MOVEABLE FEASTS:
A NEW APPROACH TO ENDOGENIZING TASTES

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Abstract

We argue that tastes can be understood as the result of utility maximizing behavior in the distant past. This previous maximizing behavior may have long-lived consequences, which we usually take as tastes or preferences. As the old maximization problem depends critically on old relative prices, we use old relative prices to endogenize tastes, overcoming many of the criticisms of the taste formation literature. We begin by illustrating how current prices and income fail to explain significant amounts of variation in demand. We estimate that as much as one-half of the variation in prices and income are due to taste differences. To test the implications of our theory, we estimate the demand for food using unique household consumption and price data from the nineteenth century. We use contemporaneous prices and prices in the home countries of immigrants measured fifteen years prior to our consumption survey. We establish that the old relative prices are uncorrelated with the contemporaneous relative prices. We find that older relative prices have a large and significant effect on the demand for food. We conclude by noting how our empirical strategy can be used to measure changes in taste in both microeconomic and macroeconomic contexts.

Preliminary and Incomplete, Comments Welcome

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"*In modern treatments of self interest, economists take statements of preferences as 'primitives.' That is, statements such as 'Mary prefers punk rock to country-and-western music' are taken as* meaningful*, as statements that require* no explanation*. The question 'Why does Mary prefer punk to country and western?' – interesting and important as it may be – is* not *treated in ordinary economic science.*"

[Eaton and Eaton, 1988, p. 40. Emphasis in original.]

Early studies of consumer behavior are rife with ethnic stereotypes about consumption. Italians were undernourished because they favored "an excess of fuel in the forms of wheat flour, pork, lard, and second-rate vegetables," and Italian "cooking is indefensibly uneconomical… too much fuel and too little protein" [Streightoff 1911, p. 94]. Another observer noted "the Italians' well known dependence on macaroni and dried beans" [Chapin 1909, p. 124]. Unlike Italians, Slavs were malnourished because they had high marginal propensities to save, and valued a saved dollar over a full stomach [Byington 1910]. The list covers almost every ethnic group--Russians and Austrian Jews consumed more meat than other ethnic groups, Germans and the Irish spent the most on alcohol [Chapin 1909].

Researchers continue to find large consumption differences by race and ethnicity today [Charles, Hurst and Roussanov 2008]. But in a very important way they show the nagging persistence of neoclassical economic thought—all these studies take "tastes" as given and beyond the scope of theoretical analysis. Italians eat macaroni and dried beans because they prefer them, just as Russians prefer meat and Slavs their savings. Despite the significant advances in consumer theory and applied economics since consumer studies laid out the first laws of demand, progress on the primitives of demand theory has been slow.

Tastes must come from somewhere, and we argue that they should not be wholly orthogonal to economic variables. In this paper we attempt to endogenize tastes empirically, and show that existing theoretical approaches justify our empirical approach. We break new ground

by noting that present consumption will be a function of old relative prices as well as current relative prices. To the extent that old relative prices are key to old consumption maximization, they will predict current consumption without assuming that preferences are stable and identical. Our basic idea is intuitive—items that are cheap in the past will be consumed, and these goods will be consumed in the future to the extent that consumer's form an affinity for these goods. This affinity could form in a variety of ways—intrinsic differences in ability to consume (as in lactose intolerance), differences in resource endowments that lead to affinities and/or aversions to certain goods, and endogenous production that depends on certain goods that are relatively inexpensive when first employed. Alternatively, high relative prices for a good may leave it desirable but outside of the budget constraint. If the budget constraint shifts out in the future, high relative prices in the past lead to increased consumption today.

Empirically, we concentrate on food demand since food consumption should be particularly sensitive to current prices and insensitive to older prices. This is most likely to be true for households who have high demand for food. The fact that we use food also makes a traditional story of inter-temporal substitution particularly unlikely, especially over long time periods. Previous work has shown that food demand was particularly high in the past [Logan 2006], and that historical households were at least as hungry as or hungrier than the poorest households in developing countries today by their calorie demand [Logan 2008]. Indeed, Becker [1996] has argued that the usual theoretical strategy of assuming that the main determinants of preferences are biological needs "may not be a bad approach for the very poorest countries, where families spend over half their income on food and another quarter on shelter" [p. 3]. As such, analyzing the empirical implications of our model for food demand in the past acts as a powerful test of our approach to tastes and taste formation.

Identifying the effect of current and former relative prices on demand is central to our empirical strategy. We turn to history to test these propositions, and analyze the effect of current and old relative prices on demand using unique data from the late nineteenth century. Because of the large migratory flows in the late nineteenth and early twentieth centuries and the prevailing wide global differences in food prices and availability, immigrant households in the past are a prime ground to test our propositions. Using immigrants to test consumption responses to changes in prices and income has a long tradition in economics (Staehle 1934). We also provide evidence that food prices in the past largely reflected resource endowments, which is key for our claim that relative prices reflect local resources and production.

We use a late nineteenth century household survey of more than 3,000 immigrant households and retail prices that were collected at the time of the survey, in 1888. Our old relative prices are actual retail prices from the immigrant's home countries measured more than 15 years earlier, on average in 1873, but no later than 1874. Both sets of prices were recorded by the same statistical agency, for the same specific food items and used the same general methodology of using actual retail prices on store shelves. Most importantly, these relative prices are appropriate for testing our model—the old and new relative prices are poorly correlated with one another, no correlation is above 0.1. This allows us to test our model of endogenized tastes by considering the effect of both old and new relative prices on demand.

We find that old relative prices, measured 15 years before and which are uncorrelated with current relative prices, are strong predictors of current food consumption. The demand for food among these hungry immigrants was a function of relative prices that they faced in their country of origin. We further show how our results can be reconciled with both traditional and case-based theory. We conclude by noting how our endogenized measure of tastes can be used

in both micro and macroeconomic contexts. In microeconomics, our strategy has implications for models of consumer demand and estimates of price sensitivity in consumption. We also describe how our strategy may lead to empirical estimates of preferences in macroeconomic models.

I. The Trouble with Forsaking Tastes in Economic Theory

We begin by describing the general critiques of the neoclassical view to preferences, as noted by economists and other social scientists. We stress that our approach is not a critique of the neoclassical view, but rather an attempt to extend the predictive power of the neoclassical approach to the question of where preferences come from, which has been a long standing research agenda. Economists have long recognized this weakness, and many have attempted to reach beyond this gap, but they usually appeal to exogenous differences in environments (not production) that could lead to differences in preferences, use long horizon utility functions that have proved difficult to verify empirically, concentrate on long term trends in consumption, or are chiefly concerned with addiction and the formation of habits, not the primitives of tastes themselves [Pollak 1970, Becker and Stigler 1977, Becker and Murphy 1988, Pollak and Wales 1992, Alesina and Fuchs-Schudein 2007].

Next, we document the failure of prices and income to explain a significant portion of the variation in consumer demand. We estimate a standard demand system and find that prices, income, and household demographics explain roughly 40% of the variation in demand. When we add nationality to the specification, which are usually considered controls for differences in tastes between groups, we find that nationality alone explains approximately 40% of the differences in demand. In short, we explain just as much of the variation in demand with

economic measures as with measures that are proxies for preferences. Third, we conclude this section by showing how food prices in the past are more closely aligned with our view of exogenous differences in resource environments. We show that the biological innovations of the early twentieth century dramatically increased food production. When combined with trade policies, we argue that it would be unwise to use current food prices to reflect exogenous differences in resource environments.

a. Critiques from Outside and Within

Both traditional methods of modeling consumer behavior in economics take preference relations as given. In a traditional preference approach, preferences (tastes) are the primary primitive. Indeed, the imposition of assumptions on the preference relation allows us to move from preferences to rational preferences to utility. In the choice based approach, the imposition of consistency of choices (axioms of revealed preference) implies that the choice set can be rationalized by a preference ordering in most cases (although it need not be unique). Indeed, restrictions on choices are needed for choice rules (behavioral consistency alone) to correspond to a rational preference ordering [Houthakker 1950, Richter 1966].

In essence, theory imposes restrictions on preferences which translate into restrictions on behavior. In most empirical work, we infer preferences from behavior. For example, strong demand for a good implies that consumers prefer it to their other options. While it would appear that empirical and theoretical approaches feed into one another, many of the restrictions placed on preferences and behavior in theory are violated for a number of reasons that lead our estimates of behavior to be questionable. The space between the intention of behavior, which would presumably be motivated by tastes and preferences, and the action taken by an individual can be wide—observing behavior and making inferences based on outcomes is problematic. In

other words, if there are several reasons why our empirical predictions may not hold, then there could also be several reasons (some consistent with theoretical assumptions, other not) why they might.

