantz (2008), pp 8-9.

The 1747 act apparently was able to reduce tax evasion significantly. Data from the 1747–57 period are therefore likely to yield a reasonable estimate of the actual number of windows. Data from earlier periods are more likely to reflect often successful efforts to evade the tax and therefore understate the actual number of windows.[11]

If the window tax distorted behavior, then we should expect to see "too many" homes with nine, 14, or 20 windows. And this in fact is exactly what we find. Figure 2 is a histogram showing the number of windows for homes in our sample. The pattern here is clear. There are sharp spikes in the number of homes at all three notches. In our sample

- 18.9% of the homes have nine windows, 4.3% eight windows, and 4.3% 10 windows.
- 17.8% have 14 windows, 6.1% 13 windows, and 1.6% 15 windows.
- 6.5% have 19 windows, 3.4% 18 windows, and 1.0% 20 windows.

We completed chi-square tests of the hypotheses that there were equal numbers of homes with eight, nine, or ten windows, with 13, 14, or 15 windows, and with 18, 19, or 20 windows. We reject each of those hypotheses at the .001 level (which is not surprising given Figure 2). It seems clear that people did respond to the window tax by choosing one of the notches.
Recall that the 1761 revisions to the window tax established a tax rate of 1s per window on houses with eight or nine windows; from 1747 until 1760 only houses with 10 or more windows were subject to the tax. This change suggests a second test of the hypothesis that the window tax distorted people's decisions. We should expect to find "too many" houses with seven windows beginning in 1761 but not in periods before 1761.

We collected a sample of 170 houses from the period 1761–1765 (as we noted above, there were significant changes to the tax rate in 1766). The houses in this second sample are from Wiltshire and Hampshire in southwest England. Figure 3 shows the distribution of the number of windows for the homes in our 1761–1765 sample. We find a very large spike at seven windows. In this sample, 28.2 percent of the houses have seven windows but just 5.3 percent have six and just 2.9 percent have eight. Chi-square tests reject the hypotheses that there were equal numbers of homes with six, seven, or eight windows at the .001 level. In sharp contrast, just 3.0 percent of the houses in our 1747–1757 sample had seven windows.

We also find concentrations in our 1761–1765 sample at 11 windows (9.4%) and 19 windows (7.6%). This is consistent with 1761–65 tax policy; there were notches at both 11 and 19 windows during this period. We can reject the hypothesis that there were equal number of houses with 10, 11, and 12 windows at the .05 level and reject the hypothesis that there were equal number of houses with 18, 19, and 20 windows at the .001 level.

[11] And in fact some studies have interpreted masses in the data as evidence of corruption. Stigler (1986) cited in Duggan and Levitt (2002), for example, showed that the height distribution among French males based on measurements taken at conscription was normally distributed except for a shortage of men measuring 1.57–1.597 meters (roughly 5 feet 2 inches to 5 feet 3 inches) and an excess number of men below 1.57 meters. Not coincidentally, the minimum height for conscription into the Imperial army was 1.57 meters.

In summary, the evidence from both samples is consistent with the hypothesis that property owners' decisions were distorted by the window tax.[12] We turn to the cost of those distortions next.

How Large Was the Deadweight Loss from the Window Tax?

In this section of the paper we present a simulation model that allows us to develop a rough estimate of the deadweight loss from the window tax. We certainly would not claim that our simple model can capture all elements of tax policy in mid-18th century England. We would, however, argue that the model can offer a sensible estimate of the order of magnitude of the efficiency cost of the tax.

The model has the following structure. There are 1,000 consumers in the simulation. Consumer i has an inverse demand function for windows (i.e., willingness to pay) of $exp(A_i)z_i^{-1/\eta}$ where η is the price elasticity of demand and z_i is the number of windows. That is, in this model all consumers have the same constant price elasticity of demand but their demands for windows differ by a multiplicative constant. We assume that the A_i are uniformly distributed between A^0 and A^1. We discuss the calibration of the model below.

