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FEAST OR FAMINE: THE WELFARE IMPACT OF FOOD PRICE CONTROLS IN NAZI GERMANY

Robin Winkler

Feast or Famine: The Welfare Impact of Food Price Controls in Nazi Germany

Robin Winkler

Oxford University

Email: robinwinkler@gmail.com

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Abstract

How good was the standard of living in pre-war Nazi Germany? Some historians have argued that household food consumption in the 1930s was at least as high as in the Weimar Republic, in spite of militarisation. This article provides new evidence against this view by demonstrating that food price controls significantly distorted consumption patterns. We estimate that involuntary substitution effects cost average working-class households 7% of their disposable income. Consumer welfare in Nazi Germany was thus meaningfully lower than observed consumption levels and prices suggest. Our finding is based on microeconometric welfare analysis of detailed budget data for 4,376 individual German households surveyed in 1927 and 1937.

Keywords: German economic history, National Socialism, household consumption
JEL codes: N14, N34, D12, D52

Introduction

The material standard of living in the Nazi Germany during peacetime has been debated by economic historians for many decades. The Weimar Republic usually serves as the benchmark. Following Thamer (1986), Abelshauser (1999) famously argued that the rapid recovery of the German economy in the 1930s—the "economic miracle" of Nazi Germany—resulted in a higher standard of living. The most persuasive critical studies rejected this view on the grounds that German households did not benefit from the recovery since their consumption level grew at a considerably lower rate than employment and disposable incomes (Buchheim, 2001; Spoerer, 2005; Steiner, 2006). Scholarly criticism notwithstanding, a popular book by Aly (2005), arguing that the National Socialist regime had retained the support of ordinary Germans by continually improving their material standard of living, became a bestseller in Germany. German and international historians scrambled to prove Aly wrong in public, but with limited success (Tooze, 2005; Wehler, 2005). The extent of scholarly and public attention received by Aly's thesis shows that the debate remains unresolved and important to this day.

The debate has reached deadlock for methodological reasons. Most economic historians of interwar Germany agree that unemployment in the 1930s was low and real wages were robust. The dispute concerns the extent to which high employment translated into consumer welfare. Absorbing half the disposable income of ordinary working-class households, food prices are central to this debate. Advocates of Nazi economic policy have correctly argued that the typical working-class food basket was cheaper in the 1930s than in the Weimar Republic. Formally, the cost of achieving utility u was lower in the 1930s than the 1920s. Yet this assumes that markets cleared at observed prices. Critics have retorted that official price caps, imposed primarily on imported foodstuffs such as wheat, resulted in excess demand. The food baskets that would have yielded utility u at official prices were not available, and u could thus only be achieved through costly substitutions. The reason this argument has failed to settle the dispute, in our view, is that the positive welfare effect of lower prices appears more quantifiable and thus objective than qualitative evidence of shortages, involuntary substitutions, and quality deteriorations. Lower prices are unambiguously good for consumers, but what is the welfare cost of a household involuntarily substituting pork for beef? Some authors have analysed the nutritional value of diets (Baten and Wagner, 2003), but in the final analysis anthropometric attempts at objectively measuring the welfare impact of shortages remain unconvincing given the temporal proximity of the two regimes.

Spoerer and Streb (2013) pioneered the necessary methodological transition towards assessing welfare on the basis of the subjective preferences revealed by consumers at the time. They demonstrated at the aggregate level that the average food basket observed in surveys in the mid-1930s would have been eschewed by the average household in the mid-1920s, even though it could have afforded that basket. We refine their approach by using richer heterogenous consumption data for 4,376 households surveyed by the *Statistiches Reichsamt* in 1927 and 1937 in order to elicit preferences through a theoretically more rigorous demand system.

We find that relative to the (undistorted) preferences revealed in 1927, households exhibited implausibly inferior consumption bundles in 1937, given observed market prices. In the presence of price controls, the distorted food baskets of 1937 are likely explained by shortages and involuntary substitution effects, since the specific shortages we identify are mostly in line with the qualitative literature. As the Nazi regime restricted imports of consumer goods while keeping their prices from rising, there was particular excess demand for beef, fruits, wheat, and coffee. Households substituted domestically produced pork, rye bread, and potatoes. Although the resulting food baskets were not necessarily inferior in nutritional terms, we show that households' preferences were frustrated in the market place, thus reducing their subjective welfare.

The important and novel contribution of this article is to quantify this welfare loss in monetary terms. To this end, we infer virtual prices for those goods subject to binding price controls. These virtual prices hypothetically render the consumption patterns observed in 1937 consistent with the preferences revealed in 1927, but they are higher than observed market prices. We calculate that the total food price index would have been at least 10% higher than at officially controlled prices. The virtual prices are used in conjunction with the cost functions underlying the estimated demand system to quantify the welfare impact of these price distortions in monetary terms. We find that for the average working-class household in 1937, the adverse impact of shortages amounted to 7% of its disposable income. More intuitively, this result demonstrates that taking consumption bundles in 1937 and 1927 at face value unduly biases a welfare comparison in favour of the Nazi regime. In reality, price controls and shortages imposed tremendous substitution costs on consumers. Accounting for this latent welfare loss thus meaningfully undermines the thesis that German households materially benefitted from the economic recovery of the 1930s.

Data

In 1927 and 1937, Germany's statistical agency (*Statistisches Reichsamt*) conducted large-scale budget surveys (*Wirtschaftsrechnungen*) among 1,940 and 2,470 German households, respectively. These years marked the peaks in the economic cycles of the Weimar and peacetime Nazi economies. As of 1927, the German economy was a relatively free market economy in general equilibrium. The mostly left-wing governments of Weimar intervened in some markets, especially housing, but refrained from intervening in consumer goods markets (Janssen, 1998). By 1937, in contrast, the Nazi regime had implemented a system of food price controls. However, the economy still operated in accordance with fundamental market forces. Government intervention only distorted markets, and selective price controls at best anticipated the centrally planned wartime economy. With local exceptions, no outright rationing was decreed until the early 1940s.

Few studies have analysed these budget data. Coyner (1977) and Triebel (1991) independently analysed how consumption patterns varied with social class but limited their analyses to descriptive statistics. Steiner (2005) used the data to compute food price indices. Other authors, such as Spoerer and Streb (2013), only used aggregated series compiled and published by the *Reichsamt* before the war. The data permit the disaggregation of households' food consumption in 1927 and 1937 into nineteen commensurate categories: milk, butter, cheese, eggs, lard, margarine, beef, pork, sausages, fish, rye bread, white bread, cereals, potatoes, vegetables, fruits, sugar, and coffee. The residual category 'other food' is small and comprises miscellaneous goods such as veal, poultry, and vegetable oil, of which households consumed little, if any at all. Non-perishable consumables are disregarded: alcoholic beverages, tobacco, tea, and chocolate. While the available data would permit a more detailed disaggregation, this would result in frequent zero expenditures. These are econometrically problematic if they reflect non-observable negative demand for particular goods at given prices. At the chosen level of dissaggregation, the frequencies of zero expenditures are negligible. The highest share of zero expenditures, at 5.2%, is observed for lard in the data from 1927. The presence of zero expenditures is thus unlikely to render the estimation results from the full sample inconsistent, though we formally test this below. Aggregating up, by contrast, would mean that unit values, which are used as proxies for market prices, would be distorted by quality differences.

The quadratic Engel curves in Figure 1 illustrate the changes in both relative budget shares and expenditure elasticities observed in the two years. As commonly observed in the literature on the Nazi economy, households in 1937 consumed less butter, cheese, eggs, beef, white bread, cereals, vegetables and fruits than in 1927.[1] Conversely, the curves tentatively confirm the common supposition that households instead consumed more pork, rye bread, potatoes, and sugar. Overall, the decrease in the consumption of more superior goods such as beef, dairy products, white bread, and fruits paints the picture of a somewhat inferior consumption bundle in 1937. Whether this preliminary assessment would have been shared by households remains to be seen.

[Figure 1 about here.]