For economists this poses a number of problems for both the interpretation and meaning of preferences. Other social scientists have noted the shortcomings of an approach that takes preferences as fixed and given, particularly when one attempts to infer intention (preferences or tastes) from actions. Sociologists and anthropologists have long questioned the link between preferences and outcomes in several areas of social behavior. Recently, Johnson-Hanks [2007] articulated such a critique:

> Rational choice and related approaches offer two ways of dealing with the problematic relationship between meanings and rates. They first suggest a method for predicting aggregate behavior from known individual preferences, intentions, or projects... Second… rational choice and related approaches propose a method of inferring preferences, intentions, or projects from aggregate behavior. This mode of inference rests on a semiotic relation in which some set of formal outcomes stands for some set of socially meaningful intentions or practices…complex chains of inference are required in order to grasp it ... Like all symbolic relations, the ones that bind formal models to social facts are valid only within a universe of practices; when the framing social context changes, the standing- for relations change along with it …. Thus, a formal pattern that in one society indexes some intention may in another society index a quite different intention, or even none at all. [Johnson-Hanks 2007, p. 1009]

In many economic contexts, we depend, crucially, on "complex chains of inference" to understand the motives of consumers. Only after we have assumed a rational preference ordering, a utility function, adopted a functional form for the utility function, and estimated the parameters (and perhaps transformed them to correspond to the parameters of the model) do we infer anything about behavior. The problem, then, is inferring information about preferences from such a causal chain. If preferences differ because of culture, genetics, or other social factors then we may mistakenly conflate preferences with these other parameters, which we

believe shape preferences themselves. While Johnson-Hanks argues for a stronger and more explicit relationship between our inferences and behavior, economists have also noted that the traditional approach is lacking in several dimensions, particularly its interpretive power:

> The assumption of independence [that choices today and not directly dependent on choices in the past] is not 'nonsense', for it usefully simplifies many problems that are not crucially affected by dependences over time. But the assumption has discouraged economists from grappling with other issues of considerable significance—including addictions, work habits, preference formation, why children support their elderly parents, preference solutions to the problem of future commitments, and the evolution and stability of institutions. [Becker 1992, pp. 327]

Becker is also critical of the reaction to explain anomalous results as "differences in preferences" when the traditional theory gives few tools to analyze why preferences would change. Indeed, economists commonly speak of results being due to changes in preferences over time, and also give reasons why these preferences change, but such explanations fall outside of the confines of traditional theory. Our ideas about changing preferences still treat them as being given, and if they do change over time it would seem to suggest that they are somewhat sensitive to other factors and could perhaps be endogenized. Becker and Stigler [1977] offered a reformulation to this idea when they argued that tastes could be treated as being stable over time. Indeed, Becker and Stigler [1977] agree with Johnson-Hanks when they claim that economists should look for the "subtle forms that prices and incomes take in explaining differences among men and periods" rather than leave those differences up to primitives beyond economic explanation [Becker and Stigler 1977, p. 76].

b. Evidence from the British Board of Trade

To consider the magnitude of the empirical implications of the traditional approach, we use evidence from the British Board of Trade (BBT), which conducted a study of the consumption of American wage-earning families of various nationalities by income class in February 1909. We use this independent historical data to foreshadow our use of historical data

on immigrants to the United States in the late nineteenth century, allowing us to estimate demand for a similarly situated group. The BBT study was initiated as part of an international inquiry into the living costs of wage-earning families in industrial areas. [1] A key issue in the study was to generate expenditure shares allowing meaningful comparisons. This task was "intricate" because many families in the U.S. industrial areas were recent migrants from diverse, though principally European, origins. The study noted: "National habits and practices as regards choice of food are … very tenacious of life, even when transferred to an entirely new country."[2]

The study collected budget data for 7,616 families classified into seven "nationalities" based on the declaration of the husband. In the terminology of the study, these "nationalities" were: (1) American-British families (included (British) American, Irish, English, Scottish, Welsh, and Canadian) who were subdivided between Northern, Southern US, and Southern US "broken" families; (2) German (including Dutch, Belgian, and Swiss); (3) Scandinavian (including Swedes, Norwegians, and Danes); (4) Southern European (including Italians, Greeks, Spaniards, and Portuguese as well as a "few French and Syrians"); (5) Slavonic and "allied" peoples (Bohemians, Croats, Hungarians, Galicians, Poles, Lithuanians, Russians, Roumanians, and Serbs); (6) Jewish (from all countries but chiefly Russia); (7) Negroes (African Americans), who were subdivided between Northern, Southern US. A breakdown of the sample by nationality is reported in Table 1.[3]

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[1] The cities included New York City, NY; Boston, MA; Brockton, MA; Fall River, MA; Lawrence, MA; Lowell, LA; Providence, RI; Baltimore, MD; Newark, NJ; Paterson, NJ; Philadelphia, PA; Cincinnati, OH; Cleveland, OH; Detroit, MI; Louisville, KY; Muncie, IN; Pittsburgh, PA; Chicago, IL; Duluth, MN; Milwaukee, WI; Minneapolis-St. Paul, MN; St. Louis, MO; Atlanta, GA; Augusta, GA; Birmingham, AL; Memphis, TN; New Orleans, LA; and Savannah, GA. Each of these locations was on or to the east of the Mississippi river.

[2] Great Britain, Board of Trade, *Cost of living in American towns. Report of an enquiry by the Board of Trade into working class rents, housing and retail prices, together with the rates of wages in certain occupations in the principal industrial towns of the United States of America.* With an introductory memorandum and a comparison of conditions in the United States and the United Kingdom, London, Pub. by H.M. Stationery off., printed by Darling and son, limited, 191, p. xxxix.

[3] For further studies in a similar vein see Staehle (1934).

The BBT study reported expenditures for nationality-by-income categories, not for individual families. For each nationality, the tables are subdivided into 8 weekly families' income categories. Associated information includes size of household and total expenditures. The tables show expenditures and quantity purchased of about 40 food items. By dividing expenditures by quantities, one can derive implicit prices (which represent an average across the cities in the sample). By combining the averages by income we can estimate a traditional demand system for food groups. We use this data because its aggregated nature allows us to look at the role of income versus nationality in explaining differences in group consumption patterns while minimizing idiosyncratic differences in consumption.

We regress the expenditure share for these foods items on prices, income and family size. This is shown in Panel A of Table 2. Prices and income, however, explain very little of the variation in demand for these food items. When we add nationality to the regressions in Panel B of Table 2, the fit of the regressions improves dramatically, the R-squares go from below 0.3 on average to above 0.8 on average with the addition of nationality. In the traditional interpretation of demand, the addition of nationality (or race or gender) are controls that proxy for preferences. But from this simple example we see that we prices and income do not explain the vast majority of variation in demand between ethnic groups. On average, ethnicity explains more than half of the variation in food demand.[4] Even more, nationality as a proxy for tastes does not lend itself to economic interpretation—nationality tells us very little about why there would be substantial differences in tastes between groups, especially after controlling for prices and income. This example from the BBT shows that prices and income can fail to capture much of the variation in demand.

[4] When we regress the budget share on nationality alone the R-squares range from 0.34 to 0.92, with an average R-squared of 0.61.

c. The Case for Using Historical Food Prices

A key insight in our approach is that old relative prices are related to old environments in which taste form. We also implicitly argue that tastes are relatively slow to change. As such, it is important that the prices we look at reflect those resource environments and not other aspects that would not be related to preferences. We show this most clearly by looking at agricultural productivity, which until the last 100 years or so reflected local conditions and climate. With the advent of biological innovations such as drought resistant hybrid corn, production came to reflect the ability to biologically change food production patterns, not the environment itself [Olmstead and Rhode 2008].

We show this most clearly in Figure 1, which displays the agricultural productivity of wheat, corn, cotton, tobacco, and cattle livestock from the middle of the nineteenth century to the middle of the twentieth century. As the figures show, there was a dramatic increase in productivity in many agricultural crops in the 1930s, which Olmstead and Rhode describe in detail as a series of interrelated biological innovations that dramatically led to increases in productivity of agricultural goods. This innovation can be seen most clearly in terms of wheat and corn, in panels A and B of Figure 1. For each of these staple food items, productivity grew dramatically in the 1930s. Wheat productivity doubled, and corn productivity increased nearly three-fold. In panel B we also see that the diffusion of hybrid corn was very fast, partially due to the drought conditions in the 1930s. The innovations led to crops that were resistant to drought, pesticides, rusts, rot and other environmental hazards.

Panels C and D of Figure 1 show that cotton and tobacco also displayed similar trends, where production increased dramatically during the 1930s. These innovations also had impacts on the number of animals supported on farms. The increase in agricultural productivity had

positive spillovers to the animal sector, which was also undergoing biological innovations. In addition, reductions in transportation costs and trade barriers in recent years have led to a globalization in food markets.

These changes allowed the United to become a large exporter of food at a time when it was receiving immigrants and its population was growing. This is in contrast to the situation of Great Britain during the Industrial Revolution and Second Agricultural Revolution a century earlier, where increased productivity in agriculture could not keep pace with population growth. Also, Olmstead and Rhode note that these innovations were duplicated by those on the technological frontier—knowledge of innovations spread quickly to other developed nations. Combining this with restrictive trade policies and government subsidization of agricultural production, and it is difficult to argue that food prices today primarily reflect resource as opposed to the combination of environment, technological sophistication in agriculture, trade, and subsidies. Since a key idea is that these tastes form as a function of the resource environment, we view historical prices as a better indicator.

II. Simple Models of Endogenized Tastes

Knowing more about preferences could potentially add more restrictions to the usual theoretical apparatus, and increase its interpretive power. If people have a taste for A and not for B, and that preference relation is related to some economic variables of interest, then we have moved beyond the traditional assumption that taste are given because we conjecture that they can be (partially) explained by some economic variables and therefore endogenized. The open question is to what degree these economic variables matter. In what follows we take the advice of Becker and Stigler and look for ways that economic variables explain differences in behavior

between groups, which we term endogenizing tastes. While the Becker-Stigler approach uses stable and identical tastes and focuses on differences in consumption capital, we allow for intrinsic differences between individuals but focus on the prices on the old maximization problem, which gives our approach significant empirical content. Our goal is to see if tastes can be modeled (at least somewhat) as the outcome of previous optimizing behavior. If so, then we have found one route to empirically endogenizing tastes.