The simulation first solves for the demand for windows in the absence of the tax. Each of the 1,000 consumers calculates consumer surplus (willingness to pay minus expenditure) if they buy 0, 1, 2, ….. 60 windows and chooses the number of windows that maximizes consumer surplus. We then re-run the model under a tax policy that is similar to the 1747–57 window tax. Consumers in our model who own nine or fewer windows pay no tax, those who own 10–14 windows pay a tax of 6d per window, and those who own 15 or more windows pay a tax of 9d per window.[13] Each consumer in the model re-optimizes given this tax policy. The model captures each consumer's demand for windows with and without the tax, consumer surplus with and without the tax, and taxes paid.

A key parameter in the simulation is the pre-tax price of windows, or its equivalent, the excise tax rate given a tax on windows of 6d or 9d. We could find no direct evidence on this point, but our reading of the literature suggests that the tax was very large relative to the price of windows. There is a good deal of evidence that the window tax was a significant fraction of rent. For example, consider this quote from a debate in the House of Commons in 1850:

> "In the smaller houses in the metropolis, for instance in Baker-street, the window tax amounted to not less than from 29 to 30 per cent upon the rental. In many other streets, which were composed of smaller houses, the window tax was found to press most unequally, to the extent of sometimes of 30 to 40, and occasionally even 50 per cent on the

[12] Some additional evidence is cited by M. Dorothy George (1926), who notes that "When the duty was increased in 1710 it became a universal practice to stop up lights. How increasingly general the practice became may be gathered from the fact that in 1766 when the tax was extended to houses with seven windows and upwards, the number of houses in England and Wales having exactly seven windows was reduced by nearly two-thirds." (p. 77)

[13] The tax policy we looked at in the simulation did not include the third notch that existed under the 1747-57 tax (consumers with homes with 20 or more windows paid 1s per window). Only 11 percent of the homes in our sample have 20 or more windows.

> rentals as ascertained by the rate book. When they came to Oxford Street, however, in which there were very large houses, the window tax instead of being 29 per cent, did not amount, in many instances, to more than 5 per cent on the rental." (HCDeb., 9 April 1850, p.71)

Suppose the window tax was on the order of 20 percent of rent, a figure that seems reasonable. A little arithmetic and an assumption on the ratio of window rents to total rent yield an estimate of the excise tax rate. If window rents are 20 percent of total rents—and it seems nearly certain that this estimate is high—then the excise tax rate on windows is 100 percent. If window rents are 10 percent of total rent then the excise tax rate is 200 percent. Our simulation is based on an assumption that a tax of 6d is a 100 percent excise tax on windows.

We searched for values of the other important parameters of the model that yield results that closely match our data. More specifically, we undertook a grid search for the values of the price elasticity of demand and the lower and upper bounds of the distribution of the constants in the demand function that minimizes a loss function that equals the sum of the squared differences between the actual and the model's value of (i) the percentage of homes with exactly nine windows, (ii) the percentage of homes with exactly 14 windows, and (iii) the average number of windows for all homes.

Our estimated elasticity of demand for windows is .147. We do not have any evidence against which we can evaluate this estimate. This estimate may seem low, but it is important to note that the demand for windows may be slow to adjust to a change in tax policy since the stock of new houses is small compared to the stock of existing houses (though as we argued above, many homeowners responded to the tax by blocking up existing windows).

The magnitude of the price elasticity has some interesting implications for our estimate of the deadweight loss from the window tax. Recall our discussion of Case II consumers—those who do not locate at a notch—and Case III consumers—those who do. The analysis of Case II consumers is straightforward. For this group, the window tax is a standard excise tax. It is well understood that the deadweight loss from a standard excise tax is small when the elasticity of demand is small. In the limit the deadweight loss will be zero if demand is perfectly inelastic (since in that case a consumer's decision will be unaffected by the tax).

But things are very different when we turn to Case III consumers. For consumers who choose to locate at a notch the window tax is a quantity distortion. The welfare loss from a policy that distorts quantity directly is large when demand is inelastic and small when demand is elastic; in the limit, the deadweight loss from a constraint on quantity is zero when demand is perfectly elastic.[14] And so we would expect the window tax to have very different effects on these two groups of consumer.