The observed budget shares are bound to compare less favourably for households in 1937 since their disposable incomes and total food budgets were lower in real and particularly per-capita terms than those of the households in the 1927 sample, largely due to the greater share of blue-collar workers in the sample. Moreover, although the average household in 1937 resided in a larger town than its counterpart in the sample of 1927, the average is raised by fact that none of the households represented in the 1927 sample lived in Berlin. In fact, only a quarter of the households surveyed in 1937 lived in towns of more than 100,000 inhabitants, as opposed to 85% in 1927. Urban tastes may have differed from rural ones. Alongside income and household size, these are the two main socio-demographic differences between the samples which we control for within our demand system framework.

[Table 1 about here.]

Unit values were calculated from quantities and expenditures for each household and category. Most of the distributions initially indicated problems with outliers that remained even after cleaning the data from obvious typographical errors. The remaining outliers pointed to

[1] The 'cereals' category is comprised mostly of wheat flour but also includes whole grains such as rice and oats, as well as noodles.

measurement errors in the original survey data. This problem was solved by using the average unit value in a geographic cluster instead of individual unit values where the latter deviated from the local average by more than three standard deviations. Cluster unit values were also used in the few cases where individual unit values were undefined due to zero expenditures.

Modelling Household Preferences in 1927

We estimate a quadratic almost complete demand system (QUAIDS) to model household food preferences.[2] QUAIDS demand functions are given by

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \left(\frac{m}{a(\mathbf{p})} \right) + \frac{\lambda_i}{b(\mathbf{p})} \ln \left(\frac{m}{a(\mathbf{p})} \right)^2 + \phi_i \upsilon \qquad i = 1, ..., n \tag{1}$$

for each good i in the system.[3] The system of equations thus has i non-linear seemingly unrelated equations. The dependent variables w_i are the shares of goods i of total food expenditure m. Budget shares are preferable to total expenditures as the dependent variables, since they are less prone to heteroskedasticity.[5] The constant α_i is included for estimation purposes and has no economic meaning. The γ-parameters capture the responsiveness of demand to variations in relative prices, including both the own price of good i and the prices of other goods j. The remaining two terms of the equation capture the relationship between demand and total food expenditure, adjusted for purchasing power by suitable price indices defined in equations (2) and (3). The coefficient β_i captures the linear expenditure effect; λ_i captures the quadratic expenditure effect evident from the Engel curves. The price indices are defined as

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j \tag{2}$$

and

$$b(\mathbf{p}) = \prod_{i=1}^{n} p_i^{\beta_i}, \tag{3}$$

[2]QUAIDS was first developed by Banks et al. (1997).

[3]See Banks et al. (1997) for the classic derivation of this reduced-form demand equation from the underlying utility and cost functions.[4] These functions will be discussed in detail in section **??**.

[5]Cf. Gao et al. (1996)

where α_0 needs to be specified prior to estimation. Following best practice, we set it to 6.3, just below the smallest logarithmic value of total food expenditure observed in the sample. This is assumed to be the minimum food expenditure level for any household.[6] The last term, $\phi_i v$, is a Wu-Hausman correction for any potential expenditure endogeneity. This allows us to relax the separability assumption, whereby households first decide on a food budget as a share of their disposable income and then spend it exactly. Total food expenditure m is instrumented by disposable income and all right-hand-side variables entering the demand equations, including relative prices. To the extent that there is expenditure endogeneity, including the residual v from the first-stage regression is sufficient to control for it and render the other model parameters consistent.[7]

Consumption theory imposes a number of restrictions on the estimation of this system of demand equations. All constants are assumed to add up to unity. The expenditure terms as well as the price terms are assumed to cancel each other out across all equations. The symmetry condition requires that estimated price terms be symmetric in the sense that demand for one good cannot be more sensitive to the price of another good than *vice versa*. These restrictions can be summarized thus:

$$\sum_{i=1}^{n} \alpha_i = 1, \ \sum_{i=1}^{n} \beta_i = 0, \ \sum_{i=1}^{n} \lambda_i = 0, \ \sum_{i=1}^{n} \gamma_{ij} = 0, \ \ \gamma_{ij} = \gamma_{ji} \tag{4}$$

In integrating socio-demographic effects, we follow the scaling technique developed by a broader body of theoretical work on equivalence scales.[8] Let $e^R(\mathbf{p}, u)$ denote a reference household with all a socio-demographic variables, such as household size and town size, set to reference values by assumption. For all observations with household characteristics deviating from these reference values, these deviations are summarized as vector $\mathbf{a}$. For households other than the

[6]Cf. Banks et al. (1997). The results reported below were insensitive to a 10% variation in α_0.

[7]See Banks et al. (1997, p. 530). Bootstrapping may be required to obtain consistent standard errors (Smith and Goodwin, 1996; Wong, 1996). We ran 100 replications without systematically different standard errors from our baseline NLSUR estimation.

[8]Cf. Blacklow et al. (2010); Poi (2012); Ray (1983, 1982). On alternative translating models, which do not condition marginal propensities to consume on socio-demographic factors, see for instance Pollak and Wales (1981, 1978); Rossi (1988). Authors using the translating technique often extol simplicity as its greatest virtue; cf. Abdulai and Aubert (2004, p. 71). It is uncommon to model household demand as being heterogenous with respect to prices. The empirical problem is that interacting the γ_i price terms with a vector of household demographics $\mathbf{a}$ increases the number of model parameters by $(i-1)^2 \times a$ and thus tends to render estimation unfeasible, and especially in the present case. Nor does the theoretical literature recommend that the price terms in the functional form of the demand equation should be interacted with household characteristics, see for instance Blundell et al. (1993, p. 573).

reference household, the expenditure function is then scaled by the function $f_0(\mathbf{p}, \mathbf{a}, u)$ so as to account for different household characteristics:

$$e(\mathbf{p}, \mathbf{a}, u) = f_0(\mathbf{p}, \mathbf{a}, u) \times e^R(\mathbf{p}, u). \tag{5}$$

Following Ray, the scaling function is decomposed into a term $\bar{f}(\mathbf{a})$ which captures changes in expenditure levels resulting from a change in $\mathbf{a}$, and a term $\phi(\mathbf{p}, \mathbf{a}, u)$ which captures changes in the composition of goods consumed.[9] The term $\bar{f}(\mathbf{a})$ expresses the idea that households with different values of $\mathbf{a}$ consume different quantities of each good simply by virtue of scale. This amounts to an income effect. The second term, $\phi(\mathbf{p}, \mathbf{a}, u)$, expresses the assumption that tastes vary with household characteristics. The functional form of $\bar{f}(\mathbf{a})$ is parameterized simply as

$$\bar{f}(\mathbf{a}) = 1 + \rho' \mathbf{a} \tag{6}$$

with ρ' being a vector of parameters to be estimated. This term is used to scale the linear price index $\ln a(\mathbf{p})$ in equation (9) below. The parameterization of $\phi(\mathbf{p}, \mathbf{a}, u)$ takes on the functional form

$$\ln(\phi(\mathbf{p}, \mathbf{a}, u)) = \frac{\prod_{j=1}^{n} p_j^{\beta_j} \left(\prod_{j=1}^{n} p_j^{\alpha_{\mathbf{j}}' \mathbf{a}} - 1 \right)}{\frac{1}{u} - \sum_{j=1}^{n} \lambda_j \ln(p_j)}, \tag{7}$$

where the α-parameters capture the effect of household characteristics $\mathbf{a}$. This functional form leads to budget share equations that have a similar structure to those in QUAIDS without demographics, as is evident from equation (9). To account for the income effect associated with the changing composition of the household expenditures, define

$$c(\mathbf{p}, \mathbf{a}) = \prod_{j=1}^{n} p_j^{\alpha_{\mathbf{j}}' \mathbf{a}} \tag{8}$$

so that, finally, the transformed expenditure share equations take on the reduced form

$$w_i = \alpha_i + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + (\beta_i + \alpha_i' \mathbf{a}) \ln \left(\frac{m}{\bar{f}(\mathbf{a}) a(\mathbf{p})} \right) + \frac{\lambda_i}{c(\mathbf{p}, \mathbf{a}) b(\mathbf{p})} \ln \left(\frac{m}{\bar{f}(\mathbf{a}) a(\mathbf{p})} \right)^2 + \phi_i \upsilon, \tag{9}$$

[9] Ray (1983).