Our basic claim is that preferences come from somewhere, and we take as a starting point the idea the preferences can be understood as, partially, the product of rational choices. In short, we endogenize tastes by considering the fact that tastes themselves are a function of economic variables. Differences in prices in the past may lead otherwise similar groups to choose different consumption bundles in the present. This idea is similar to the Becker-Stigler notion of consumption capital, but is more flexible. These differences could be due to endowments, differences in technology use and adaptation, or other primitives such as culture or genetics. The key is that these "tastes" develop and are maintained over a long period of time. For example, low levels of mobility and technological change throughout human history will cause people to face the same maximization problem over and over again.

Our approach differs from the behavioral approaches offered by many contemporary theorists, who seek to explain departures from the rational choice model with the tools of psychology.[5] We instead use a variant of the rational choice model to endogenize tastes, taking old relative prices as part of the primitives that determine the preference relation itself. Our goal also differs from that of Becker and Stigler [1977] in that we do not assume a long lived, stable preference relation, precisely because these have been difficult to estimate empirically. Crucial to their model was the idea that consumers purchase commodities and only indirectly consume

[5] For reviews of this expanding literature see DellaVigna (2007) and Rabin (1998).

market goods, so the price and income changes reflected both market and non-market changes. Similarly, our model does not look at changes in consumption over time, only the demand at present as a function of the old maximization problem – the former relative prices. Our model is a traditional "snap-shot" of a consumer's choice with the added idea that their tastes are themselves functions of economic variables faced in the distant past.

As an illustrative example, consider the preference for spicy food. Parts of the world that are not well endowed with spices will have high relative prices for spices. In the traditional theory, we would expect low consumption of spices. This would imply that recipes, to the extent that they form from the food environment, will use few spices. People come to form an affinity with foods that lack spice, and people from those places will not have strong preferences for spice. Even when moving to a new environment, where the relative price of spices may be very different, these consumers will not have high demand for spice because they formed no affinity for it. Also, to partake in spicy foods households would have to change existing recipes, learn new cooking techniques, and generally alter the production process. This does not mean that they would never eat spicy foods, but less than others who lived in different environments where the relative price of spices was low in the past. This argument implies, however, that the current demand for spice is a function of spice prices in both the past and the present. Note also that preferences for spice could change as a function of the relative price change when moving to the new environment. Our estimates of demand responsiveness should include the older relative prices as a conditioning factor on demand. In this way, the old relative prices endogenize tastes because we they have a separate, testable effect on demand.

a. Induced Innovation

We can begin to think about taste formation within the context of an induced innovation model of a household production process. Suppose a household combines consumption items, q_i, in a CES production process to produce utility as follows:

$$U=(\sum_i(A_iq_i)^\rho)^{1/\rho}$$

where A_i is the augmentation coefficient of q_i and ρ is related to the elasticity of substitution $\sigma= 1/(1- \rho)$ and lies in the range $-\infty<\rho<1$.

The augmentation coefficient, A_i, captures how effectively input q_i generates utility.

$$\partial U/\partial A_i = A_i^{\rho-1} q_i^{\rho} (\sum_i(A_iq_i)^\rho)^{(1- \rho)/\rho}= q_i ((A_iq_i)^\rho/\sum_i(A_iq_i)^\rho)^{(\rho-1)/\rho} >0.$$

We can think of the A_i as recipes associated with the different inputs. Just as increasing an input lead to diminishing marginal utility, so does increasing the augmentation coefficients:

$$\partial^2 U/\partial^2 A_i = ((1- \rho)A_i^{\rho-2}q_i^{\rho} (\sum_i(A_iq_i)^\rho)^{(1- \rho)/\rho})(-1+ (A_i q_i)^{\rho}/\sum_i(A_iq_i)^\rho)\leq 0$$

because each of the terms in the first parenthesis is positive and $1\geq(A_iq_i)^{\rho}/\sum_i(A_iq_i)^\rho$.

In an induced innovation model, the household can trade-off investing (learning) to increase the augmentation coefficients of different inputs. There exists different ways of formulating the trade-offs. A simple approach is to specify a positive cost of increasing A_i.

For the moment, let us focus on the static household optimization problem holding A_i constant. At prices P_i, the optimum ratio of q_j to q_k is:

$$q_j/q_k=(P_j/P_k)^{1/(\rho-1)} (A_j/A_k)^{\rho/(1- \rho)}.$$

Given $\rho<1$, $\partial(q_j/q_k)/\partial(P_j/P_k)<0$. The relative input quantities move inversely with the relative prices. But how the input ratio varies with the augmentation coefficients is more complicated. That is, $\partial(q_j/q_k)/\partial A_j/A_k)$ depends on the sign of ρ (and thus on the elasticity of substitution, σ).

If $0<\rho<1$, $\partial(q_j/q_k)/\partial(A_j/A_k)>0$.

That is, when ρ is positive, the elasticity of substitution is high; an increase in the augmentation coefficient of one input leads the household to *use* more of that input.

If $\rho<0$, $\partial(q_j/q_k)/\partial(A_j/A_k)<0$.

That is, when ρ is negative, the elasticity of substitution is low; an increase in the augmentation coefficient of one input leads the household to *save* that input. It is also informative to examine the relationships for budget shares. Let $S_j=P_jq_j/\sum_i(A_iq_i)$. Then, at prices P_i, the optimum combination yields $S_j/S_k=P_jq_j/ P_kq_k=(P_j/P_k)^{\rho/(\rho-1)} (A_j/A_k)^{\rho/(1-\rho)}$.

The relationship between budget shares and the augmentation ratio depends on the sign of ρ. But so does the relationship between budget shares and the price ratio. And they move in exactly opposite ways.

If $0<\rho<1$, $\partial(S_j/S_k)/\partial(P_j/P_k)<0$ and $\partial(S_j/S_k)/\partial(A_j/A_k)>0$.

If $\rho<0$, $\partial(S_j/S_k)/\partial(P_j/P_k)>0$ and $\partial(S_j/S_k)/\partial(A_j/A_k)<0$.

For what follows, it will be useful to consider the dual formulation. If M is total consumption expenditure, the indirect utility function at prices, P_i, is:

$V=M(\sum_i(A_i/P_i)^{\rho/(1-\rho)})^{(1-\rho)/\rho}$.

$\partial V/\partial A_i =M P_i^{-\rho/(1-\rho)}A_i^{(2\rho-1)/(1-\rho)}(\sum_i(A_i/P_i)^{\rho/(1-\rho)})^{(1-2\rho)/\rho}>0$.

$$\partial^2 V/\partial^2 A_i = M(2\rho-1)(1-\rho)^{-1} P_i^{-\rho/(1-\rho)} A_i^{(3\rho-2)/(1-\rho)} (\sum_i (A_i/P_i)^{\rho/(1-\rho)})^{(1-2\rho)/\rho}$$

$$*(1-(A_i/P_i)^{\rho/(1-\rho)}/\sum_i (A_i/P_i)^{\rho/(1-\rho)})$$

Because $1>(A_i/P_i)^{\rho/(1-\rho)}/\sum_i (A_i/P_i)^{\rho/(1-\rho)}$,

$\partial^2 V/\partial^2 A_i<0$ if $\rho<1/2$ and $\partial^2 V/\partial^2 A_i>0$ if $1/2<\rho<1$.

If $1/2<\rho<1$ or equivalently $\sigma<2$, the SOC condition will not be satisfied. Investing in augmenting the input with the highest (A_i/P_i) will yield the highest payoff.

Now consider an inter-temporal utility maximization problem where it is possible to devote some of the income, Y, to increase A_i. A motivating example would be to buy additional recipes to utilize the specific input q_i better. At time t, the current stock will be $A_{t,i}$ and it can be increased $\Delta A_{t,i}$ via an investment process involving instantaneous costs:

$C(\sum_i \Delta A_{t,i})$ where $C'>0$ and $C''>0$.

Denote $c=C'(0)>0$. The assumption that the investment costs are positive and convex captures the idea that changes to the augmentation coefficients will occur only gradually.

The household can choose to divide its income, Y_t, between current consumption, M_t, and investing $C(\sum_i \Delta A_{t,i})$ to increase the augmentation coefficients permanently.

That is, its budget constraint is:

$$Y_t=M_t - C(\sum_i \Delta A_{t,i}).$$

For fixed prices, P_{0i}, the household's maximization problem is

$$L=\sum_{t=0} (1/(1+r))^t M_t (\sum_i (A_{t,i}/P_{0i})^{\rho/(1-\rho)})^{(1-\rho)/\rho}$$

subject to:

$Y_t=M_t -C(\sum_i \Delta A_{t,i})$ and $A_{t+1,i}= A_{t,i} + \Delta A_{t,i}$.

In this formulation, if $\rho <1/2$, the optimal investment in ΔA_i will involve setting:

$\partial V/\partial A_{t,j} =\partial V/\partial A_{t,k}$.

This implies along any steady state path for $\rho <1/2$:

$A_{t,j}/A_{t,k} = (P_{0,j}/ P_{0,k})^{\rho/(2\rho -1)}=(P_{0,j}/ P_{0,k})^{(\sigma -1)/(\sigma -2)}$.

