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Social Savings

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Introduction

The Cliometrics revolution that began in the 1960s is usually thought of as the application of formal economic modelling and econometrics to questions which had long interested economic historians, and which had previously been approached using primarily literary and archival techniques familiar to conventional historians. Although there is a considerable degree of truth in this understanding, it is incomplete, because the Cliometric revolution also involved the development of new concepts, including "social savings".

This review of social savings will consist of 5 substantive sections. In section 1 we will define social savings and compare it with other methods of assessing technological change, namely consumer surplus, total factor productivity and growth accounting. This will provide a theoretical underpinning and will be useful as a stand-alone section for those who are interested in the concept, but who have little interest in the particular ways in which it has been used by other economic historians. Section 2 will look in some detail at the early work of Robert Fogel, whose work on railroads represents the pioneering application of the concept of social savings to technological change in economic history. This section will not aim to adjudicate on the various criticisms made of his specific estimates, but rather to use the debates to explore the issues that are critical in actually constructing an estimate of social savings for an historical event. Section 3 will list and contrast the various other railway social savings estimates that have been compiled. Again, the aim is not to say whether railways were of more use on one country than in another, but rather to show the strengths and weaknesses of the social savings methodology, both in general and in the particular ways in which economic historians have actually applied them. Section 4 will go on to outline some applications of the social savings methodology to non-railway issues, and to explore other areas to which the approach could be used, perhaps profitably. Some very basic new social savings estimates will be presented, and these will again be used to explore the strengths and weaknesses of the concept. Section 5 will conclude, by summarising what we have learned, and setting out some ways in which social savings estimates could be improved in future, and setting out some areas to which social savings estimates could be applied by other researchers, whether economic historians interested in the past, or economists interested in present day issues.

I: The definition of social savings, and a comparison with other measures

The concept of social savings is defined as how much extra society would have to pay to do what it did after an innovation, without it. Algebraically, therefore, we can write that:

$$\text{Social savings} = (c_{t-1} - c_t).Q_t \qquad \text{(i)}$$

Where c represents marginal cost and Q total quantity, and where t means post-innovation and t-1 pre-innovation.

Assuming that the market is perfectly competitive, we can take prices as the measure of cost. In this situation, we can write that:

$$\text{Social savings} = (P_{t-1} - P_t).Q_t \qquad \text{(ii)}$$

Where P represents price, and all other notation remains the same. Since data on costs as opposed to prices are usually very hard to come by, economic historians use this definition as a matter of routine, and as such *de facto* assume that markets are competitive, and thus that price is equal to cost.

Social savings are usually expressed as a percentage of national income, and can be thought of as equivalent to national income. Thus, if a million people get something for $8 instead of $10 as a result of an innovation, the social saving of that innovation is calculated as $2 million, which can be taken to mean that society is $2 million better off. Sometimes the benefits of an innovation are not monetised – for example time savings caused by faster transport. These time savings clearly have a value, but only those time savings that occur during hours for which people are paid form part of national income. Time savings for people who are commuting to work, or engaged in leisure journeys are not captured in GDP but are clearly welfare enhancing. The value of this sort of time saving is captured as part of a social savings estimate. In this case a social saving estimate of a particular magnitude is still equivalent to a rise in national income of that magnitude, but does not imply that measured national income has risen by that magnitude. If railways save leisure travellers time that they value at $1bn, then they would be willing to pay $1bn for that time saving, and the railway has increased welfare by an amount equal to a rise in national income of $1bn, whether or not passengers have to pay the $1bn or whether it takes the form of greater consumer surplus, not captured by either the railway company, or the national income statisticians.

A comparison of social saving and other measures in economics

The social savings methodology is a way to calculate the value of technological change, but it is self-evidently not the only one. It is therefore useful to investigate how social savings compares with these other measures. We shall look at three alternative measures: consumer surplus, total factor productivity, and growth accounting, in turn.

The relationship to consumer surplus

The standard measure of welfare, taught to generations of economists, is consumer surplus. Under competitive conditions, the area between the demand curve and the price represents the extent to which firms have transformed resources into items whose value to consumers outweighs their cost to society (where cost in turn is determined by competing uses for those resources). This remains the best definition of the welfare value of a new technology and therefore we shall look detail at this comparison.

Let us imagine that a technological change leads to a fall in the price of a product produced under perfectly competitive conditions. The rise in consumer surplus will be the previous quantity sold, multiplied by the fall in price, plus the area above the price and under the demand curve between the old and new quantities. The exact size of this area will depend on the shape of the demand curve. This can be written algebraically as:

$$\Delta \text{ Consumer surplus} = (P_{t-1} - P_t).Q_{t-1} + \alpha(P_{t-1} - P_t).(Q_t - Q_{t-1}) \qquad \text{(iii)}$$

The notation follows that of equation (ii), while α representing a parameter determined by the shape of the demand curve.

Since we are interested in the relationship between the consumer surplus and social saving measures under different circumstances, it is helpful to express the change in consumer surplus as a proportion of the social saving estimate. When we do this, and setting $Q_t = 1$ without loss of generality we find that:

$$\Delta \text{ CS / SS} = \alpha + (1-\alpha).Q_{t-1} \quad \text{(iv)}$$

Let us investigate three categories of value of α: α > 1, α = 1, and α <1.