where an additional adding-up restriction requires that

$$\sum_{i=1}^{n} \alpha_{i,r} = 0 \qquad r = 1, ..., a. \tag{10}$$

Elasticities are derived from the estimated equations above. Expenditure elasticities are given by

$$e_i = 1 + \frac{1}{w_i}\left[\beta_i + \alpha_i'\mathbf{a} + \frac{2\lambda_i}{c(\mathbf{p},\mathbf{a})b(\mathbf{p})}\ln\left(\frac{m}{\bar{f}(\mathbf{a})a(\mathbf{p})}\right)\right]. \tag{11}$$

Uncompensated price elasticities are given by

$$\begin{aligned} e_{ij} = -\delta_{ij} + \frac{1}{w_i}\Bigg\{\gamma_{ij} - \left[\beta_i + \alpha_i'\mathbf{a} + \frac{2\lambda_i}{c(\mathbf{p},\mathbf{a})b(\mathbf{p})}\ln\left(\frac{m}{\bar{f}(\mathbf{a})a(\mathbf{p})}\right)\right] \times \\ \left(\alpha_j + \sum_l \gamma_{jl}\ln p_l\right) - \frac{(\beta_i + \alpha_{\mathbf{i}}'\mathbf{a})\lambda_{\mathbf{i}}}{c(\mathbf{p},\mathbf{a})b(\mathbf{p})}\ln\left(\frac{m}{\bar{f}(\mathbf{a})a(\mathbf{p})}\right)^2, \end{aligned} \tag{12}$$

where the Kronecker delta is defined as

$$\delta_{ij} = \begin{matrix} 1 \text{ if } i = j \\ 0 \text{ if } i \neq j \end{matrix} \quad . \tag{13}$$

Compensated price elasticities are obtained from the Slutsky equation, $e_{ij}^c = e_{ij} + e_i w_j$. In what follows, we only report compensated price elasticities for the sake of brevity.

The basic QUAIDS model is augmented by four demographic variables: household size, age, town size, and professional status. Household size is converted into adult equivalents using the OECD-Oxford weights.[10] The 'household age' is given by the average age of the household head and his spouse. Age being a taste-shifter, and hence it is the age of the household members with the greatest bargaining power that is expected to influence household decisions as to how spend their budgets. The 1937 sample data only permits the identification of five town sizes. The two smallest categories, up to 20,000 residents, are empty sets for the 1927 data, and only few households in the 1927 sample lived in towns of fewer than 50,000 inhabitants. Hence, we classify towns with fewer than 100,000 inhabitants as 'rural'; 'urban' households resided in towns more than 100,000 inhabitants. By way of controlling for any effects of socio-economic heterogeneity that are not reflected in the level of food expenditure, instrumented by disposable

[10] The household head is weighted by a factor of 1. Further adult members of the household are weighted by a factor of 0.7, whereas children under the age of 15 were weighted by a factor of 0.5. Cf. OECD (1982).

income, we further include dummies for household heads being civil servants or white-collar employees, with blue-collar workers being the reference category.

[Table 2 about here.]

The expenditure and own-price elasticities estimated from the 1927 sample are reported in table 2. They are calculated at sample means. All elasticities are economically plausible and consistent with microeconomic theory. Almost all goods have negative own-price elasticities. Demand for butter, meats, and white bread is highly price-elastic. Expenditure elasticities in excess of unity plausibly classify butter, eggs, pork, vegetables, fruits, sugar, and coffee as luxury goods. As households spend more on food, the budget shares of these goods increase more than proportionately. Necessities such as milk, lard, and rye bread have the lowest expenditure elasticities.

[Table 3 about here.]

[Table 4 about here.]

Price elasticities are reported in their entirety in table 3. The estimates confirm all the complementarities and substitutabilities that one would expect to see, though some elasticities such as the high substitutability between fish and butter are difficult to explain. Instead of the standard errors of the elasticities, we report the estimated coefficients of the γ-parameters along with their standard errors in Table 6 in the Appendix. The standard errors of γ parameters are low, rarely exceeding 20% of the coefficients in absolute magnitude. Standard errors are the best indicator of the precision with which the coefficients are estimated, as many of the parameters are not expected to differ from zero.

Table 4 provides an overview of the non-price parameters estimated for 1927. As for the socio-demographic variables, the effect of household size runs counter to that of total food expenditure, being positive for necessities and turning negative for normal goods. It effectively normalizes expenditure to per capita terms. Age turns out to be economically insignificant. Nor did the preferences of urban households differ markedly from those of rural households. Urban households tended to consume more margarine and white bread, and somewhat less meat overall. Overall, however, the significant differences in the consumption patterns of rural and urban households turn out to be not so much the consequence of differing tastes as of divergent relative prices. Once price differentials are controlled for, preferences vary little between these two segments of the population.

Occupational status is more important. Households headed by either civil servants or white-collar employees tended to consume significantly more butter, vegetables, and fruits than blue-collar workers even when controlling for more generous budgets. The fact that members of the professional classes consumed less meat than workers is probably explained by their residing in the very largest cities, which is not captured by the binary urban dummy. The fact that households in the professional classes also consumed significantly less rye bread is perhaps explained by the stigmatising association of these foodstuffs with the pauperised classes.

Overall, these results paint the picture of a well-functioning, if not very prosperous, market economy. Demand was sensitive to prices in accordance with the fundamental law of demand, and households with larger budgets were able to consume disproportionately more luxurious goods than households on smaller budgets. The preferences elicited from the households in the 1927 sample can thus plausibly be interpreted as the preferences of unconstrained households making consumption decisions against a background of market-clearing prices. They are robust to a range of estimation issues such as expenditure endogeneity and zero expenditures. The Wu-Hausman technique controls for considerable expenditure endogeneity. We also tested whether zero expenditures led to inconsistent estimates. A Hausman test confirmed that the more efficient results obtained from the full sample.[11]

Inferring Consumption Bundles In 1937

In this section we use the preferences inferred from the 1927 sample to predict food expenditures in 1937. Given that the elasticities in 1927 were estimated whilst controlling for the most important taste shifters, using the results from 1927 will predict changes in the budget shares due to changes in household characteristics as well as in the relative prices and food budgets observed in the 1937 sample. The fundamental assumption is that preferences remained constant over the decade. The qualitative literature suggests that consumers did not adapt their preferences

[11] Although we used a linear Hausman test, this is asymptotically feasible with results obtained from the non-linear seemingly unrelated regression estimator. The χ^2 value of 11.37 implies a p-value of 0.878.

easily as the food supply changed in the 1930s ((Wiesen, 2011).)

The predicted average budget shares for 1937 are visually compared to the observed budget shares in figure 2. The average household in 1937 consumed significantly less milk, butter, cheese, eggs, beef, white bread, cereals, vegetables, fruits, and coffee than desired, given the right-hand-side values observed in 1937 and the preferences revealed by households in 1927. The implied under-consumption of these goods is in line with the qualitative evidence in the literature, which suggests that these goods were affected most severely by price distortions in the second half of the 1930s. The over-consumption of pork, fish, potatoes, rye bread, and sugar is similarly reflected in the literature. These deviations between predicted and observed budget shares signal market disequilibrium. In undistorted markets, scarcity would have raised prices for these goods, thus reducing demand for them.

[Figure 2 about here.]

Figure 3 plots the density distributions of the deviations of the observed from the predicted budget shares in 1937 at the level of individual households.[12] Generally speaking, the deviations for 1937 confirm the interpretation of the average budget shares, but they also reveal some interesting nuances. Beef, white bread, cereals, and fruits all have long, flat tails to the right of the dashed line marking equality between the predicted and observed budget shares. This indicates that very few households in the sample over-consumed these goods. By contrast, in the cases of vegetables and coffee the cumulative densities of positive deviations are much higher. Assuming that over-predicted consumption in 1937 is both a necessary and a sufficient condition for households facing binding quantity constraints, this implies that price controls over vegetables and coffee cannot be assumed to have led to binding rationing across all households. This, however, is a critical assumption underpinning the argument made in this chapter. In the case of eggs, furthermore, the seeming under-consumption is predicted by only some of the literature on price controls. Steiner (2006) is the only author to point out that the officially decreed prices for eggs led to shortages and a flourishing black market trade. Hence, we conclude rather conservatively that households faced binding quantity constraints in their demand for beef, white bread, cereals, and fruits only. It is these four goods only which virtually all households underconsumed. Classifying eggs, vegetables, or coffee as rationed goods would magnify the

[12] Households with non-positive observed budget shares are excluded.

results regarding the impact of rationing on welfare. Our identification thus biases the results against our argument.