The exponent $(\sigma-1)/(\sigma-2)$ is positive if $\sigma<1$, implying a higher relative price leads to a higher augmentation ratio. It becomes negative, implying a higher relative price leads to a lower augmentation ratio, if $1<\sigma<2$. (For $\sigma>2$, the SOC of the problem is not satisfied.) The change in behavior at $\sigma=1$ (i.e. the Cobb-Douglas case where it is not possible to distinguish between augmentation coefficients) is expected and well-understood. The singularity at $\sigma=2$ is more surprising. But note that other studies allowing investment in augmentation coefficients (such as Acemoglo 2004) also find $\sigma =2$ is a critical value for unusual behavior. The intuition for the difficulties is that if $\sigma>2$, the relative quantities change more than proportionally to the relative rates of augmentation. The present model admits a range of behavior in the effect of relative prices on relative augmentation coefficients.

Let us now apply our approach to the case of an immigrant moving from sending economy with prices, $P_{S,i}$ to a receiving economy with prices, $P_{R,i}$. If $P_{S,i}$ reflect long-standing relative scarcities in the sending countries, it is reasonable that the consumer/immigrant will have invested over the long-run in augmentation coefficients to adjust to relative prices, $P_{S,j}/ P_{S,k}$. Thus, the consumer/immigrant initial demand function in the receiving country will be:

$q_j/q_k=(P_{R,j}/P_{R,k})^{-\sigma}(P_{S,j}/P_{S,k})^{(\sigma-1)(\sigma-1)/(\sigma-2)}$.

The relative shares will be:

$S_j/S_k=(P_{R,j}/P_{R,k})^{1-\sigma}(P_{S,j}/P_{S,k})^{(\sigma-1)(\sigma-1)/(\sigma-2)}$.

That is, both relative demand and shares will be functions of both the current, receiving country prices and the old, sending country prices. So long as $\sigma<2$, the dynamic process is well-behaved and the model predicts *higher relative prices in the old country will lead to lower consumption in the receiving country.*

b. Learning by Doing

As an alternative to modeling the consumer as being able to consciously choosing to increase in Ai, one may consider a process of learning by doing. In this habit-formation variant, Ai may costlessly increase with qi. As in the form:[6]

$\Delta A_{t,i.} = L(q_{t,i})$ where $L'>0$.

On the steady-state path with prices, P_0,

$A_{t,j}/A_{t,k} = q_{t,j}/q_{t,k}$, which implies $A_{t,j}/A_{t,k} = (P_{0,j}/P_{0,k})^{1/(2\rho-1)} = (P_{0,j}/P_{0,k})^{\sigma/(\sigma-2)}$.

This differs from the induced innovation case because the exponent is $\sigma/(\sigma-2)$ rather than $(\sigma-1)/(\sigma-2)$ as before. As in the induced innovation case, for $\sigma>2$, the learning-by-doing model generates unusual behavior. We will suppress its consideration for the moment.

[6] In a rational addiction version of this model, the consumer is aware to this relationship and takes the future effects into account in making their current choices.

If a consumer/immigrant with preferences defined above moves from a sending county with prices, P_S, to a receiving country with prices, P_R , the initial demand function will be:

$$q_j/q_k=(P_{R,j}/P_{R,k})^{-\sigma}(P_{S,j}/P_{S,k})^{\sigma(\sigma-1)/(\sigma-2)}.$$

The relative shares will be:

$$S_j/S_k=(P_{R,j}/P_{R,k})^{1-\sigma}(P_{S,j}/P_{S,k})^{\sigma(\sigma-1)/(\sigma-2)}.$$

The learning-by-doing model admits the possibility of either a positive or negative relationship between past relative prices and current consumption.

c. Case-Based Decisions

A third way of predicting the behavior of consumer response to old relative prices is to think of the situation in terms of a case-based decision. Case-based theory takes at its heart that the consumer looks for past analogues to the current decision. Actions that served well in past cases will be repeated. Case-based theory also takes aim at the treatment of the consumers problem. For example, case-based theory beings by noting that consumer purchase products, not bundles of goods, this can pose problems for the neoclassical approach because while preference ordering over bundles may be well-behaved, it need not be over products. Similarly, case-based theory can analyze, separately, decisions of different types. For example, the decision to buy a home is different from the decision to buy a sandwich for lunch in part because the latter decision is made more often and with little uncertainty. We following the seminal work of Gilboa and Schmeidler (1995, 1996, 1997), and give the intuition of a consumer's problem both with and without uncertainty.[7]

[7] There are several extensions that we do not discuss here. See Gilboa and Schmeidler (2001)

In the uncertain case, we can think of a consumer who arrives in a new market and faces the challenge of, say, preparing a meal. In terms of case-based decisions, the consumer thinks back to the actions of the past (when they faced this decision before) as a way to solve the present problem. Past cases therefore serve as a source of information—it is highly likely that is the same action is chosen the same result will be had. For a meal planning option, the implication is obvious—purchasing the same food items as purchased before will lead to the same utility of food. In this way, the immigrant's past behavior (and past prices when the action was previously chosen) will have a direct effect on their current choice.

The case without uncertainty is more interesting. Consider the case where a consumer makes the same small decision again and again (to be specific we can think of this decision as what to eat for dinner). Even with certainty, it can be difficult to think of the consumer having perfect knowledge of all possible choices and combinations of choices that they could make. To deal with this issue Gilboa and Schmeidler adopt the notion of a "cumulative utility," which allows people to differ in the degree to which they are bored with past choices. Even with this, the frequency of the items purchase is important, past cases not only serve as information, but they affect preferences. The implication is the same, items that are frequently consumed yield greater utility than others, and therefore past decisions will impact current consumption.[8] In both cases, consumers make decisions that are functions of past decisions, and they also learn from previous behavior.

A difficulty with the case-based approach is that it can be difficult to predict the sign of the effect of old prices. In many respects, the case-based and learning-by-doing approaches

[8] Gilboa and Schmeidler (1997) also consider that prices enter directly into the utility function. While we do not describe that situation here, the empirical implications are the same.

allow for the previous prices to have positive or negative effects, and it is easy to imagine situations where a consumer who was previously denied a particular action due to the budget constraint may actually partake in that action in the present. For this reason, we concentrate on the key empirical implication from all of these models: that old relative prices should be strongly related to current demand. As such, we test for the effect of old relative prices on current consumption. As we noted earlier, since we concentrate on food it is highly unlikely that a traditional inter-temporal substitution model would generate significant effects for the demand for food, especially among consumers with high demand for food. Logan [2006] notes that households in the late nineteenth century had demand elasticities for food above 0.8. Below, we describe our unique data that allows us to test to the central proposition that we have about taste—that demand is a function not only of current prices, but of old prices as well.

III. Data

a. Consumption Data

We use the "Cost of Living of Industrial Workers in the United States and Europe 1888-1890" survey published by the United States Department of Labor, and available from the Inter-University Consortium for Political and Social Research at the University of Michigan- Ann Arbor [study no. 7711]. The study was conducted under the direction of Carroll D. Wright, then the U.S. Commissioner of Labor. As the director of the Massachusetts Bureau of Statistics of Labor Wright conducted one of the first large scale household surveys in the United States in 1874. Of the 1874 study, Stigler [1954] noted that it "was, for its time a model of full reporting and careful analysis" (p. 100). When Wright was appointed the U.S. Commissioner of Labor in 1885 one of his goals was to conduct the first national expenditure survey. The 1888CEX retains

many of the features of the 1874 study. The findings of the 1888CEX, as well as studies of the costs of production, would inform the Congressional debate on the McKinley Tariff. This historical coincidence leaves us with a household survey that is broad in its scope, large in size, rich in detail, and allows us to test the predictions of our model.

The 1888CEX data set contains a sample of 8,544 families working in iron, steel, coal, textile, and glass industries in both Western Europe and the United States. Nearly 80% of the sample, 6,809 households, is from the United States. Due to sample universe constraints, the geographic distribution of households in the United States is not even, which we should expect given the focus on industrial households in the late nineteenth century. For the American households surveyed, enumerators from the Department of Labor were sent to firms in the nine selected industries and collected information on the costs of production and the standard of living of the workers in the firms surveyed for costs of production. As Haines [1979] notes, how the household sample was chosen remains unclear. The report notes that it attempted to obtain information on a representative number of employees at each firm surveyed, although it is not known in what ways the employees were deemed to be representative. These selected households were surveyed about their annual expenditures on various items, and the annual income of the household head was obtained from the employer. Despite these potentially limiting features, Haines [1979] notes that, in comparison to the age distributions of the household head for each industry in the Census of 1890 that "the broad similarities were more striking than the differences, and the case for the representativeness of the survey is strengthened [by the comparison]" (pp. 294-295).

Modell [1978] posits that Wright used a quota system to obtain his representative sample in the 1888CEX, meaning that Wright wanted the household survey to reflect the size of the

various firms where the workers were employed. This would mean that families headed by a worker employed in a large industrial firm would be more prevalent in the 1888CEX than families whose heads were employed by small industrial firms.[9] Modell further notes that the usual banes of household surveys, age-heaping and dollar-heaping are not prevalent in the 188CEX. In inspecting the budgets he finds that budgets are "careful documents, filled out with sufficient care to give one confidence in the outline they reveal" (p.208).