α will take a value in excess of 1 only in the case of a Giffen good, characterised by an upwards sloping demand curve. By inspection of equation (iii) we can see that if α > 1, then Δ CS / SS > 1, that is to say, in the case of a Giffen good the social savings estimate of the value of technological change will understate the value as assessed by the consumer surplus method. The intuition is that the technological change that lowers the price of the product will also lower its consumption, since the income effect will outweigh the substitution effect. Since $Q_t < Q_{t-1}$, the social savings measure is multiplying the fall in cost by "too small" a quantity. Giffen goods are, however, uncommon, and the possibility that the social savings estimate will be smaller than a consumer surplus estimate of the value of technological change is best thought of as a technical curiosity.

α takes the value of 1 when demand is perfectly inelastic. In that instance, equation (iv) can clearly be seen to equal 1, that is, the social savings and consumer surplus measures are identical. Note too that when α = 1, equation (iii) can be simplified to:

$$\Delta \text{ Consumer surplus} = (P_{t-1} - P_t).Q_t \quad \text{(v)}$$

Comparing equations (ii) and (v) again shows that when the demand curve is perfectly inelastic, the consumer surplus and social saving measures of welfare are identical. Although demand is not generally perfectly inelastic, there exist circumstances in which this would be an accurate depiction. Let us take the case of a medical procedure which is sufficiently cheap that everyone who needs it within a particular society is able to afford it, either because everyone is rich enough to purchase it, or because it is provided by an insurance- or state-provided healthcare system. Antibiotics or plaster casts for broken limbs would fall into this category in many countries, and in rich countries with collective health care systems of one form or another, the provision of kidney transplants is generally limited by the availability of kidney donors rather than inability to afford the procedure. A second category would be where demand is *de facto* determined by regulation. Few Californians have their car's smog emissions tested more often than is required by state law, and few British companies check their fire extinguishers more often than required by UK health and safety regulations. In both of these cases, therefore, demand is completely price inelastic. In these cases – unusual but not unheard of – the consumer surplus and social saving measures of welfare are identical.

Finally, α will take a value less than 1 in all other circumstances. Inspection of equation (iii) shows that the ratio of consumer surplus to social savings is less than one, that is, the social savings measure exceeds the consumer surplus measure of welfare. If the demand curve is linear α will take the value of ½, and will take a value of less than one half if the demand schedule is convex. The classic example of a convex demand schedule is when demand exhibits constant elasticity.

A demand schedule characterised by constant elasticity of demand can be written algebraically as:

$$Q = P^e \qquad \text{(vi)}$$

Where e is the elasticity of demand, and other notation is consistent with earlier equations.

In this circumstance, the rise in consumer surplus is the integral of Q with respect to P (noting that in this case the equation has been written with Q as a function of P, rather than P as a function of Q, as is more common in graphical depictions of demand curves). Thus we find that, algebraically:

$$\Delta CS = \int_{P_t}^{P_{t-1}} P^e \, dp = \frac{1}{e+1}\left(P_{t-1}^{e+1} - P_t^{e+1}\right) \qquad \text{(vii)}$$

The relationship between the change in consumer surplus and the estimate of social savings in the case of constant elasticity of demand can be found by substituting equation (vi) into equation (ii) to find social savings as a function of price and elasticity of demand, and then dividing equation (vii) by the amended equation (ii). This gives the following expression:

$$\frac{\Delta CS}{SS} = \frac{P_r^{e+1} - 1}{(e+1)(P_r - 1)} \qquad \text{(viii)}$$

Where P_r is the ratio of the pre-technology to post-technology price, that is $P_r = P_{t-1}/P_t$.

We can see immediately that the two measures of welfare diverge when P_r increases or when e becomes more negative, that is to say, social savings overestimates consumer surplus by more when the price falls are larger, or when demand is more elastic.