[Figure 3 about here.]

Deriving Virtual Prices for Rationed Goods

We have argued that the under-consumption of beef, white bread, cereals, and fruits was due to price controls preventing prices from reflecting latent shortages. At the observed and officially controlled prices, households should have consumed more of these goods, and the difference between the predicted and the actual quantities consumed constituted the degree of rationing in quantitative terms. Allowing the quantities of rationed goods to rise to levels implied by official prices is theoretically equivalent to leaving the effective bindig quantity constraints in place but raising prices to hypothetical levels at which markets would be fully cleared at the observed quantities.[13] Theoretically, the virtual price of a rationed or generally quantity-constrained good is the price at which, given observed expenditures on all other goods, a consumer would voluntarily and freely demand exactly the quantity to which she is constrained anyway.[14] The concept can be expressed formally through cost functions. Let goods k be rationed goods, consumed by households at binding ration levels z_k at observed prices p_k. Under binding rationing of goods k, the cost of attaining utility level u is greater than in the absence of rationing:

$$c(p, p_k, z_k, u) > c(p, u). \tag{14}$$

This is because of costly substitution effects. At prices p_k, z_k falls short of the quantities which households would like to consume of goods k. In order to maintain their utility level u, they have to switch to an inferior consumption bundle and spend more on this bundle to achieve u. In reality, substitution may remain incomplete, leaving u to fall at constant total expenditure. Virtual prices p_k^* are now defined as the prices for goods k at which unconstrained households would seek to consume k at exactly the binding ration levels z_k such that:

$$c(p, p_k, z_k, u) = c(p, p_k^*, u). \tag{15}$$

[13] Neary and Roberts (1980).

[14] The concept of a virtual price was introduced as early as 1941 by (Rothbarth, 1941).

The deviation of virtual prices from observed prices therefore captures the degree of rationing just as accurately as the shift in the consumption bundles due to rationing.

Virtual prices can be backed out from the observed variables in 1937 in conjunction with the conditional demand equations estimated for 1927.[15] We use the coefficients estimated by the QUAIDS from the 1927 sample to calibrate the four budget share equations for beef, white bread, cereals, and fruits, along with the sample means of the independent variables, and solve for the unknown prices in each equation. In a second step, we solve the system for each household in the sample. This permits insights into which households were most affected by shortages. Since the predicted budget shares of the four goods thought to be rationed did not exceed the observed budget shares for all households, for some households the implied virtual prices are in fact expected to be lower than the observed prices. The virtual prices thus obtained for 1937 at the sample means as well as for the average individual household are compared to the observed prices of the rationed goods in table 5.

[Table 5 about here.]

Using virtual prices instead of observed prices raises the food price index $a(\mathbf{p})$ for 1937 by 11.2% at the sample means. This represents an important revision of previous estimates as to the rise in food prices in the 1930s. There is a consensus among economic historians that the rise in official food prices of 10.8% reported for the period 1933-38 was grossly understated by the authorities. Steiner (2005) presented a new estimate based on the same budget data used here, finding that food prices rose by 21.9% over this period. Steiner correctly argued that the budget data likely reported observed market prices, unlike the official data reported by the regime. Yet my estimate from virtual prices indicates that even accurately measured market prices around 1937 understate the extent to which the cost of living rose under the Nazis.

Computing The Welfare Impact

Finally, we use the estimation results from the QUAIDS model in conjunction with the virtual prices to assess the impact of rationing on consumer welfare in 1937. To use the results from

[15] This 'backing-out' approach is often attributed to Hausman (1995, 1997), but it was already proposed by Neary and Roberts (1980) who used it in the context of a linear demand system. Hausman's method has been applied to rationed demand systems with satisfactory results by Huffman and Johnson (2004a,b).

QUAIDS in making welfare assessments, we render more explicit the cost and utility functions underpinning the demand equations estimated above. Equation 1 being a rank 3 quadratic logarithmic budget share system, it is theoretically consistent with an indirect utility function of the form

$$\ln V = \left[\left(\frac{\ln m - \ln a(\mathbf{p})}{b(\mathbf{p})}\right)^{-1} + \lambda(\mathbf{p})\right]^{-1}, \tag{16}$$

where

$$\lambda(\mathbf{p}) = \sum_{i=1}^{n} \lambda_i p_i, \qquad \sum_i \lambda_i = 0. \tag{17}$$

Intuitively, the utility level V that a household derives from total food expenditure m depends on the purchasing power of m, which is determined by relative prices p. The specific price indices are interpreted below. The indirect utility function in equation (16) is consistent with a cost function that expresses the cost of achieving utility level V given the price vector $\mathbf{p}$. For a basic QUAIDS model, this is derived by rearranging the utility function to obtain

$$\ln m = \ln c(p, u) = \ln a(\mathbf{p}) + b(\mathbf{p}) \left(\frac{\mathbf{1}}{\frac{\mathbf{1}}{\ln \mathbf{V}} - \lambda(\mathbf{p})}\right).^{16} \tag{18}$$

The expenditure term m is interpreted as the budget required to obtain utility level V given prices $\mathbf{p}$. The first price index in this equation, $\ln a(\mathbf{p})$, as defined in equation (2), captures the benefit or cost of changing prices through the α- and γ coefficients estimated by QUAIDS. The α-coefficients determine the income effect of a price change. Given the adding-up condition ($\sum_{i=1}^{n} \alpha = 1$), a uniform change in the price level is passed on entirely to the utility level. A doubling of the price level, without any changes in relative prices, doubles the cost of achieving utility level V. As per equation (2), the term also measures the cost associated with any substitution effect through the γ coefficients. In the case of a uniform price change, there is no substitution effect at all and the cost function is unaffected. Where relative prices change, however, the sign of the substitution effect renders the combined effect through $a(\mathbf{p})$ ambivalent. For price rises, the combined effect is likely negative. Falls in specific relative prices can have a greater adverse substitution than beneficial income effect. The second term of equation (18), incorporating the price indices $b(\mathbf{p})$ and $\lambda(\mathbf{p})$, captures the law of diminishing marginal utility. Since $b(\mathbf{p})$ is strictly positive and $\lambda(\mathbf{p})$ tends to be positive, the marginal cost of raising utility

[16] Cf. Martini (2009, p. 17).

level V increases with V.

The cost function described in equation (18) can be used in a straightfoward way to make welfare assessments. A number of authors have used the concept of compensating variation to translate estimation results from demand systems into welfare terms.[17] Deaton and Muellbauer (1980) define the CV as the minimum amount by which a consumer would have to be compensated after a price change in order to be as well off as before. Where the CV is negative, consumers would desire the price change, and thus no compensation is required. Rather, a negative CV can be interpreted as consumers being willing to pay up to the absolute value in order to receive the price change.[18]

Suppose a consumer, having revealed her preferences in period 0, is faced with a change in relative prices in period 1. The CV measures the decrease or increase in the cost of maintaining the utility level V enjoyed in period 0 after the price change in period 1. A positive CV implies that moving from period 0 to period 1 prices makes it more expensive for consumers to maintain their initial utility level. In other words, a positive CV means that the consumer is worse off. This can be expressed more formally as

$$CV = c(p^1, u^0) - c(p^0, u^0) \tag{19}$$

where in the present analysis periods 0 and 1 can serve as placeholders either for the years 1927 and 1937 or for the levels of observed and virtual prices in 1937. The cost functions, described in equation (18), are parameterized by setting $u^0 \equiv \ln V_0 = \ln m_0$, that is, utility in the base period is given by the level of total food expenditure in that period.[19]

At observed controlled prices, the total cost of achieving any utility level is understated relative to what it would cost at latent market-clearing prices. Equivalently, at observed prices the utility of a food budget in real terms is overstated due to households' inability to purchase their preferred consumption bundles at those prices. To assess the degree to which price distortions bias consumer welfare in 1937 upwards, we calculate the CV implied by moving from observed prices in 1937 to virtual prices. This can be interpreted as a hypothetical lifting of price controls

[17] Cf. Banks et al. (1997); Huffman and Johnson (2004b); Martini (2009); Tiezzi (2002, 2005).