The data set contains detailed annual expenditure information for both food and non-food items and annual income information for all members of the household (father, mother, and children). Annual rent from boarders is also included in the data. In addition, the data also contains demographic information on the household's age and sex composition, as well as a detailed enumeration of the husband's occupation. The data also contains the nationality of the head of the household, and more than 3,000 of the households have a nativity that is not from the United States. These households form the sample that we use in the following empirical work.

Table 3 shows the summary statistics for our household survey, both for the entire American sample and for the households who have a nativity other than the United States. There are relatively few differences between the native and immigrant subsamples. For example, immigrant household heads (and their wives) are four years older than native household heads, immigrants have .5 more persons in their household, and immigrant children provide more income to the household. Overall, however, there are more similarities between natives and immigrants on most measures.

b. Price Data

[9] This would mean that Wright's definition of representative would mean that the sample was weighted to reflect the firms that were surveyed.

We use the report by the United States Senate Committee on Finance, entitled "Retail Prices and Wages: A Report by Mr. Aldrich" [1892] to estimate the contemporaneous relative prices of food items. The Aldrich report lists the retail quantity prices of various foods for a sample of stores in each state from June, 1889 to September, 1891.[10] For each state we take the annual average price of each food item from June, 1889 to May, 1890. For the former relative prices, we use the report "Labor in Europe and America: A Special Report on the Rates of Wages, The Cost of Subsistence, and the Condition of the Working Classes in Great Britain, France, Belgium, Germany, and Other Countries of Europe," which was published in 1875 by Edward Young, Chief of the US Bureau of Statistics. The report list the retail prices of subsistence items from England, Ireland, Scotland, Wales, France, Belgium, Bohemia, Austria, Switzerland, Italy, Sweden, Denmark, Russia, and Canada. The general methodology for obtaining these relative prices is the same as those in the Aldrich Report—actual retail prices in stores in particular cities, which are listed in the report. Table 4 lists the food items for which we have retail prices in the past and present, listing the specific name of the food item and the years the prices were collected in each country. Table 4 also shows the geographic distribution of the immigrant sample of the 1888CEX. Other than food items, only one other item that was consistently listed in both the Aldrich and Young reports was the price of a pair of "men's heavy boots." As such, all relative prices that we calculate are relative to the price of "men's heavy boots" in that specific location and year.

IV. Empirical Results

a. The Correlation of Old and New Relative Prices

[10] Indeed more states are included in this report, and price estimates for all states surveyed in the Aldrich Report are available from the author. In the rare instance in which a good's price was not available for a specific state, we took the simple average of the two nearest states' prices.

Key for our empirical test is the lack of a correlation of the old and current relative prices. If current and former relative prices are highly correlated with one another it can be difficult to identify the effect of old relative prices on demand. Table 5 shows the correlations of the old and new relative prices. As the Table shows, the current and former relative prices are not well correlated with one another. In only one instance is the correlation greater than 0.10, and no correlation is above 0.15. Of the thirteen food items for which we have relative price comparisons, eight have a negative correlation between the old and new relative prices, although these correlations are not strong either. When we regress the old relative prices on the new to see how strongly the new relative prices predict the old.[11] As with the correlations, the relationship is slight. The overall fit from the models is quite poor, and the point estimates show that increases in the new relative prices are met just as often with decreases in the relative prices as with increases. Beyond this, the size of the coefficients suggest a weak economic relationship between the old and new relative prices.

One fact is that prices are derived from geography. A key drawback here is that we cannot use geographic controls in our estimates of demand because they are perfectly correlated with the prices. This holds, however, for any demand estimates that use prices since market prices apply to locations. In some ways, the derivation from geography works to our advantage—prices should be functions of the local environment, and goods that must be imported should be relatively more expensive and therefore have higher relative prices than others. In this way geography captures some of the taste formation because it is a proxy for the environment in which these taste are formed. Indeed, our model does not distinguish between the two for that reason.

[11] See the appendix.

b. Empirical Strategy

We use a standard Almost Ideal Demand System (AIDS) to estimate the effects of old and new relative prices on demand. In the AIDS the Engel curve is a function of income, prices, and other controls such that

$$w = \alpha + \beta \ln\left(\frac{x_i}{n_i}\right) + \delta P_{OLD_i} + \lambda P_{NEW_i} + \Theta Z_i + \varepsilon_i \quad (1)$$

where w is the budget share, P are the relative prices, and Z is a vector of controls for household size, composition, and occupation. Since the prices themselves are not well correlated with one another this regression will capture the effect of old relative prices on current demand.

c. Empirical Estimates of Endogenized Tastes

We take two approaches to estimating the effect of old and new relative prices on current food demand. First, we regress the food item's budget share on the old and new relative prices, and second we regress the food item's share of the food budget on the old and new relative prices for robustness. Table 6 shows the results of the first approach. As the results show, the effect of old relative prices on current demand is statistically significant for nine of the thirteen foods for which we can estimate demand. In the majority of instances where the old relative price has a statistically significant impact on current consumption, the effect is negative, which concurs with the induced innovation model outlined in the previous section. For sugar, a one standard deviation increase in the old relative price would decrease the sugarshare by 0.28 standard deviations, a sizable effect. For pork, the effect is 0.27 standard deviations, also a sizeable effect. We obtain smaller, but similar effects for coffee (0.084 standard deviations), milk (0.16), and potatoes (0.029).

The old relative prices of eggs and beef, however, are strongly correlated with increased current consumption, which is consistent with a variant of the learning-by-doing model or the case-based model. For beef, a one standard deviation increase in the old relative price would increase the beefshare by 0.26 standard deviations, once again a sizable effect. For eggs, the effect is 0.09 standard deviations. Old relative prices for rice and tea have marginally significant positive effects on current consumption. Interestingly, the effect of the old relative prices on intermediate foods, such as butter and lard, is not significant. Overall, Table 6 shows that the old relative prices of food have a large and significant effect on current food consumption.

New relative prices should have their own effect on consumption, and Table 6 confirms that the current relative prices are related to consumption. For example, a one standard deviation in the current coffee price would decrease the coffeeshare by 0.37 standard deviations, a large effect. Lard prices have the same effect (0.11 standard deviations). In some instances, the old and new relative prices move in opposite directions. For example, while an increase in the old relative price decreases sugar consumption, a one standard deviation increase in the current sugar price increase the sugarshare by 0.16 standard deviations. Current relative prices also have positive effects for eggs (0.26 standard deviations), potatoes (0.082 standard deviations), butter (0.10 standard deviations), beef (0.47 standard deviations), and tea (0.44 standard deviations).

Table 7 shows the results from our second approach, where we regress the food items share of the food budget on the same set of covariates. This, we believe, gets closer to the key insight of our model since foods share of the budget could be crowded out by other needs such as shelter and heating. This specification allows us to look at food directly. The table shows that the result holds when looking at the share of the food budget devoted to these items. For sugar, a one standard deviation increase in the old relative price would decrease sugars' share of the food

budget by 0.41 standard deviations, once again a sizable effect. For pork, the effect is 0.24 standard deviations of pork's share of the food budget, also a sizeable effect. We obtain smaller, but similar effects for coffee (0.11 standard deviations), milk (0.18), and potatoes (0.032). For beef, a one standard deviation increase in the old relative price would increase beef's share of the food budget by 0.39 standard deviations. For eggs, the effect is 0.09 standard deviations. In general, the effects are larger when looking at the food budget itself, which we would expect.

As with Table 6, Table 7 shows that current prices also affect current consumption. Coffee, pork, and lard prices each have negative effects. A one standard deviation in the coffee price reduces coffee's share of the foodbudget by 0.38 standard deviations—pork and lard have similar effects (0.28 and 0.14 standard deviations, respectively). Egg, sugar, potato, beef and tea prices each have positive effects. A one standard deviation in the egg price increases egg's share of the foodbudget by 0.16 standard deviations—sugar, potatoes, beef, and tea have similar effects (0.11, 0.06, 0.26, and 0.42 standard deviations, respectively).

In general, the effects of the old relative prices are close to the effects of the current relative prices, which suggest that a significant amount of demand can be explained by old relative prices. We stress here that the old relative prices are not correlated with the current relative prices, and also note that the correlations differ across food items. As such, we exploit more variation here in the underlying relative prices than a dichotomous measure of country of origin could. In this way, we not only have a way of endogenizing tastes, but we can compare it to a benchmark case where we ignore the old relative prices and simply use country of origin. When we compared the r-squares of the regressions in Table 6 and 7 with regressions in which we drop the old relative prices and add nationality indicators, the tests reveal that our regressions

with old relative prices have just as much explanatory power. We take this as confirmatory evidence that our method empirically endogenizes tastes in an economically tractable way.

V. Conclusion

Rather than thinking of tastes as primitives, we modeled tastes as a function of a path dependent production process where old prices cause households to adapt to certain types of production that are slow to change. This slow adaptation implies that tastes are a function of older relative prices as well as current relative prices. In contrast to traditional models of intertemporal substitution, we applied our model to consumption goods for which old relative prices, particularly those in the distant past, should have little effect on demand. We empirically tested our model with unique consumption data from the nineteenth century, which allowed us to produce old and new relative prices that were uncorrelated with one another and measured fifteen years apart. Consistent with our predictions, we found that old relative prices for food were strong predictors of current food consumption for a number of food groups.