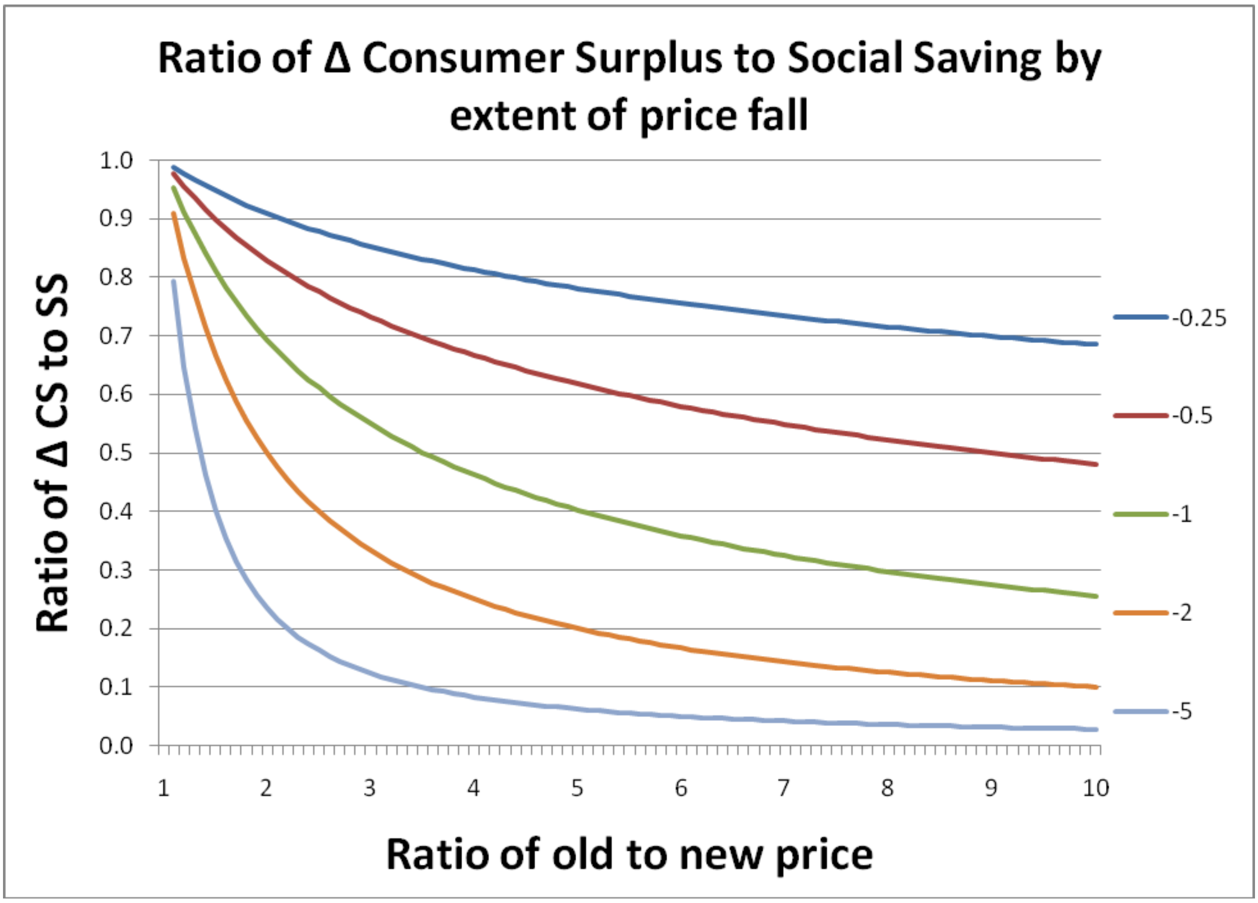

figure 1: the ratio of the change in consumer surplus to social savings for different elasticities and for different price falls.

Figure 1 shows us, for five different elasticities, the effect of an increase in the extent of the price fall on the divergence between consumer surplus and social savings estimates of the welfare gain from a new technology. Thus we see that at an elasticity of -1, the consumer surplus estimate of the benefit of a 10% fall in price is 95% of the social savings estimate. When the price fall is 2 to 1, however, the change in consumer surplus is 69% of the social savings estimate, 40% when the price fall is 5 to 1, and 26% when the price fall is 10 to 1. Figure 1 demonstrates the extent to which a large fall in price implies that the social savings estimate of the benefit of a new technology outweighs the "true" measure of the welfare gain, as conventionally defined in economics.

We can also plot this information with the elasticities given on the x-axis, so that the different lines refer to different ratios of the old to new price. This is shown in figure 2.