[18] In such cases, it is more common to use equivalent variations to take account of the fact that consumers willingness to pay for an expected utility gain tends to be lower than their willingness to pay to avoid a welfare loss. This conceptual issue notwithstanding, we use the CV throughout the analysis for the sake of clarity.

[19] See Martini (2009).

in the absence of supply adjustments in the short run.

The price indices comprising the cost function (18) can be derived by parameterizing the price indices with the coefficients estimated by the relevant QUAID systems, as per equations (2), (3), (6) and (8). To calculate $c(p^0, u^0)$ at observed prices in 1937, we derive the price indices from the coefficients estimated by the QUAID system fitted to the observed price data. For $c(p^1, u^0)$, we use the coefficients obtained from the system fitted to virtual prices. All non-price variables are constant across the two cost functions. At sample means, moving from observed 1937 prices to virtual prices yields a CV of 137.34 RM. This implies a welfare loss equivalent to 6.7% of disposable income and 14.4% of total food expenditure.

For individual households, the welfare effect varies considerably with households and tends to be less adverse on average. The average CV of 74.24 RM is in fact almost exactly half of the CV at the sample means, amounting to only 6.4% of total average food expenditure. Nevertheless, as demonstrated by the kernel density distribution of the individual CVs shown in figure 4, the CV is positive for almost all households, reflecting that the majority of households were affected by shortages.

[Figure 4 about here.]

It is evident from the cost function that the welfare loss varies with the total expenditure level m. The welfare impact from price controls is magnified for households with high levels of total expenditure. Rationing also affected large families more severely in absolute terms, though household size is positively related to total food expenditure (Figure 5).

[Figure 5 about here.]

How does 1937 compare to 1927 in welfare terms? In nominal terms, observed food prices were generally lower in 1937 than in 1927. The average urban household headed by blue-collar worker in 1927 would have preferred 1937 prices. Ignoring rationing, the CV turns out to be negative with a nominal value of -283.92 RM. This is calculated on the basis of preferences revealed in 1927. The negative value implies that this hypothetical household in 1927 should have paid up to 284 RM to move the price level observed in 1937. This is equivalent to 9.4% of average disposable income in 1927. The positive income effect of lower food prices in 1937 outweighs a slightly negative substitution effect from a change in relative prices.

Whether this implies a real welfare gain is not clear because it is not known exactly how incomes changed for the households in the 1927 sample over the next decade. Nominal working-class incomes were on average lower in 1937 than in 1927, thus offsetting the benefit of lower food prices in real terms. At the sample means, the problem of measuring changes accurately is less serious. Restricting the analysis to urban blue-collar workers minimises the bias stemming from the different sample compositions. The average urban blue-collar worker in the 1937 sample earned 678 RM less than his counterpart in the 1927 sample, suggesting that the fall in nominal food prices falls far short of having a positive real welfare effect. However, workers in the 1927 sample tended to be more skilled than those in the 1937 sample and earned higher wages. Furthermore, even if disposable incomes had decreased by more than food prices, an aggregate net welfare effect might have been maintained by a reduction in the prices of non-food goods and services, which are beyond the scope of this paper.

However this may be, the interesting question that we can answer confidently is by how much the nominal welfare gain from lower food prices is reduced when accounting for shortages. We calculate the CV using virtual prices for rationed goods instead of observed prices controlled by the government. As virtual prices of rationed goods tend to exceed observed prices, the substitution of virtual prices in the cost-of-living index for 1937 dampens the positive income effect from lower prices and aggravates the negative substitution effect. The CV from changes in food prices between the two years rises to -134.61 RM, implying that the welfare gain of food shortages in monetary terms was only 134.61 RM. This amounts to a welfare gain of only 4.4% of average nominal disposable income in 1927. Adjusting food prices in 1937 for the utility cost of shortages corrects for an undue positive bias to the overall welfare assessment if made on the basis of observed prices. Quantifying the welfare cost of shortages and price controls through virtual prices therefore is an important step towards resolving the debate as to whether households in the 1930s were better or worse off than in the 1920s. Once shortages are taken into account, the real welfare change is considerably less likely to be positive overall.

Conclusion

Household consumption in 1937 was distorted relative to preferences revealed in 1927. We argued this can be explained on the grounds of price controls. We found that households in the late 1930s tended to under-consume goods which the historical literature has singled out as being most affected by shortages, particularly beef, white bread, cereals, and fruits. Conversely, households were found to have consumed more pork, rye bread, and potatoes than would be predicted by the preferences revealed in the free market economy of the Weimar Republic. These findings are largely in line with those of Spoerer and Streb (2013), but they quantify the extent of shortages more precisely once virtual prices are derived from the estimated demand systems.

We also showed that taking into account the utility cost of distortionary price controls by calculating virtual food prices for rationed goods significantly reduces the gross welfare gain derived by consumers from lower food prices. The welfare loss from shortages was estimated to have been 6.7% of nominal disposable income at sample means. Ignoring the distortionary effects of price controls unduly biases any assessment of consumer welfare in 1937in favour of Nazi economy policy.

Appendix

[Table 6 about here.]

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Table 1: Descriptive statistics for the samples of 1927 and 1937

Sample means / (St. deviation)	1927	1937
Total food expenditure (RM)	1,368	964
	(369)	(254)
Household size (adult equivalents)	2.74	2.92
	(0.74)	(0.76)
Age (years)	37.4	36.1
	(6.7)	(6.7)
Blue-collar workers (%)	47.0	94.7
Civil servants (%)	25.7	0.9
White-collar employees (%)	27.4	4.4
Urban households (%)	85.0	25.9
Observations	1,940	2,436

Age measured as average age of parents.
Urban households reside in towns with more than 100,000 inhabitants.

Table 2: Income and own-price elasticities estimated from 1927 sample

	Elasticities calculated at 1927 sample means	
	Expenditure	Comp. own-price
Milk	0.62	-0.77
Butter	1.67	-1.36
Cheese	1.21	-0.66
Eggs	1.17	-0.06
Lard	0.30	-0.37
Margarine	0.80	-0.83
Beef	0.89	-1.10
Pork	1.14	-1.31
Sausages	1.16	-0.82
Fish	0.95	-0.93
Rye bread	0.43	-0.69
White bread	0.77	-1.17
Cereals	0.75	-0.56
Potatoes	1.19	-0.47
Vegetables	1.44	-0.78
Fruits	1.24	-0.52
Sugar	1.15	-0.77
Coffee	1.58	-0.67
Other	0.93	-0.65