Table 1 shows the actual and simulated values of the three moments of the data. As that table shows, we were able to replicate the key features of our 1747–57 data fairly closely. In the simulation 21.9% of the homes had nine windows, 13.3% had 14 windows and the average

[14] This argument is similar in many ways to the Weitzman (1974) analysis of price and quantity instruments in environmental policy.

number of windows is 13.9. In our 1747–57 sample 18.9% had nine windows, 17.8% had 14 windows, and the average home had 13.9 windows.

Table 1. Simulation Results and 1747–54 Data

Simulation Results and 1747–57 Data		
	Simulation	1747–57 Data
Percent of Houses with 9 Windows	21.9	18.9
Percent of Houses with 14 Windows	13.3	17.8
Mean Number of Windows	13.9	13.9

The window tax has a significant impact on the demand for windows in the simulation. None of the consumers in the simulation chose 10, 11, 15, or 16 windows when faced with the 1747–57 window tax; it is never optimal to buy just to the right of a notch. The tax reduces average demand from an estimated 15.9 windows in the absence of the tax to an estimated 13.9 windows.

We focus initially on the consumers in the simulation who chose one of the notches (what we have called Case III consumers). As we noted above, 21.9 percent of the households in the simulation chose nine windows when faced with our version of the 1747–57 tax schedule. This includes 5.5 percent of the sample that also chose nine windows in the absence of the tax and whose choices were therefore not distorted. Thus 16.4 percent of the simulated households chose nine windows under the tax but more than nine windows in the absence of the tax. All of the households that chose 14 windows when faced with the tax chose more than 14 windows in a world without the window taxes. And so in total, 29.7 percent of the households in the simulation chose one of the notches in direct response to the window tax.

How large is the distortion from the window tax? The estimated losses were very large for the households at the one of the two notches. We find that for those consumers the deadweight loss equaled 62.2 percent of the taxes those consumers paid. That is to say, for every dollar collected the simulated version of the window tax imposed an additional burden of 62.2 cents on the households at the notches (over and above the direct burden of one dollar). The excess burden, not surprisingly, is particularly large for households that chose nine windows. Those consumers paid zero tax and so for them the entire burden of the tax is excess burden.

We now turn to the entire sample of 1,000 simulated households. There are a number of alternative ways to think about the excess burden of a tax. We could focus on ***total*** excess burden as a fraction of ***total*** tax. In our simulation, the deadweight loss from the window tax is 13.6 percent of tax revenues. Alternatively, we might focus on the marginal excess burden (MEB) of the window tax. MEB is a common measure of the distortionary effect of a tax. It is defined as the ***marginal*** excess burden from a ***marginal*** increase in tax revenue. We have calculated the MEB of the window tax by increasing the tax rates by 10 percent in the model and then calculating the resulting change in deadweight loss divided by the change in tax. We find a MEB of .23; raising an additional dollar of tax revenue through the window tax would generate an additional $.23 of excess burden.

Summary and Conclusions

We had three objectives in this paper. First, we presented a brief summary of the history of the window tax. Second, we offered some empirical evidence that strongly suggests that the window tax distorted decisions. Throughout much of its history, there were notches in the window tax schedule. We found in both our 1747–57 and 1761–1765 samples that far more houses were located at one of the notches in the tax schedule than we would expect to find if the window tax were not an important element in homeowners' decisions. We found that that the losses for families at one of the notches were very large. For those consumers the deadweight loss equaled 62.2 percent of the taxes those consumers paid.

And third, we hoped to provide a clear illustration of the deadweight loss from taxation. The discussion of deadweight loss can sometimes become a tangled debate over the measurement of Harberger triangles, partial versus general equilibrium estimates, and so on. Here is a clear case of what we mean when we talk about excess burden. The window tax led many people to live in very dark houses and in environments that had significant, pernicious effects on their health.