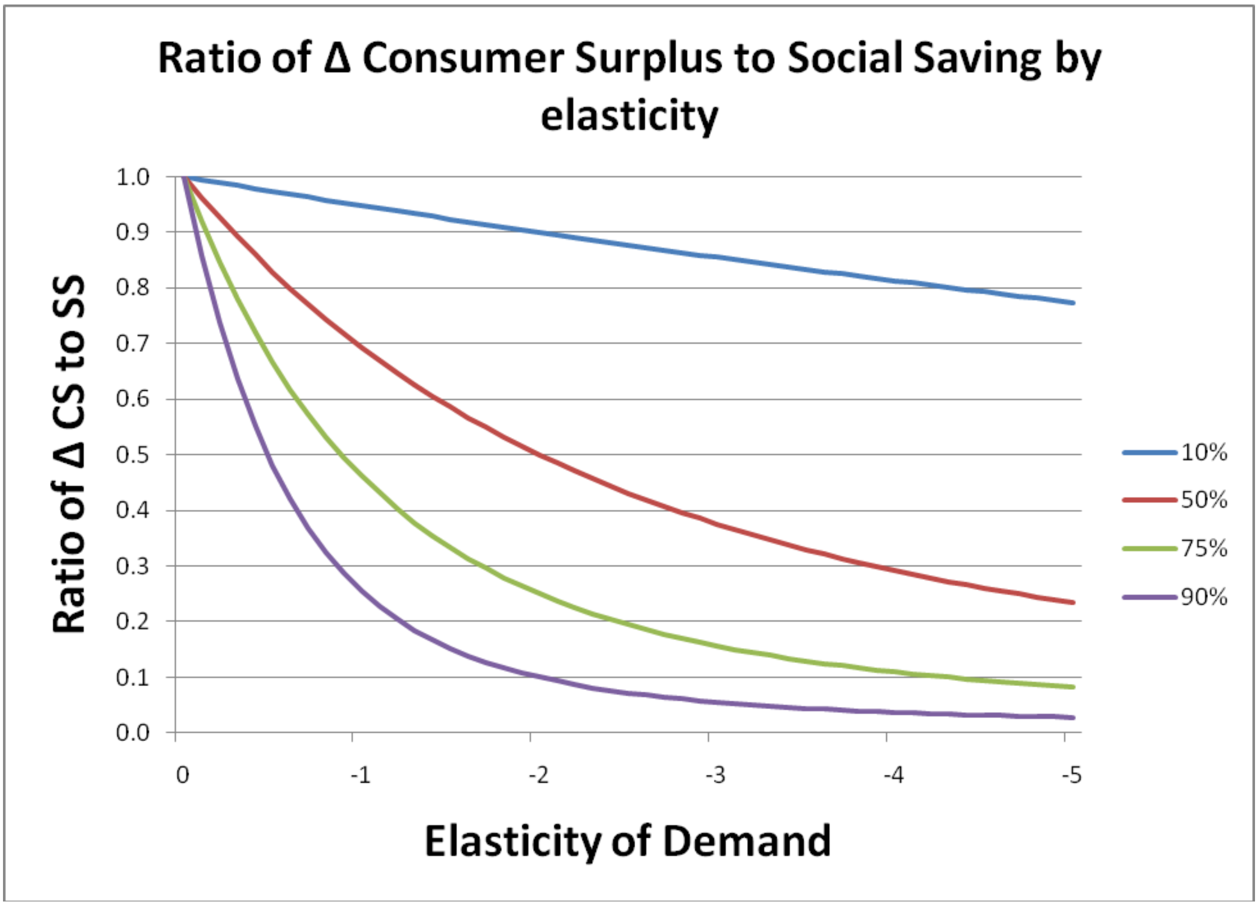

figure 2: the ratio of the change in consumer surplus to social savings for different price falls and for different elasticities.

When we look at figure 2 we can see clearly the extent to which more elastic demand implies a divergence between the consumer surplus and social savings measures of the value of the technology in question. If we take a 75% fall in the price of the product – not untypical for the sorts of products for which social savings studies have been carried out – we find that even at an elasticity of -1, the consumer surplus measure is only 46% of the social savings measure. At an elasticity of -2 the figure is 25%, falling further if demand is more elastic.

These calculations assume constant elasticity of demand, but the following two statements generalise to other functional forms that the demand curve can take. First, when the price fall is large, the extent to which the social savings estimate overstates the rise in consumer surplus is also large. Second, when the product in question is characterised by a highly elastic demand schedule, the extent to which social savings estimates overstates the rise in consumer surplus is again large. Clearly, when the product is price elastic, and when the price falls significantly, the divergence will be very great indeed.

We can see an example of this by looking briefly at Foreman-Peck's estimates of the consumer surplus value of passenger railways in 1865. He calculated that the fall in the price of transport – defined as being stage coaches prior to the railway – as being at least 8 to 1. In addition, he estimates that the elasticity of demand was constant at -1.3 (Foremen-Peck 1991, pp. 75-76). Inserting these numbers into equation (viii) tells us that a social savings estimate of the value of passenger rail transport in England and Wales in 1865 would be 4.5 times as high as the consumer surplus estimate. Foreman-Peck also presents altenative estimates, namely that the fall in price was 12 to 1, and that the elasticity was -1.5. Under those circumstances the social savings estimate would be 7.7 times as high as the consumer surplus estimate. Thus we can see that the difference between the two measures increases as the elasticity increases, and as the extent of the price fall increases, and that the extent of the divergence can be large.

A third factor is also critical in establishing the extent to which social savings and the change in consumer surplus diverge: the extent of previous demand. We have so far assumed that $Q=P^e$. If we assume an elasticity of -1, then if price is 1, quantity is also 1, whereas if price is 2, then quantity is 0.5. Imagine now that previous demand at a price of 1 was not 1 but 10, and that a rise in the price from 1 to 2 still leads to a fall in quantity of 0.5, that is, to 9.5. In this case the demand schedule will take the form:

$$Q = A + P^e \qquad \text{(ix)}$$

Where in this particular case A = 9 and e = 1. When the demand curve takes this functional form, it is straightforward to see that, ceteris paribus, the change in consumer surplus and social savings estimates will converge as A increases. This is because both measures increase by $A.(P_{t-1} – P_t)$, and therefore the ratio of the two measures converges as A increases. What this means in practice is that the greater the quantity sold in the pre-technological improvement world, the closer the two welfare measures will be.

This finding, along with the two stated earlier, tells us that the social savings and change in consumer surplus measures will be relatively similar for micro-inventions. If there exists a product with high levels of demand, whose price does not fall dramatically, and for which demand is relatively inelastic, then the two measures are likely to be relatively close in practice. If, however, the invention under consideration is a “macro-invention”, for which price falls are dramatic, for which previous levels of quantity sold are relatively small, and for which price elasticity of demand proves to be high, then it is likely that the social savings estimates will be hugely out of line with the conventional, and correctly defined, measure used by economists to value the welfare effects of improvements to technology, namely the rise in consumer surplus. As we will see later, this is an important finding that must be kept in mind when assessing the results of social savings studies.

The relationship between social savings and total factor productivity

Having looked in detail at the comparison of social savings and changes in consumer surplus, we will now look much more briefly at the comparison of social savings and changes in total factor productivity. Here, James Foreman Peck has shown that there exists an identity between social savings and total factor productivity. This identity is best explained verbally. Social savings measures a resource saving, that is, how much the technology has saved society when society produces the final quantity of goods. If society in fact produced the final quantity of goods both before and after the technological improvement, the saving measured by the social saving methodology would literally be a saving of resources needed to produce a given volume of output. Total factor productivity is defined as the ratio of outputs to inputs, and a rise in total factor productivity is defined as the rise in this ratio. Thus being able to produce a certain volume of output with fewer inputs represents a rise in total factor productivity, and total factor productivity can be thought of as identical to cost reduction – the very definition of social savings (Harberger, 1998, Foreman-Peck

1991). We can see therefore, that the social saving and total factor productivity measures are in essence different methods of expressing the same thing, since both capture the fall in resources needed to generate a certain level of output. Strictly speaking, since social savings are habitually expressed as a share of national income, social savings equal the rise in total factor productivity multiplied by the industry in question's share of GDP (Crafts, 2004).