Table 3: Compensated price elasticities at sample means, 1927

	Price																		
Quantity	Milk	Butter	Cheese	Eggs	Lard	Margarine	Beef	Pork	Sausages	Fish	Rye bread	White bread	Cereals	Potatoes	Vegetables	Fruits	Sugar	Coffee	Other
Milk	-0.77	0.01	0.11	0.00	-0.00	0.14	-0.09	-0.15	-0.05	0.02	0.26	0.10	0.17	0.02	0.00	0.04	0.06	0.01	0.08
Butter	0.01	-1.36	-0.22	-0.28	0.00	0.22	0.22	-0.06	0.70	0.10	-0.14	-0.16	0.15	0.10	0.11	0.20	0.06	0.08	0.16
Cheese	0.48	-0.70	-0.66	0.43	-0.04	-0.13	0.24	0.23	0.04	-0.03	-0.45	-0.05	0.11	0.15	0.14	0.13	0.10	0.06	-0.09
Eggs	0.01	-0.47	0.23	-0.06	0.01	0.01	-0.18	-0.10	-0.08	-0.00	0.03	0.41	0.15	0.03	-0.09	-0.04	-0.00	0.01	0.14
Lard	-0.03	0.02	-0.07	0.04	-0.37	-0.12	0.39	0.31	-0.10	-0.08	0.07	0.44	-0.15	-0.08	-0.05	-0.18	0.05	-0.02	-0.07
Margarine	0.42	0.49	-0.09	0.02	-0.05	-0.83	-0.01	0.25	0.05	-0.11	-0.02	-0.42	-0.01	0.22	0.27	0.03	0.01	-0.05	-0.14
Beef	-0.20	0.35	0.12	-0.16	0.11	-0.01	-0.93	0.30	0.12	0.05	0.29	0.12	0.03	-0.09	-0.11	-0.14	-0.01	0.00	0.28
Pork	-0.38	-0.11	0.14	-0.11	0.10	0.21	0.36	-1.31	0.25	-0.09	0.63	0.06	-0.02	0.04	0.02	0.01	0.09	0.03	-0.03
Sausages	-0.06	0.52	0.01	-0.03	-0.01	0.02	0.05	0.10	-0.82	0.03	-0.07	-0.00	-0.04	0.09	0.06	0.08	0.03	0.02	-0.03
Fish	0.14	0.45	-0.05	-0.01	-0.07	-0.22	0.14	-0.22	0.16	-1.17	-0.16	-0.08	0.00	0.10	0.30	0.32	0.05	0.02	0.07
Rye bread	0.34	-0.13	-0.13	0.01	0.01	-0.01	0.17	0.31	-0.09	-0.03	-0.69	0.15	-0.10	0.13	0.01	-0.05	0.11	0.04	-0.06
White bread	0.26	-0.30	-0.03	0.46	0.15	-0.36	0.15	0.06	-0.00	-0.03	0.31	-1.17	0.10	-0.12	0.03	0.09	0.04	0.01	0.29
Cereals	0.25	0.16	0.04	0.10	-0.03	-0.00	0.02	-0.01	-0.06	0.00	-0.12	0.06	-0.56	-0.04	0.10	0.09	0.03	0.00	-0.02
Potatoes	0.04	0.17	0.08	0.03	-0.03	0.17	-0.10	0.04	0.21	0.04	0.24	-0.10	-0.07	-0.47	-0.02	-0.11	-0.07	-0.00	-0.10
Vegetables	0.01	0.19	0.08	-0.10	-0.02	0.21	-0.13	0.02	0.16	0.11	-0.08	0.07	0.13	-0.10	-0.78	0.06	-0.02	0.02	-0.02
Fruits	0.09	0.30	0.06	-0.04	-0.05	0.02	-0.14	0.01	0.16	0.11	-0.08	0.07	0.13	-0.10	0.05	-0.52	-0.14	-0.08	0.08
Sugar	0.24	0.16	0.09	-0.01	0.02	0.01	-0.01	0.13	0.11	0.03	0.32	0.06	0.08	-0.11	-0.03	-0.26	-0.77	-0.02	0.08
Coffee	0.05	0.26	0.06	0.03	-0.01	-0.07	0.01	0.06	0.10	0.02	0.13	0.02	0.00	-0.01	0.04	-0.17	-0.02	-0.67	0.11
Other	0.11	0.17	-0.03	0.09	-0.01	-0.06	0.18	0.02	-0.04	0.02	-0.07	0.15	-0.02	-0.06	-0.01	0.06	0.03	0.03	-0.65

Elasticities are estimated from the full sample and computed at sample means.

Table 4: Coefficients and standard errors of non-price QUAIDS parameters, 1927

	α	β	λ	Household size	Age	Urban household	Civil servant	White-collar Employee	Wu-Hausman correction
Milk	**.127**	**.061**	**-.029**	**.024**	**-.001**	-.004	.001	-.003	.011
	(.023)	(.003)	(.002)	(.003)	(.000)	(.002)	(.002)	(.002)	(.012)
Butter	-.011	.012	**.018**	**-.021**	.000	-.003	**.015**	**.015**	-.011
	(.027)	(.012)	(.003)	(.003)	(.000)	(.002)	(.002)	(.002)	(.013)
Cheese	**.081**	-.002	**.003**	**-.006**	.000	**-.001**	-.001	-.000	.001
	(.008)	(.006)	(.001)	(.001)	(.000)	(.001)	(.000)	(.000)	(.004)
Eggs	**.214**	-.005	**.005**	**-.006**	**-.000**	-.001	.001	**.002**	-.003
	(.017)	(.005)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.006)
Lard	.005	-.004	**-.002**	**.003**	-.000	**.001**	**-.002**	**-.002**	.004
	(.007)	(.003)	(.001)	(.001)	(.000)	(.001)	(.000)	(.000)	(.004)
Margarine	.018	-.013	**-.007**	**.010**	-.000	**.005**	**-.004**	**.003**	-.013
	(.014)	(.007)	(.002)	(.002)	(.000)	(.001)	(.001)	(.001)	(.008)
Beef	-.005	**-.014**	**.004**	**-.004**	**.000**	**-.003**	**-.003**	**-.002**	.006
	(.014)	(.007)	(.002)	(.001)	(.000)	(.001)	(.001)	(.001)	(.007)
Pork	.028	.003	**.005**	**-.005**	-.000	**-.002**	-.001	**-.002**	.001
	(.016)	(.006)	(.002)	(.001)	(.000)	(.001)	(.001)	(.001)	(.007)
Sausages	-.005	**.022**	**.019**	**-.019**	**-.000**	-.002	**-.007**	**-.005**	**.031**
	(.022)	(.011)	(.003)	(.003)	(.000)	(.002)	(.002)	(.002)	(.011)
Fish	.003	-.002	**.002**	**-.002**	.000	.001	**.001**	**.001**	**.008**
	(.008)	(.003)	(.003)	(.001)	(.000)	(.001)	(.000)	(.000)	(.004)
Rye bread	**.102**	-.013	**-.020**	**.024**	**.000**	.002	**-.008**	**-.008**	**.021**
	(.019)	(.009)	(.003)	(.002)	(.000)	(.002)	(.002)	(.002)	(.009)
White bread	**.101**	-.007	**-.007**	**.006**	**.000**	**.007**	-.001	.000	.003
	(.016)	(.007)	(.002)	(.001)	(.000)	(.001)	(.001)	(.001)	(.007)
Cereals	**.147**	**-.022**	**-.006**	**.010**	.000	-.001	-.001	**-.002**	-.006
	(.008)	(.005)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.006)
Potatoes	**.050**	.000	.001	-.000	**-.000**	**-.002**	**-.002**	-.001	**-.014**
	(.007)	(.004)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.005)
Vegetables	**.021**	.006	**.004**	**-.005**	-.000	**-.002**	.001	**.004**	**-.017**
	(.006)	(.004)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.005)
Fruits	**.020**	-.003	.000	.001	-.000	-.000	**.006**	**.004**	**-.017**
	(.009)	(.006)	(.001)	(.001)	(.000)	(.000)	(.001)	(.001)	(.006)
Sugar	**.022**	.001	**-.002**	**.001**	.000	-.000	**.001**	.000	**-.008**
	(.004)	(.002)	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)	(.004)
Coffee	-.005	**.013**	.001	**-.003**	.000	-.001	**-.001**	.000	**-.010**
	(.005)	(.004)	(.001)	(.001)	(.000)	(.001)	(.000)	(.001)	(.004)
Other	**.085**	**-.034**	**.010**	**-.009**	**.000**	**.005**	**.004**	**.003**	.003
	(.014)	(.009)	(.002)	(.002)	(.000)	(.001)	(.001)	(.001)	(.004)

Standard errors in parentheses. Boldened coefficients are significant at the 10% level.
Coefficients for the ρ-parameters are not reported here.

Table 5: Observed and virtual prices for rationed goods at sample means, 1937

Good (kg)	Observed price (RM), average	Virtual price (RM), at sample means	Virtual price (RM), average
Beef	1.92	2.90	3.28
White bread	0.73	1.56	1.22
Cereals	0.68	2.11	1.29
Fruits	0.49	0.85	0.80