We believe that our approach to tastes could be incorporated into both micro and macroeconomic contexts. For microeconomists, our results suggest that estimates of price sensitivity would need to be augmented by the fact that old relative prices exert an independent effect on demand. Rather than asking how consumption would change for a given change in price, we may want to ask how consumption would change for a given change in old and current prices. For macroeconomists, our results suggest that in addition to price stickiness, there may also be a degree of household demand stickiness that should find its way into micro-founded macroeconomics models. While much more research is needed on how to fully incorporate and

interpret the results we find, we provide strong evidence that a portion of preferences can be endogenized in the traditional neoclassical framework.

References

Acemoglu, Daron (2004). "Labor-Augmenting and Skill-Biased Technical Change." Mimeo, MIT.

Alesina, Alberto and Nicola Fuchs-Schundeln (2007) "Good bye Lenin (or not?): The Effect of Communism on People's Preferences." *American Economic Review* 97 (3): 1507-1528.

Becker, Gary S. (1991). *A Treatise on the Family*. Enlarged Edition. London: Harvard University Press.

Becker, Gary S. (1992). "Habits, Addictions, and Traditions." *Kylos* 45 (3): 327-346.

Becker, Gary S. (1996). *Accounting for Tastes.* London: Harvard University Press.

Becker, Gary S. and George J. Stigler (1977) ""De Gustibus Non Est Disputandum". *American Economic Review* 67 (1): 76-90.

Becker, Gary S. and Kevin Murphy (1988). "A Theory of Rational Addiction." *Journal of Political Economy* 96: 675-700.

Charles, Kerwin, Erik Hurst and Nikolai Roussanov (2008). "Conspicious Consumption and Race." Forthcoming, *Quarterly Journal of Economics*.

DellaVigna, Stefano (2007). "Psychology and Economics: Evidence from the Field." Working Paper, University of California, Berkeley.

Eaton, B. Curtis and Diane F. Eaton (1988). *Microeconomics.* New York: W.H. Freeman and Company.

Gilboa, Itzhak and David Schmeidler (1995). "Case-Based Decision Theory." *Quarterly Journal of Economics* 110: 605-639.

Gilboa, Itzhak and David Schmeidler (1996). "Case-Based Optimization." *Games and Economic Behavior* 15: 1-26.

Gilboa, Itzhak and David Schmeidler (1997). "Cumulative Utility Consumer Theory." *International Economic Review* 38: 737-761.

Gilboa, Itzhak and David Schmeidler (2001). *A Theory of Case-Based Decisions.* London: Cambridge University Press.

Haines, Michael R. (1979). "Industrial Work and the Family Life Cycle." *Research in Economic History* 4: 289-356.

Houthakker, Hendrick S. (1950). "Revealed Preference and the Utility Function." *Economica* 17: 159-174.

Johnson-Hanks, Jennifer (2007). "Natural Intentions: Fertility Decline in the African Demographic and Health Surveys." *American Journal of Sociology* 112 (4): 1008-1043.

Lees, Lynn H. (1979). "Getting and Spending: The family Budgets of English Industrial Workers in 1890." in John Merriman, ed. *Consciousness and Class Experience in Nineteenth Century Europe*. New York: Holmes and Meier: 169-186.

Logan, Trevon D. (2006). "Nutrition and Well-Being in the Late Nineteenth Century." *Journal of Economic History* 66 (2): 313-341.

Logan, Trevon D. (2008). "The Transformation of Hunger: The Demand for Calories Past and Present." Forthcoming, *Journal of Economic History*.

Modell, John. (1978). "Patterns of Consumption, Acculturation, and Family Income Strategies in Late Nineteenth-Century America." in Tamara K. Hareven and Maris A. Vinovskis, eds. *Family and Population in Nineteenth Century America.* Princeton, NJ: Princeton University Press: 206-240.

Oddy, D. J. (1990). "Food, Drink, and Nutrition." In F. M. L. Thompson, ed. *The Cambridge Social History of Britain 1750-1950, Vol. 2 People and their Environment.* New York: Cambridge University Press: 251-278.

Olmstead, Alan L. and Paul W. Rhode (2008). *Creating Abundance: Biological Innovation and American Agricultural Development.* London: Cambridge University Press.

Pollak, Robert A. (1970). "Habit Formation and Dynamic Demand Functions." *Journal of Political Economy* 70: 745-763.

Pollak, Robert A. and Terence J. Wales (1992). *Demand System Specification and Estimation*. New York: Oxford University Press.

Rabin, Matthew S. (1998). "Psychology and Economics" *Journal of Economic Literature* 36 (1): 11-46.

Richter, Marcel K. (1966). "Revealed Preference Theory." *Econometrica* 34: 635-645.

Solow, Robert M. (1985). "Economic History and Economics." *American Economic Review* 75 (2): 328-331.

Staehle, Hans (1934). "The Reaction of Consumers to Changes in Prices and Income: A Quantitative Study in Immigrants Behavior." *Econometrica* 2(1): 59-72.

Stigler, George J. (1954). "The Early History of Empirical Studies of Consumer Behavior." *Journal of Political Economy* 42: 95-113.

U.S. Department of Labor. "Cost of Living of Industrial Workers in the United States and Europe 1888-1890." Study No. 7711. Ann Arbor, MI: ICPSR.

U.S. Senate Committee on Finance. (1892). "Retail Prices and Wages: A Report by Mr. Aldrich." U.S. Senate Report No. 986. Washington, DC: Government Printing Office.

Young, Edward (1875). *Labor in Europe and America: A Special Report.* Philadelphia: S.A. George & Company.

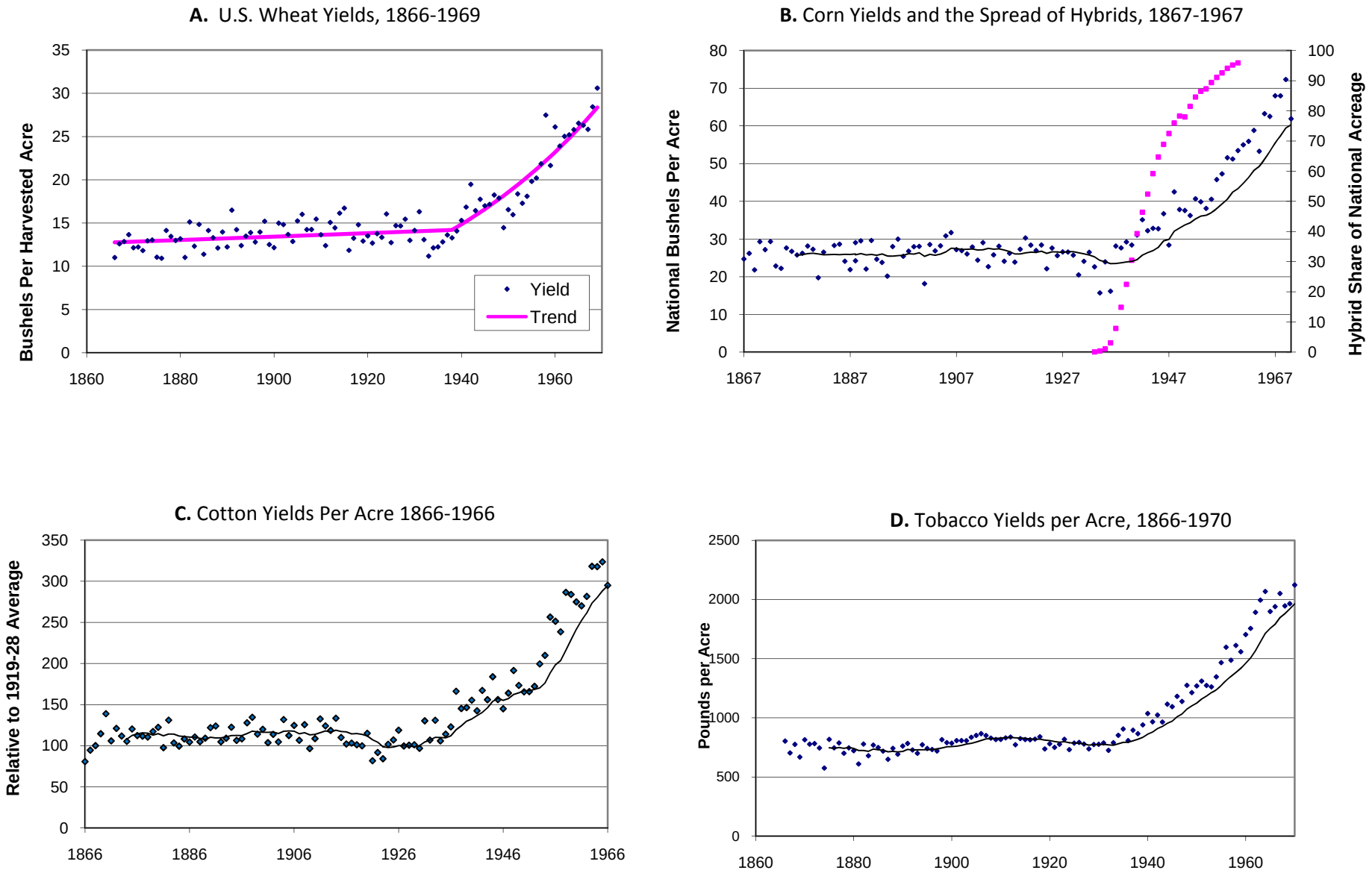

Figure 1 Agricultural Productivity, 1865-1975

Notes: All figures come from Olmstead and Rhode (2008). Sources: Figure A: Carter, et al., *Historical Statistics of the United States* Tables Da717-729. Figure B: Carter, et al., *Historical Statistics of the United States* Tables Da693-694; USDA, *Agricultural Statistics 1962*, 41. Figure C: Carter, et al., *Historical Statistics of the United States* Table Da755-756. Figure D: U.S. National Agricultural Statistics Service. *Quick Stats*. Figure E: Holstein-Friesian Association of America, *Herd Book*, 1530-1533.