This in turn gives us a better understanding of the relationship between total factor productivity and rises in consumer surplus. It alerts us to the fact that total factor productivity numbers can be exposed to the same dangers that we saw for social saving numbers earlier. In essence, this is a classic index number problem. If we weight production by final quantities, we risk overstating the importance of the change that has occurred in previous years. There is in practice no perfect answer to this conundrum, even were the data to be as good as exists in the present day, let alone with the sort of data with which economic historians regularly have to deal.

The Relationship with Growth Accounting Estimates

Recent literature that seeks to place a numerical value on the impact of a new technology on society has commonly used a "growth accounting approach". This has been particularly common in papers that seek to assess the value of information and communication technology over the last twenty years. Thus, for example, Oliver and Sichel (2000) use this approach when assessing recent US growth performance, and van Ark et al (2003) do likewise for Europe. In contrast Bayoumi and Haacker (2002) state that they use a social savings approach to make the same type of assessment, albeit for slightly different dates. (In fact they calculate the change in consumer surplus not the social saving).

The existence of these two sets of papers led Crafts (2004) to discuss the relationship between the two measures explicitly in this context. The fundamental intuition is as follows: 'The social saving concept was devised to answer the counterfactual question "how much faster was economic growth than it would have been in the absence of the new technology?" whereas growth accounting simply addresses the ex-post accounting question "how much did the new technology contribute to growth?" and ignores issues of crowding out.' (Crafts, p. 8) In essence then, growth accounting (implicitly) assumes that the resources used by a new technology would otherwise have remained idle, whereas the social savings estimate assumes that there was an opportunity cost to using them, which should not be included in any estimate of the value of the technology under consideration. As such, the growth accounting estimate will always exceed the social savings estimate. It will be important to remember this later, when considering whether social saving estimates are too high.

Thus we find clear and stable relationships between our four measures. Excluding cases in which price elasticity of demand is zero or positive, we find that a consumer surplus measure will always be lower than a social savings measure, which will in turn be equal to a total factor productivity estimate, and all of these will be smaller than a growth accounting estimate. Clearly, different estimates, prepared at different times and for different purposes can all have their own rationale. Nevertheless, the change in consumer surplus has the strongest underpinnings as a welfare measure, and in that sense the divergence should be seen as a potential – although as we will see, not necessarily an actual – issue with using social savings and other measures of welfare.

2: The initial application of social savings: Fogel's work on American railroads in 1890

The concept of social savings goes back to work by the-then young Robert Fogel. Although now more famous for his work with Stanley Engerman on slavery, Fogel's initial career was built on his work as a graduate student on the history of the American Railroads. As part of this body of work he developed and used a new concept, which he termed "social savings". He first introduced the concept of social savings in his 1962 Journal of Economic History article, "A Quantitative Approach to the Study of Railroads in American Economic Growth: A Report of Some Preliminary Findings", following an oral exposition at the first annual Purdue Cliometrics meetings in December 1960. The subtitle of that article is appropriate: the paper is very preliminary in many ways. One way in which, looking back, it is clearly preliminary is that the explanation of the concept of social savings, its advantages and disadvantages, is not particularly clearly expressed, something Fogel himself admitted later (Fogel, 1979, p. 3).

Fogel's best definition of social savings came in his 1978 Economic History Association Presidential Address, published in the March 1979 issue of the Journal of Economic History as "Notes on the Social Savings Controversy". In a section entitled "The Nature and Limitations of the Social Saving Model", Fogel wrote that "I defined the social saving of railroads in any given year as the difference between the actual cost of shipping goods in that year and the alternative cost of shipping exactly the same bundle of goods between exactly the same points without the railroad" (Fogel 1979, pp. 2-3).

Fogel initially applied the concept of social savings to American railroads in 1890. As we have mentioned, Fogel's first article appeared in 1962, and was followed by his 1964 book, *Railroads and American Economic Growth: Essays in Econometric History*. The first important aspect of Fogel's original article is the statement that an innovation's universal adoption does not demonstrate that it is of high value to society. That the railroad was pervasive is not in dispute. Its pervasiveness had led others, such as Christopher Savage, to state that the influence of the railroad in American development "can hardly be over emphasised" (Savage, 1959 p. 184), while Rostow went further and saw it as "decisive" in generating America's take-off into self-sustained growth. (Rostow, p. 55). Fogel argued in contrast that were the railways to have been a tiny fraction cheaper than previously existing transport methods, and to have been perfect substitutes for them, then railways would have become pervasive while being of only limited value to society. (Fogel, 1962, pp. 174-5) This argument was taken to its logical conclusion by Lebergott, (Lebergott, United States Transportation, p. 439) who argued that if both modes of transport survived and competed, then neither could offer lower total costs to the consumer, and so the social saving must not only be small, but zero. This argument only holds if the two modes of transport are perfect substitutes, which is in reality an assumption too far. Even if the extreme case is rejected, Fogel's basic point that the pervasiveness of the railroad is not evidence of their importance to the economy remains strong.

The correct way to assess the importance of railroads needs to take into account the extent to which costs fall as a result of their invention, as well as the extent to which the railways were used. Hence the need for a measure such as social savings, which takes into account both the change in costs as well as the amount of traffic handled by the railroads.

The 1962 article set out the question about the role of the railroads that Fogel wanted to address, outlined the generally applicable social savings methodology that he would use to address it, and gave the results that he found when the method was applied to one element of that question. The general question was broad but simple: “how much did railroads affect the nineteenth century American economy?”, and the particular part that was answered in that original article was the extent to which inter-regional agricultural trade was facilitated by the railroad, as judged by the social savings methodology. Inter-regional trade was never perceived to be the most important aspect of railroads, but it served as a straightforward aspect to which the social savings methodology could be readily applied.