Table 6: Appendix 1: Estimated coefficients of the γ-parameters, 1927 sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
(1) Milk	-.010																		
	(.008)																		
(2) Butter	-.004	**-.029**																	
	(.010)	(.010)																	
(3) Cheese	**.010**	**-.020**	**.009**																
	(.002)	(.002)	(.001)																
(4) Eggs	-.003	**-.026**	**.009**	**.041**															
	(.004)	(.004)	(.001)	(.004)															
(5) Lard	-.003	-.001	-.001	.000	**.009**														
	(.002)	(.002)	(.001)	(.001)	(.001)														
(6) Marg.	**.009**	**.015**	**-.004**	-.001	-.002	.004													
	(.004)	(.005)	(.001)	(.002)	(.001)	(.003)													
(7) Beef	**-.014**	**-.013**	**.005**	**-.011**	**.005**	-.002	-.005												
	(.004)	(.004)	(.001)	(.002)	(.001)	(.002)	(.003)												
(8) Pork	**-.019**	-.009	**.005**	**-.007**	**.004**	**.008**	**.013**	**-.012**											
	(.004)	(.005)	(.001)	(.002)	(.002)	(.003)	(.003)	(.005)											
(9) Saus.	**.012**	**.044**	-.002	**-.010**	-.003	-.001	-.000	.005	.013										
	(.006)	(.006)	(.002)	(.004)	(.002)	(.004)	(.004)	(.004)	(.008)										
(10) Fish	.001	**.006**	-.001	-.001	-.001	**-.004**	.002	**-.005**	.001	.000									
	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)	(.001)	(.002)	(.002)	(.001)									
(11) Rye	**.014**	**-.014**	**-.013**	-.002	-.000	**-.017**	**.011**	**.024**	**-.014**	**-.004**	**.017**								
	(.005)	(.005)	(.002)	(.004)	(.002)	(.003)	(.003)	(.004)	(.002)	(.002)	(.006)								
(12) White	.004	**-.014**	-.002	**.017**	**.005**	-.017	.004	.001	-.001	-.002	**.008**	-.006							
	(.004)	(.005)	(.002)	(.003)	(.002)	(.003)	(.003)	(.003)	(.004)	(.002)	(.004)	(.005)							
(13) Cereals	**.009**	**.007**	.001	**.004**	**-.003**	**-.003**	-.002	**-.004**	**-.011**	-.001	**-.016**	.001	**.027**						
	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.002)	(.001)	(.001)	(.001)	(.001)						
(14) Potat.	-.002	**.002**	**.003**	-.001	**-.002**	**.006**	**-.007**	-.000	**.004**	.000	**.007**	**-.007**	**-.007**	**.025**					
	(.002)	(.002)	(.001)	(.001)	(.001)	(.001)	(.001)	(.001)	(.002)	(.001)	(.001)	(.001)	(.001)	(.001)					
(15) Veget.	**-.003**	**.005**	**.002**	**-.006**	**-.001**	**.008**	**-.008**	-.001	.000	**.004**	**-.003**	-.001	**.004**	**-.003**	**.010**				
	(.002)	(.002)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.001)	(.001)				
(16) Fruits	-.001	**.012**	**.002**	**-.004**	**-.003**	**-.001**	**-.010**	**-.002**	.002	**.005**	**-.009**	.001	**.003**	**-.007**	.001	**.026**			
	(.002)	(.002)	(.001)	(.001)	(.000)	(.001)	(.001)	(.001)	(.002)	(.000)	(.001)	(.004)	(.001)	(.001)	(.001)	(.001)			
(17) Sugar	**.003**	**.003**	**.002**	**-.001**	.000	-.001	**-.002**	**.002**	.000	.000	.001	.000	.000	**-.004**	**-.002**	**-.009**	**.002**		
	(.001)	(.001)	(.000)	(.001)	(.000)	(.001)	(.001)	(.001)	(.003)	(.000)	(.001)	(.001)	(.000)	(.000)	(.000)	(.000)	(.000)		
(18) Coffee	**-.002**	**.004**	**.001**	-.001	**-.001**	**-.002**	-.001	.000	-.008	**-.010**	.000	-.001	**-.001**	**-.001**	-.000	**-.005**	**-.001**	**.009**	
	(.001)	(.001)	(.000)	(.000)	(.000)	(.001)	(.001)	(.000)	(.008)	(.003)	(.000)	(.001)	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)	
(19) Other	.004	**.005**	**-.005**	.008	-.002	**-.007**	**.009**	-.003	**-.013**	-.000	**-.010**	**.010**	**-.008**	**-.008**	**-.005**	.000	.000	.001	**.026**
	(.003)	(.004)	(.001)	(.002)	(.001)	(.002)	(.002)	(.002)	(.003)	(.001)	(.003)	(.002)	(.001)	(.001)	(.001)	(.001)	(.001)	(.004)	(.003)

Standard errors in parentheses. Boldened coefficients are significant at the 10% level.