Table 1
Classification of Budgets by Nationalities in British Board of Trade Study

	Number of Budgets	Percentage of Total
American-British		
Northern	3215	42.2
Southern	580	7.6
Southern-Broken Families	46	0.6
German	906	11.9
Scandinavian	335	4.4
Southern European	599	7.9
Slavonic	598	7.9
Jewish	758	10.0
American Negro		
Northern	303	4.0
Southern	276	3.6
Total	7616	100.0

Source: British Board of Trade Study, "Cost of Living in the United States" p. 40

Table 2
Traditional Demand Estimates from British Board of Trade Study

Panel A	*Dependent Variable: Food Item's Share of Total Expenditure*						
	Coffee	Milk	Eggs	Cheese	Sugar	Potatoes	Rice
Imputed Price	-0.01598	-0.0187	0.0103	0.0286***	0.0290*	-0.0500***	-0.0391***
	[0.0099]	[0.0186]	[0.0084]	[0.0036]	[0.0158]	[0.0072]	[0.0051]
Log Income	0.00357	-0.0199*	-0.0022	-0.0056	-0.0006	-0.0029	-0.0035
	[0.0039]	[0.0105]	[0.0060]	[0.0036]	[0.0035]	[0.0049]	[0.0029]
Observations	70	70	70	70	70	70	70
R-squared	0.36	0.10	0.19	0.51	0.35	0.45	0.62
	Butter	Pork	Beef	Lard	Tea	Fish	
Imputed Price	-0.0076	-0.0728***	0.0747*	0.0203	0.0122*	-0.0093	
	[0.0412]	[0.0187]	[0.0432]	[0.0130]	[0.0064]	[0.0114]	
Log Income	0.0334***	0.0159*	-0.0003	-0.0003	0.0028	-0.0065	
	[0.0107]	[0.0090]	[0.0169]	[0.0071]	[0.0029]	[0.0066]	
Observations	70	63	70	70	70	69	
R-squared	0.15	0.31	0.05	0.29	0.11	0.05	

Panel B	*Dependent Variable: Food Item's Share of Total Expenditure*						
	Coffee	Milk	Eggs	Cheese	Sugar	Potatoes	Rice
Imputed Price	-0.0078	0.030***	-0.0039	0.011	0.0307***	0.004	-0.0091
	[0.0078]	[0.0076]	[0.0055]	[0.0077]	[0.0103]	[0.0078]	[0.0066]
Log Income	-0.0055*	-0.0018	-0.0012	0.0005	-0.0116***	-0.0077**	-0.0088***
	[0.0029]	[0.0054]	[0.0048]	[0.0034]	[0.0029]	[0.0035]	[0.0027]
Nationality	X	X	X	X	X	X	X
Observations	70	70	70	70	70	70	70
R-squared	0.85	0.90	0.78	0.81	0.81	0.88	0.86
	Butter	Pork	Beef	Lard	Tea	Fish	
Imputed Price	0.0133	0.0234	0.0193	0.0048	0.0247***	0.0041	
	[0.0191]	[0.0183]	[0.0449]	[0.0093]	[0.0055]	[0.0060]	
Log Income	-0.0013	-0.0017	-0.0149	-0.0080**	-0.0002	0.0003	
	[0.0057]	[0.0073]	[0.0159]	[0.0034]	[0.0024]	[0.0035]	
Nationality	X	X	X	X	X	X	
Observations	70	63	70	70	70	69	
R-squared	0.89	0.83	0.61	0.93	0.73	0.86	

Robust standard errors in brackets *** p<0.01, ** p<0.05, * p<0.1. Note: Regressions include log of household size. Imputed prices are constructed by dividing expenditure by quantity. Ethnicities are American-British, German, Jewish, Negro, Scandinavian, Slavonic, and Southern European. American-British and Negro are recorded seperately for Northern/Souther location in US.

Table 3
Summary Statistics for 1888CEX

Entire Sample (N=6,809)

Variable	*Mean*	*Std. Dev*	*Min*	*Max*
Per Capita Expenditure	134.9	68.6	27.14	750
Per Capita Income	151.1	91.3	15.71	1500
Husband Age	38.1	12.3	0.0	84.0
Wife Age	35.4	11.4	0.0	88.0
Household Size	5.2	2.3	1.0	22.0
Husband Income	517.6	307.6	0	4500
Wife Income	12.8	54.3	0	800
Children's Income	104.7	214.8	0	1795
Total Income	683.3	335.0	84	4500
Food Expenditure	269.4	114.8	38.42	1300

Sample Native to United States (N=3,735)

Variable	*Mean*	*Std. Dev*	*Min*	*Max*
Per Capita Expenditure	134.8	71.8	27.14	748
Per Capita Income	150.9	93.8	15.71	1500
Husband Age	36.2	12.0	0	78
Wife Age	33.8	10.6	0	78
Household Size	4.9	2.1	1	22
Husband Income	521.2	313.2	0	4500
Wife Income	12.2	53.2	0	800
Children's Income	71.9	160.7	0	1406
Total Income	646.6	318.3	84	4500
Food Expenditure	243.9	95.8	38.42	1300

Sample Not Native to United States (N=3,074)

Variable	*Mean*	*Std. Dev*	*Min*	*Max*
Per Capita Expenditure	135.1	64.6	30.95	750
Per Capita Income	151.2	88.1	29.42	1052
Husband Age	40.3	12.2	0	84
Wife Age	37.3	12.0	0	88
Household Size	5.5	2.4	2	22
Husband Income	513.2	300.7	0	3000
Wife Income	13.5	55.7	0	606
Children's Income	144.6	260.6	0	1795
Total Income	727.8	349.2	120	3192
Food Expenditure	300.3	127.6	81	1040

Note: Income and expenditure are annual amounts.
Authors' Calculations based on 1888CEX.

Table 4
Home Nations in the 1888CEX and Historical Price Data

Country	Number of Households	Years Prices Collected
French Canada	239	1873
Canada	107	1872, 1873, 1874
England	650	1872, 1874
Ireland	947	1873, 1874
Scotland	147	1872, 1873, 1874
Wales	144	1872
France	80	1874
Belgium	12	1872, 1874
Switzerland	11	1872, 1873
Germany	667	1872, 1873, 1874
Austria	12	1872
Bohemia	14	1873
Italy	13	1873
Russia	1	1872
Sweden	23	1873
Denmark	7	1872
Total Sample	3074	

Note: Number of Households is number of households with the given country of origin in the 1888CEX. Years prices collected list the year of any price report for the country in Young (1875).

Table 5
Food Items Descriptions and Old/New Relative Price Correlations

Food Item	Specific Matched Description	Old/New Price Correlation
Coffee	Coffee, Rio Roasted, Per Lb.	-0.039
Milk	Milk, Per Quart	0.084
Eggs	Eggs, Per Dozen	0.104
Cheese	Cheese, Per Lb.	0.066
Sugar	Sugar, Good Brown, Per Lb.	-0.085
Potato	Potatoes, Per Bushel	0.047
Rice	Rice, Per Lb.	-0.049
Butter	Butter, Per Lb.	-0.290
Pork	Pork, Fresh, Per Lb.	-0.072
Beef	Beef, Fresh Roasting Pieces, Per Lb.	-0.012
Lard	Lard, Per Lb.	-0.077
Tea	Tea, Oolong Black, Per Lb.	0.021
Fish	Dry Codfish, Per Lb.	-0.053

Note: Food item descriptions match between the Aldrich Report (1892) and Young Report (1875). All food relative prices are recorded as relative to the price of men's heavy boots in each respective country/state and year.