Fogel noted that the cost of railroad transport was dramatically lower than the cost of wagon transport. He presented basic data which showed that were wagons to have been the only alternative to railroads, then the social saving of railroads would have exceeded one third of national income in 1890. In contrast, when the alternative to railroads was canals, then "the social saving attributable to the railroad in the interregional transportation of agricultural products was about 1% of national income" (Fogel, 1962, page 195-196).

Fogel broadened the scope in his 1964 book. The 1962 article appeared essentially unchanged as chapter two, supplemented by chapter 3, which constructed detailed estimates of the value of railroads to intra-regional agricultural trade. Although the book contained other material, these are the two chapters that deal with social savings, and are the strongest sections of the book (Davis, 1966, p. 660). This brought the issue of adaption to the fore: to what extent should the counterfactual involve doing exactly what was done with the innovation, without it? Fogel noted this issue in his 1962 article but addressed it for the first time substantively in the subsequent book, and it remains critical to any proper understanding of the nature of social savings estimates.

In this case, the issue was that some land was used for agriculture because it was close to a railroad. Had the railroad not existed, the cost of shipping produce by wagon from that location would have outweighed its value, sometimes many times over. To say that the value of the railroad was the cost of shipping such produce by wagon is clearly not meaningful: the annual value of a railroad to a piece of agricultural land cannot exceed the value of the crops produced on that land.

For that reason Fogel developed two estimates, which he called (somewhat unintuitively) alpha and beta estimates. The alpha estimate preserves the pure assumption of the social savings methodology, namely that the value of the railroad is the additional cost of transporting everything that the railroad moved, without it. The alpha estimate is therefore best seen as an absolute upperbound, and in all probability something of an overestimate.

The beta estimate allowed some – inevitably ad hoc – adjustments, accepting that some activities only happened because of the existence of the railroad. In essence, this is a tacit acceptance that the implicit social savings assumption that demand is perfectly inelastic is not correct. As such, however, it risks moving social savings away from a clearly defined concept, and towards an estimate of consumer surplus. As we have noted, what matters in particular is that some land that was used for agriculture in the presence of the railroad would not have been used for agriculture in the absence of the railroad, because it was too far from a canal to be economically viable, given the cost of wagon transport. It is worth noting that although most of the counterfactual mileage is by canal, the dramatically higher cost of wagon transport means that 85% of the total “alpha” social saving from the railroad comes from replacing wagon transport with railroad transport (Fogel 1964 pp. 23-25, 46-47, 51, 73, 212-14). Thus the extent to which wagons would have been used without the railroad is critical in estimating social saving correctly. To try to eliminate farming that would no longer have been economic, Fogel assumes three things. First, he argues that 37 additional canals totalling 5000 miles would have been economically viable without the railroads (Fogel, 1964, pp. 92-93, and appendix a). Second, notwithstanding these additional canals, some land would no longer have been used for agriculture, and therefore the cost of shipments from that land should not be included. Third, a greater proportion of roads would have been improved, since these would have been the primary method of transport in a greater number of places. Depending on which adjustments are included, the estimate of the social saving for intra-regional railroads falls as low as 0.8% of GNP. (Fogel, 1964, pp. 214, 218, see also Davis 1966, p. 661.)

Finally, Fogel rather crudely extrapolates his results to cover non-agricultural products, but not passengers, finding that even on the alpha basis the total value of railroads in the United States did not exceed 4.7% of GNP in 1890, small enough for him to argue that railroads were not "decisive" in generating self-sustaining growth (Fogel, 1964, p. 223)

Criticisms of the initial social savings estimates (*625 words so far)*

The initial social savings estimates generated many criticisms, of many types. One group of criticisms were concerned with individual data issues, and thus relate to the application of social savings methodology to this specific example. These are important for assessing the social savings of American Railroads at a specific date, but they are not important in understanding the strengths and weakness of social savings per se, save only to note that the quality of cliometric work will always be dependent to a huge extent on the availability, quality and suitability of the data. Although we will not go into individual data issues here, it is worth noting in passing that while equation (ii) might imply that the data requirements for calculating social savings are relatively small, the reality is anything but: Fogel devotes an entire page of his 1979 article to simply listing the algebra, with definitions of over 50 different items (Fogel, 1979, p. 4).

In addition to criticisms of the data, economic historians also criticised the assumptions that underlie the concept and application of social savings.

The first such criticism concerned the (implicit) identity between price and marginal cost. In calculating social savings, Fogel had assumed that price was equal to marginal cost. Clearly the gain to society comes from a fall in costs, not from a fall in prices, since a fall in prices without a fall in costs represents a transfer from producers to consumers, not a net gain to society (McClelland 1968, p. 114). This is a serious criticism not only at an intellectual level, but also at a practical one, as data on costs as opposed to prices are hard for economic historians to obtain. That said, those trying to calculate social savings are not the only cliometricians to assume away the difference between prices and costs.

Second, Fogel (implicitly) assumes that marginal costs for the previous technology do not change between the old and new output levels. (McClelland, 1968 p. 114). If the extra canals had been harder to build, or canal loading congestion had been an issue, then canal transport might have been more expensive in 1890 than Fogel assumes. Equally, if higher traffic volumes had allowed larger, more efficient canals or vessels to have been constructed, canal costs would have been lower than Fogel assumes. Again, this is a serious criticism, since assessing the cost structure for an obsolete technology facing significant rises in demand is not a straightforward counterfactual to develop, particularly if, like Fogel, you are trying to make an assessment in a period long after efforts to improve that previous technology have ended.