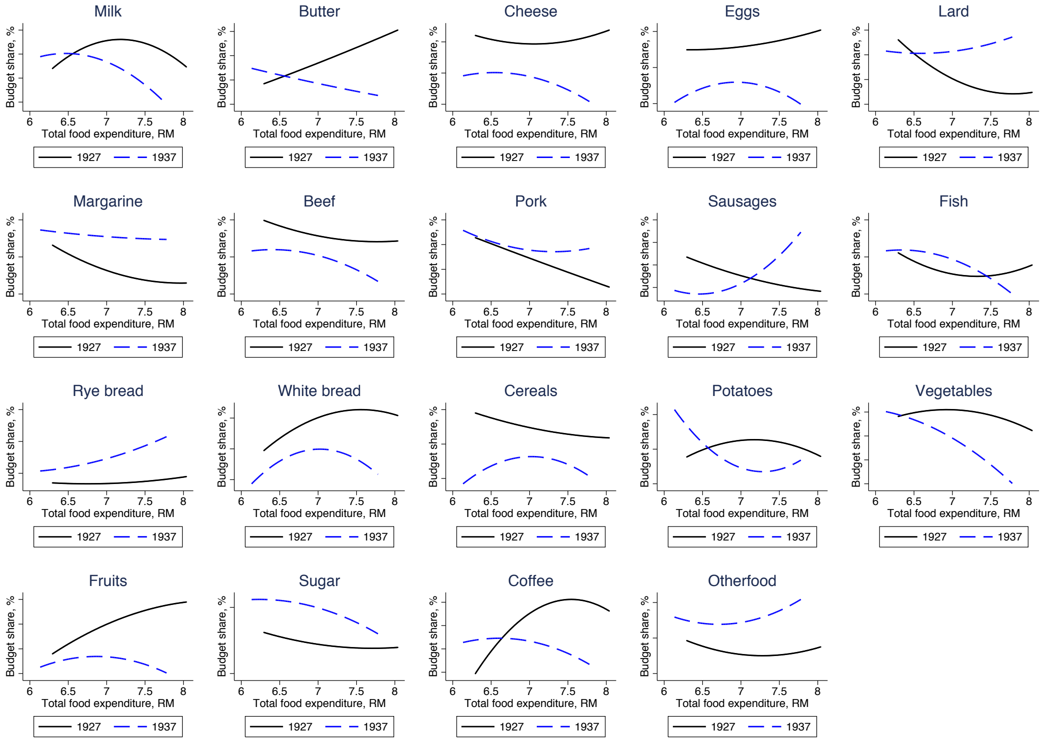

Figure 1: Quadratic Engel curves for food budget shares

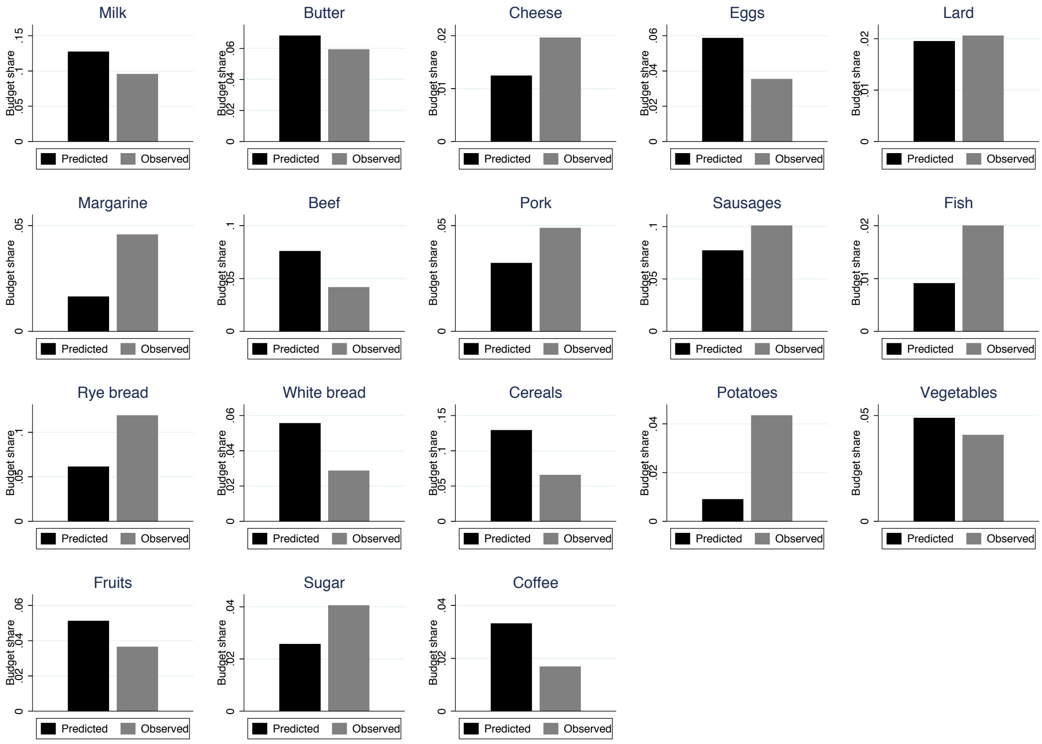

Figure 2: Budget shares for 1937 implied by preferences revealed in 1927

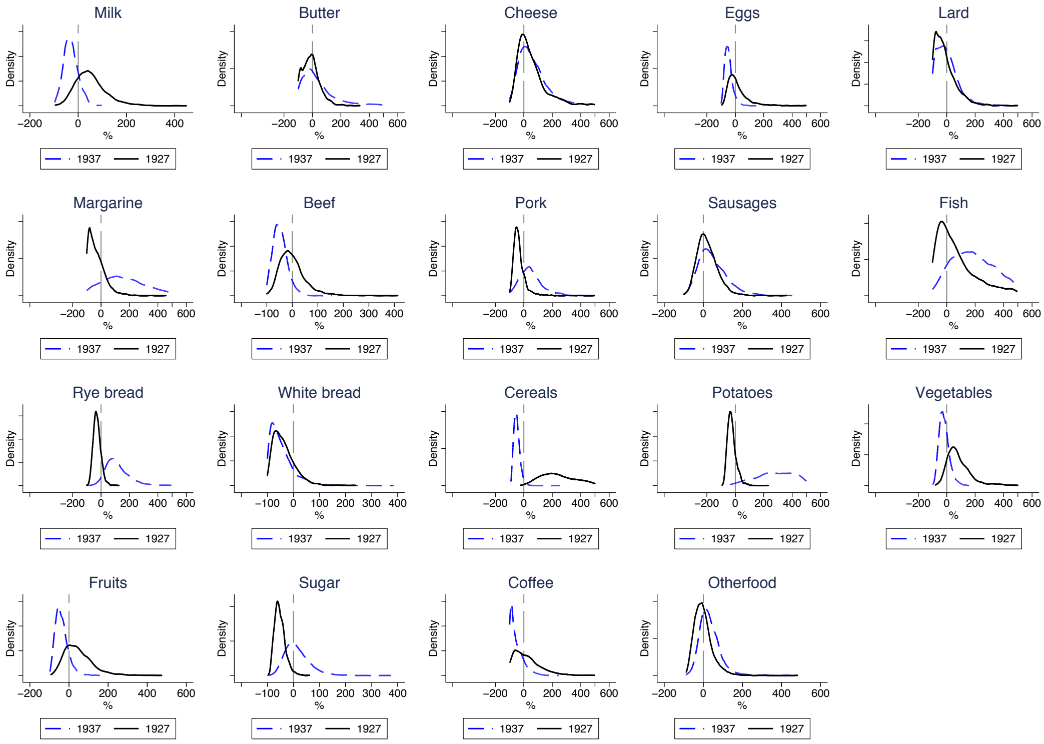

Figure 3: Deviations of observed from predicted budget shares

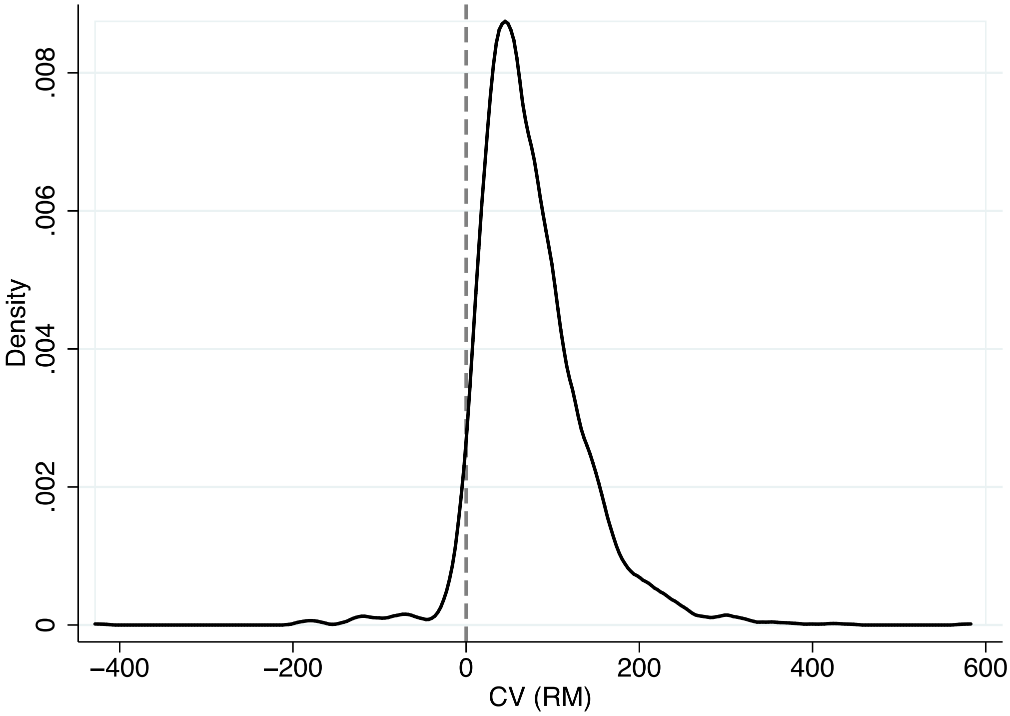

Figure 4: Distribution of CVs estimated for each household in 1937

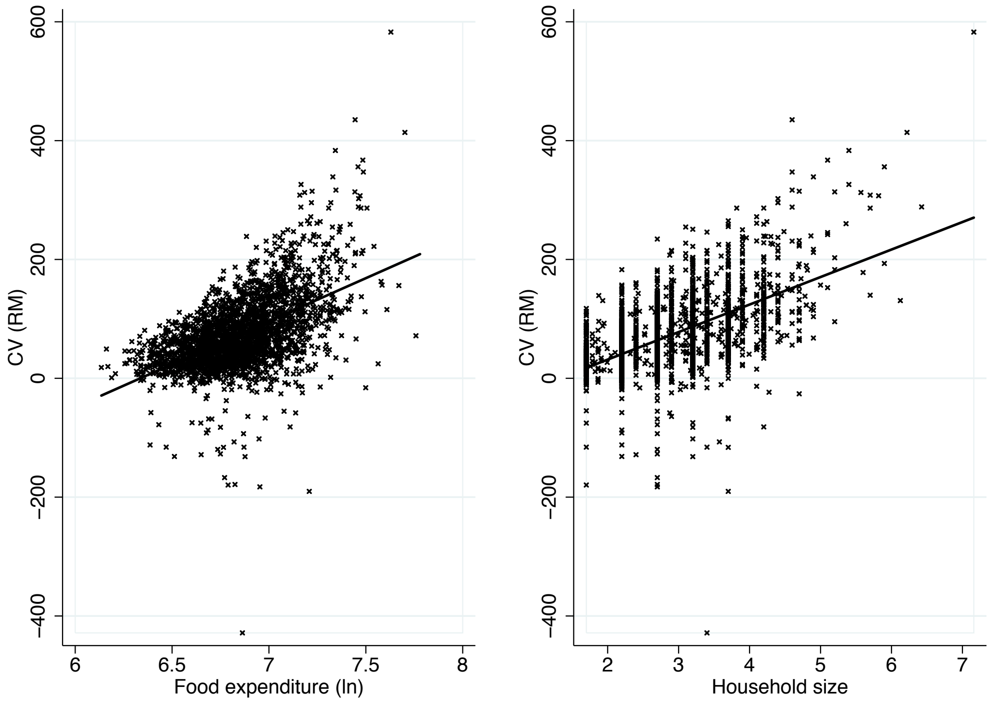

Figure 5: The welfare cost of shortages relative to total food expenditure and household size, 1937