Table 6
Demand for Food as a Function of Old and New Relative Prices

Dependent Variable: Food Item's Share of Total Expenditure

	Coffee	Milk	Eggs	Cheese	Sugar	Potatoes	Rice
Old Relative Price	-0.0395***	-0.179***	0.0501***	-0.0109	-0.305***	-0.0092***	0.0138*
	[0.015]	[0.051]	[0.015]	[0.013]	[0.031]	[0.0022]	[0.0082]
New Relative Price	-0.0402***	-0.0137	0.0279***	0.00075	0.0844***	0.0052***	-0.0031
	[0.0049]	[0.030]	[0.0087]	[0.0065]	[0.023]	[0.0011]	[0.0054]
Log of Per Cap. Exp.	-0.0104***	-0.0062***	-0.0028***	-0.0008**	-0.0150***	-0.0075***	-0.001***
	[0.00083]	[0.0011]	[0.00095]	[0.00032]	[0.00095]	[0.00072]	[0.00015]
Observations	3074	3074	3074	3074	3074	3074	3074
R-squared	0.17	0.19	0.21	0.04	0.21	0.17	0.03

	Butter	Pork	Beef	Lard	Tea	Fish
Old Relative Price	-0.00481	-0.188***	0.184***	-0.00595	0.0124*	-0.022
	[0.027]	[0.062]	[0.068]	[0.014]	[0.0072]	[0.022]
New Relative Price	0.0268*	-0.041	0.151***	-0.0210*	0.0207***	0.0101
	[0.014]	[0.035]	[0.041]	[0.012]	[0.0040]	[0.0081]
Log of Per Cap. Exp.	-0.0152***	-0.0111***	0.00288	-0.0035***	-0.0051***	-0.0003
	[0.0018]	[0.0016]	[0.0026]	[0.00052]	[0.00077]	[0.00055]
Observations	3074	3074	3074	3074	3074	3074
R-squared	0.09	0.08	0.21	0.08	0.14	0.11

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Old relative prices are calculated from the Young Report (1875) and are relative to the price of a pair of men's heavy boots as given in the same country in the Young Report. New relative prices are calculated from the Aldrich report and are relative to the price of men's heavy boots as given by the state the household resides in in the 1888CEX. Old relative prices are calculated for households based on the nativity of the household head as recorded in the 1888CEX.
Regressions include log of household size, share of household in five year age sex categories, and the industry that employs the household head.

Table 7
Demand for Food as a Function of Old and New Relative Prices

Dependent Variable: Food Item's Share of Total Food Expenditure

	Coffee	Milk	Eggs	Cheese	Sugar	Potatoes	Rice
Old Relative Price	-0.0806**	-0.287***	0.0711**	-0.017	-0.671***	-0.0150***	0.0256
	[0.033]	[0.11]	[0.032]	[0.028]	[0.063]	[0.0046]	[0.017]
New Relative Price	-0.0944***	-0.11	0.0360*	0.00528	0.132***	0.0087***	-0.00529
	[0.011]	[0.067]	[0.019]	[0.014]	[0.051]	[0.0026]	[0.011]
Log of Per Cap. Exp.	-0.0138***	0.00118	0.00262	0.0002	-0.0147***	-0.0079***	-0.0009***
	[0.0019]	[0.0023]	[0.0021]	[0.00072]	[0.0021]	[0.0015]	[0.00031]
Observations	3074	3074	3074	3074	3074	3074	3074
R-squared	0.16	0.18	0.18	0.04	0.12	0.1	0.03

	Butter	Pork	Beef	Lard	Tea	Fish
Old Relative Price	0.0276	-0.248**	0.423***	-0.0131	0.018	-0.0237
	[0.056]	[0.11]	[0.14]	[0.029]	[0.014]	[0.047]
New Relative Price	0.03	-0.174**	0.184**	-0.0570**	0.0429***	-0.000343
	[0.029]	[0.080]	[0.092]	[0.026]	[0.0086]	[0.018]
Log of Per Cap. Exp.	-0.0039	-0.0166***	0.0271***	-0.00199*	-0.00412**	0.00351***
	[0.0037]	[0.0034]	[0.0058]	[0.0011]	[0.0016]	[0.0012]
Observations	3074	3074	3074	3074	3074	3074
R-squared	0.05	0.07	0.22	0.06	0.13	0.12

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Old relative prices are calculated from the Young Report (1875) and are relative to the price of a pair of men's heavy boots as given in the same country in the Young Report. New relative prices are calculated from the Aldrich report and are relative to the price of men's heavy boots as given by the state the household resides in in the 1888CEX. Old relative prices are calculated for households based on the nativity of the household head as recorded in the 1888CEX.
Regressions include log of household size, share of household in five year age sex categories, and the industry that employs the household head.

Appendix Table 1
Nationality Coefficients from BBT Demand Regressions

Commodity		British-American South	British-American South-Broken	African-American North	African-American South	German	Jewish	Scandavian	Slavonic	Southern European	Constant
Rice											
	Coeff.	0.74	0.99	0.29	1.06	0.21	0.37	0.08	0.50	0.33	0.27
	St. Err	0.13	0.13	0.10	0.13	0.09	0.11	0.09	0.10	0.12	0.59
Potatoes											
	Coeff.	-0.55	-0.59	-0.42	-0.91	-0.05	-0.39	-0.22	-0.02	-0.65	1.49
	St. Err	0.09	0.11	0.08	0.11	0.07	0.08	0.08	0.08	0.09	0.38
Beef											
	Coeff.	-0.13	-0.24	-0.49	-0.26	-0.05	0.29	-0.16	-0.24	-0.46	1.03
	St. Err	0.10	0.12	0.12	0.13	0.10	0.11	0.10	0.14	0.12	0.96
Pork (fresh and salt)											
	Coeff.	0.16	0.41	-0.03	0.36	0.20	NA	0.08	0.38	-0.78	0.38
	St. Err	0.14	0.17	0.16	0.16	0.14		0.15	0.16	0.17	1.84
Bacon, Ham, & Brawn											
	Coeff.	0.50	0.50	0.55	0.39	-0.29	NA	-0.36	-0.22	-0.97	-0.32
	St. Err	0.14	0.19	0.14	0.17	0.12		0.12	0.14	0.14	1.27
Veal											
	Coeff.	-1.12	-0.41	-0.53	-1.29	0.47	0.35	0.03	0.32	0.44	1.22
	St. Err	0.22	0.31	0.26	0.24	0.21	0.25	0.23	0.25	0.27	1.92
Sausage											
	Coeff.	0.26	-0.49	0.52	0.63	0.41	-0.27	0.00	1.04	0.08	-0.64
	St. Err	0.17	0.22	0.20	0.19	0.17	0.23	0.18	0.19	0.25	1.29
Fish											
	Coeff.	-0.05	0.20	0.73	0.53	-0.31	0.71	0.08	-0.01	0.37	0.25
	St. Err	0.10	0.13	0.11	0.10	0.09	0.11	0.10	0.11	0.12	0.65
Lard											
	Coeff.	0.67	0.65	0.42	0.63	0.01	-1.51	-0.27	0.11	0.13	-0.24
	St. Err	0.09	0.12	0.09	0.09	0.08	0.14	0.08	0.09	0.10	0.74
Butter											
	Coeff.	-0.23	-0.08	-0.41	-0.54	-0.18	-0.20	0.17	-0.72	-1.05	0.10
	St. Err	0.10	0.13	0.12	0.11	0.10	0.12	0.11	0.11	0.12	1.55

Appendix Table 1 (Continued)
Nationality Coefficients from BBT Demand Regressions

Commodity		British-American South	British-American South-Broken	African-American North	African-American South	German	Jewish	Scandavian	Slavonic	Southern European	Constant
Cheese											
	Coeff.	0.31	0.57	-0.47	0.27	0.28	0.49	0.28	0.20	0.82	-1.56
	St. Err	0.12	0.14	0.13	0.12	0.11	0.20	0.12	0.16	0.22	1.03
Milk											
	Coeff.	-0.67	-0.77	-0.78	-1.05	0.09	0.48	0.43	0.23	0.21	0.77
	St. Err	0.11	0.13	0.12	0.11	0.10	0.12	0.11	0.12	0.13	0.66
Eggs											
	Coeff.	-0.39	-0.24	-0.58	-0.63	-0.11	0.12	-0.01	-0.15	-0.19	1.23
	St. Err	0.07	0.09	0.08	0.08	0.07	0.08	0.08	0.08	0.09	0.38
Tea											
	Coeff.	-0.80	-0.78	-0.30	-0.59	-0.70	-0.48	-1.16	-0.57	-1.20	-3.72
	St. Err	0.15	0.21	0.17	0.16	0.14	0.16	0.15	0.18	0.18	1.57
Coffee											
	Coeff.	0.14	0.41	-0.41	-0.10	0.28	-0.17	0.31	0.12	-0.08	1.76
	St. Err	0.06	0.07	0.07	0.06	0.06	0.07	0.07	0.08	0.07	0.69
Sugar											
	Coeff.	0.03	0.11	-0.06	0.03	-0.25	-0.12	0.10	-0.18	-0.38	0.66
	St. Err	0.05	0.06	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.35

Source: BBT data. Omitted category is British-American North
NA= no quanitity reported.

Appendix Table 2
Relative Price Regressions

Dependent Variable: Old Relative Price

	Coffee	Milk	Eggs	Cheese	Sugar	Potatoes	Rice
New Relative Price	-0.0111**	0.0501***	0.0475***	0.0278***	-0.0651***	0.0230***	-0.0216***
	[0.0052]	[0.011]	[0.0082]	[0.0075]	[0.014]	[0.0087]	[0.0079]
Observations	3074	3074	3074	3074	3074	3074	3074
R-squared	0	0.01	0.01	0	0.01	0	0

	Butter	Pork	Beef	Lard	Tea	Fish
New Relative Price	-0.015	-0.0391***	-0.00647	-0.0613***	0.0112	-0.0209***
	[0.0093]	[0.0097]	[0.0097]	[0.014]	[0.0098]	[0.0071]
Observations	3074	3074	3074	3074	3074	3074
R-squared	0	0.01	0	0.01	0	0

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Note: Old relative prices are calculated from the Young Report (1875) and are relative to the price of a pair of men's heavy boots as given in the same country in the Young Report. New relative prices are calculated from the Aldrich report and are relative to the price of men's heavy boots as given by the state the household resides in in the 1888CEX. Old relative prices are calculated for households based on the nativity of the household head as recorded in the 1888CEX.