The third set of criticisms made of the social savings approach relate to what it excludes. Social saving clearly measures only the gain to direct beneficiaries of improved transport. Paul David pointed out that were transport-using industries to be characterised by declining long-run marginal costs, then an innovation such as railroads would, by lowering transport costs also lower the long-run costs of a host of other industries for which transport is an input by leading to an increase in output. He suggested that this could lead to benefits ten times the estimates of social savings. This is a very strong claim, somewhat weakened by his failure to give any examples of such industries, let alone estimating the effect for such industries. Nevertheless, the point is clearly correct in principle, and it is not difficult to imagine examples. (David 1969*,* pp. 515-9). One such would be the Sears Corporation, which, by 1897, had a mail order catalogue which ran to 786 pages, and included more than 7000 types of goods in the index, and perhaps 40,000 different products in all. Its scale was dependent on being able to ship very large numbers of goods to consumers quickly and reliably (Sears Catalogue, 1897). Canal transport was not a good substitute for railways for the Sears Corporation. Here, then, is an example of an important company who was able to reduce costs for consumers through economies of scale in purchasing, manufacturing, stock control, overhead management, and so on, and whose ability to do so was predicated on the availability of a transport network along the lines of that provided by the railways. More generally we could link David's criticism with the work of Alfred Chandler (1990), who argued that one of the reasons that the United States became the leading economic superpower was the scale and scope of its firms. Such scale demands ready access to transport, and the railways could be seen as part of preconditions for the success of the Chandlerian firm in many sectors. More generally, Atack and Passell set out that transition from workshop to factory that began in this period (Atack and Passell, chapter 17). Nevertheless, although benefits related to scale economies are not included in a social savings measure, benefits derived from scale of markets are included. That is, the benefits of (say) bringing more land into cultivation are fully captured within a social saving framework (Metzer, 1984, pp. 67-9).

A more recent critique of social savings comes from the work of Crafts and Mulatu (2006). This starts from two observations. First, that the spatial location of firms is endogenous to the generalised cost of transport, and second that the location of firms can affect the productivity of firms. This point is thus complementary to, but distinct from, the points made by David on scale economies. For David (and for Chandler) the point is that large firms can gain internal economies of scale, but that this is only economic if they can transport their products to dispersed consumers cheaply. For Crafts and Mulatu the point is that firms of any size can gain Marshall-Arrow-Romer agglomeration economies if they can locate near to each other, but again, this is only economic if they can transport their products to dispersed consumers cheaply. It is worth noting that Crafts and Mulatu find that the size of this effect, for Britain in 1911, is small, and do so for exactly the same reason as Fogel and Fishlow found that the social savings of American Railroads were relatively small, namely that canals were already an effective transport technology. In addition, Crafts has also noted that if the transport using sector is characterised by imperfect competition, then a fall in the cost of transport will lead to an expansion of output in the transport using sector. Since marginal revenue exceeds marginal cost in the imperfectly competitive transport using sector, this expansion of output is welfare increasing in a way that is not captured by traditional social saving (or consumer surplus) studies. Crafts notes that this might increase estimates by 10% for the UK economy in the late 1990s (Crafts 2004, p. 8).

The fifth set of criticisms relates to the failure of the social savings methodology to say anything about the changing structure of the economy. In many ways what was remarkable about the nineteenth century was not so much economic growth as structural change. It is not for nothing, for example, that the arrival of sustained economic growth is traditionally referred to as “The Industrial Revolution”, rather than “The growth revolution”. Because social savings calculates only a value to a user whose demand is assumed not to change, it is unable to say anything about the role transport may have had in (for example), the movement from agriculture to industry either for a nation as a whole, or for one region of it. Williamson estimated social savings of transport improvements in the context of a general equilibrium model (Williamson 1974 ch 9), but this model had its criticisms (Kahn 1988), and no other economic historian has produced social savings estimates within a general equilibrium framework. For that reason it is best to see social savings as failing to speak effectively to debates as to the changing structure of the economy.

Finally Boyd and Walton (1972) noted that multiplying the final quantity by the fall in price is equivalent to assuming that the price elasticity of demand is zero. Although as we have argued already there may be cases for which that is a good assumption, it is not a good assumption in general, and they show that it is not a good assumption for passenger transport. As such, it will lead to an over-estimate of the welfare benefits of railways, perhaps by a huge margin. Boyd and Walton further argue that data generally exist to allow us to be more accurate as to the correct elasticity. In the case of passenger rail travel, the specific focus of their 1972 paper, they argued that there was sufficient evidence that a price elasticity of demand of around unity was strongly supported by the evidence. 35 years later Leunig, following UK Department for Transport methodology, came to much the same conclusion. Fogel accepted this point in his 1979 paper, writing that “it seems to me that Boyd and Walton were right in urging that we go beyond calculations based on the assumption that E = 0. It is time to move from guesses about the relevant elasticities to estimation of them.” (Fogel 1979, p. 11) What is important to note here is that moving from an elasticity of 0 to an elasticity of 1 does not alter the social savings estimate on a consistent basis across different social savings estimates. Fogel records, for example, that his agricultural social saving would be reduced by 28% were an elasticity of 1 to be used, whereas the equivalent figure for Fishlow’s freight estimate is 48%, while Boyd and Walton found that the effect of using an assumption of unitary rather than zero elasticity was to reduce the estimated social saving by 45% for passenger transport (Fogel, 1979, p. 12, Boyd and Walton, 1972, pp. 249-250). At this point, however, what is being assessed is not social savings, but consumer surplus, and these figures are better seen as estimates of the extent to which different estimates of social savings overstate the welfare gain to society.