The window tax, as we have seen, is a quite striking example of a tax that led to radical tax-avoiding behavior with high associated levels of excess burden. This raises a further, intriguing question that goes beyond the scope of this paper but is worthy of mention here. If this was such a bad tax that generated such adverse effects and intense criticism, why did it persist over such a lengthy period? In fact, the rates were raised, in some instances quite dramatically (e.g., Pitt's Triple Assessment), when increased revenues were required.

The answer to this question requires a broader consideration of the political and fiscal issues of the times. But it was the case that these were years of intense fiscal pressures, involving at various junctures massive military expenditures. The monarch and Parliament resorted in several instances not just to increases in the land and window taxes but to a range of new taxes on various commodities and the introduction of an income tax (Dowell, 1884, Vol. Two). Thus, it appears that the continued use of the window tax was, in part at least, a response to a setting of extreme budgetary tightness in which there was little room for reduction in any tax rates. Perhaps the lesson here is that when governments need to raise significant revenue, even a very bad tax can survive for a very long time.

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Figures

Figure 1

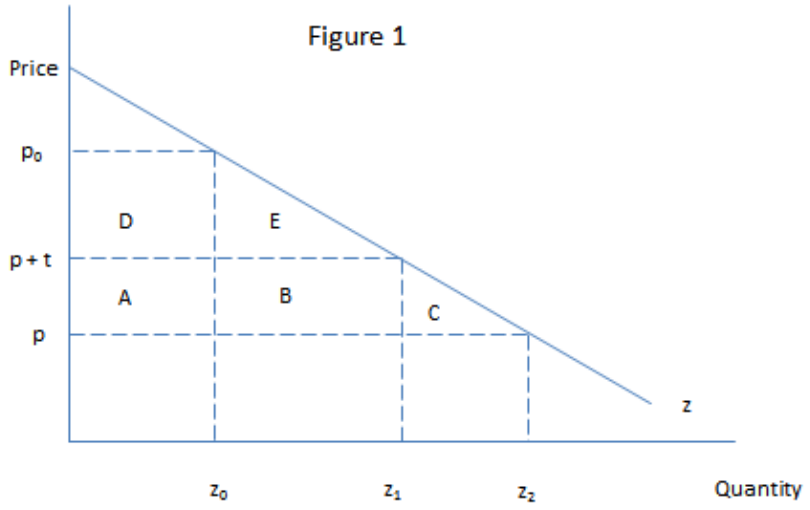

Figure 2

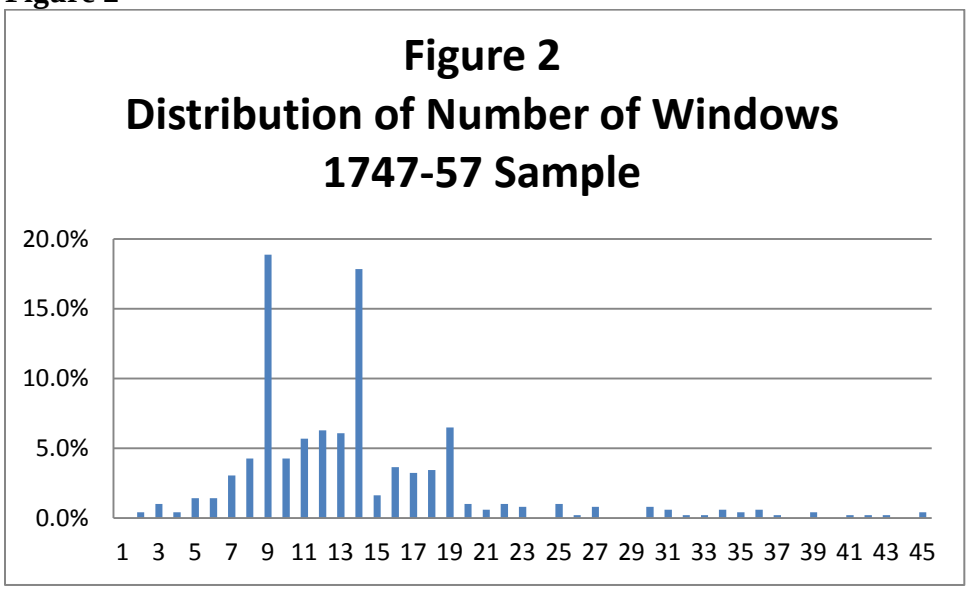

Figure 3

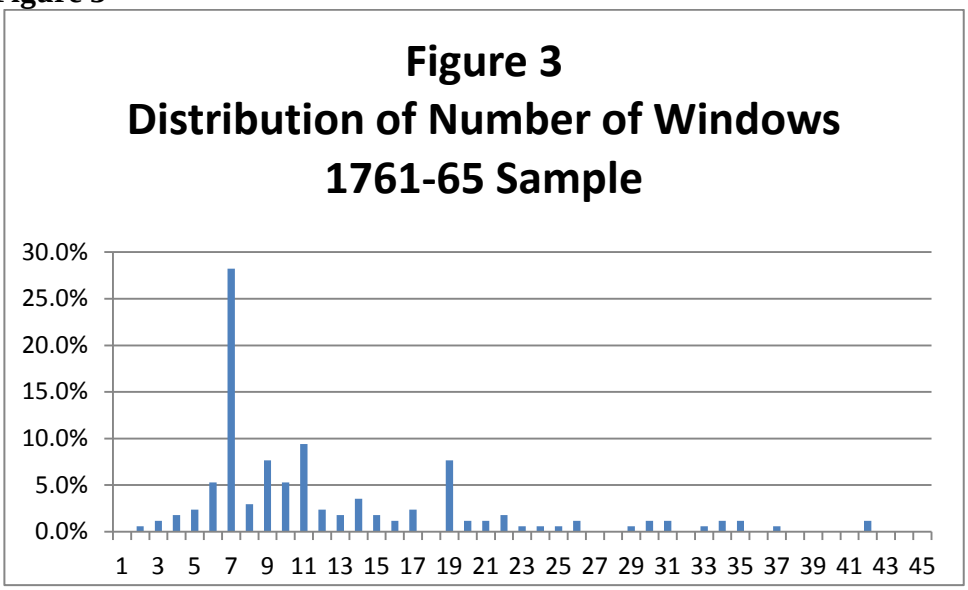
Figure 3
Distribution of Number of Windows
1761-65 Sample
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45

Appendix: The Data

The empirical part of our analysis draws on a data set that tracks the number of windows per household for nearly 1,400 households over the years 1747 to 1830. We could find no such data published in any websites, journal articles, books, or other secondary sources. In fact, the online sources provided only very limited information on the tax rate structure and revenues.

But, as a result of a very careful and determined effort by our superb research assistant, Katherine Hamilton, we were able to go back to original sources at the local level from which we were able to assemble our data set.[15] With help from the Family History Center in Kensington, Maryland, Katherine was able to identify 67 microfilm reels that were potential sources of local window tax records. From these, we selected nine reels of microfilm that provided the longest spans of data and which encompassed a widely distributed sample of counties.

What these microfilms revealed was local window tax records with the name of the owner of the dwelling along with the "number of windows owned" and the "window tax charged" next to each name for each year. We kept track of each household to see how the number of windows changed over time.

This, incidentally, involved an extended effort. The data (which were not always very clear on the microfilm) had to be manually transcribed. There were a number of problems to be addressed. For instance, if a particular household disappeared from the records, we had no way to determine whether the individual had died, moved away, or simply changed name (perhaps as a result of marriage).

Drawing on these records, we have assembled tabulations of window and tax data by household and by year that provide the basic information that we use for the empirical analysis in the next section. As we argued in the body of this paper, these data themselves tell a very compelling story about the impact of the window tax.

[15] We are grateful to Dr. Richard Price, Professor of English History, who pointed out to us that national records at such an early date would not be available and that we would have to search out local records.