A modern evaluation of the quality of Fogel’s early work on railroads would step back from some of the individual points about which contemporaries were much concerned. It would instead celebrate that the invention of the concept of social savings allowed economic historians, for the first time, to place a value on an innovation such as the railroads. In all of the criticisms that have been made, sight should not be lost of the fact that prior to the invention of the concept of social savings, no estimate had been made of the value of the railroads, one of the defining features of the nineteenth century economy. Until that date it was accepted as self-evident that railways, which had transformed the face of many nations, had also transformed the underlying economies of these nations. After the publication of Fogel and Fishlow's books, that assumption was no longer tenable. The numbers that they presented might not be correct, but the very act of presenting numbers that were reasonably well-substantiated gave the profession a basis from which to begin more detailed work, and which gave a good sense of the broad order of magnitude of the results that were likely to be found.

Furthermore, the social savings methodology allowed Fogel and Fishlow to state which railways within the United States had the highest value to society. Surprisingly to those who had judged value from use, the most valuable lines were not the mainlines, for these tended to follow routes that already had good canal transport available. That they accounted for a large proportion of traffic did not mean that they accounted for a large proportion of the value of railroads to society. Fishlow, for example, finds that only 8% of the total social saving was attributable to the trunk lines (Fishlow, 1965 p. 93). The most valuable lines were those that replaced very poor (that is, very expensive) wagon transport. Here there are shades of the later work by Aschauer (1989), who found that the most valuable transport infrastructure was that which completed a network, allowing efficient end to end journeys. It was the same for nineteenth century railways: what was valuable was getting rid of bottlenecks.

Second, preparing estimates of social savings methodologies forces economic historians to be explicit about the counterfactual. In many ways making a counterfactual explicit is the the most appealing characteristic of all good Cliometric work. When a non-Cliometric historian says that something is critical, the reader is left wondering what would have been different had that thing not happened. With a properly defined counterfactual, the reader knows what the writer thinks would otherwise have happened, and can consider the evidence for that alternative.

One of the remarkable aspects of Fogel's book is his set of counterfactual canals. Noting that without the railroads, much land that was used for agriculture would not have been viable given the cost of wagon transport, Fogel asks the question "would additional canals have been economic?". As we have noted, he argues that a network of 5000 miles would have been economic. But he does so not by considering a simple map, but by looking at detailed topological maps, in the manner of a would-be canal engineer. Fogel's counterfactual canals are supported by a wealth of evidence, including details on the route, and the gradients that would have been encountered along the way. Whether or not the reader finds the counterfactual convincing, there can be no doubt that this is a well-constructed counterfactual, allowing the reader to assess its merits or otherwise from a well-informed position.

From a modern perspective, and indeed since Fogel's 1978 Presidential address, we are much more aware of the extent to which social savings estimates, with their implicit zero elasticity assumption are in some sense untenable as measures of welfare. Looking back, there is no reason why Fogel, or any of his critics, could not have prepared consumer surplus estimates instead. After all, provided that one is prepared to assume constant elasticity of demand, or some other readily tractable demand schedule, and provided that one has some sense of the price elasticity of demand, it is not particularly hard to move from being able to make a social savings estimate to being able to make an estimate of the rise in consumer surplus. Of course, that is two more assumptions, but the pioneering Cliometricians were rarely afraid to make assumptions, and any author who can devise

5000 miles of counterfactual canals could surely make a passable attempt to estimate price elasticity of demand.

That Fogel did not do so reflects the fact that although Fogel claimed to be trying to answer the question "how much did railroads affect the nineteenth century American economy?", this was not really his question. To answer that question, a consumer surplus methodology would be appropriate. Instead, Fogel set out to show that railways were not indispensible. For this the social savings methodology was perfectly appropriate. After all, if a technology was not that important even when the price elasticity of demand was assumed to be zero, and the final quantity used to measure its value, then clearly it would not be important were a more realistic assumption of price elasticity to have been used. The creation of the concept of social savings needs to be seen in the context of wanting to create an upperbound estimate of the value of a technology. It is a strong intellectual creation in that context, but that does not mean that it can be used in all contexts without considering whether it is the appropriate criterion to use.

3: Comparing different social saving estimates

Table 1 about here.

Table 1 sets out the findings of a broad range of social saving estimates for railways in different places and in different times. Before we go on to discuss the exact results it is worth noting that the quality of the individual results is extremely heterogeneous. Some are based on years of scholarly endeavour, while others appear to be little more than back of the envelope calculations. The lowest estimate is one half of one percent, for China in 1933, while the highest overall estimate is in excess of 40%, for Brazil in 1913.

We need to be extremely careful when comparing the different social saving numbers. As we have noted already, the original definition of social savings included an implicit assumption that the price elasticity of demand was zero. Since the work of Boyd and Walton not all authors have followed this assumption, and therefore it is always necessary to check the different results have been compiled under identical elasticity of assumptions. In order to better facilitate comparison table 1 uses zero price elasticity of demand throughout. For that reason some of the figures that appear in the table not identical to those in the original text, but instead use the data in the original text to construct a zero elasticity estimate.

Even once that change has been made in order to ensure comparability we still have to be extremely careful in using the numbers in table 1 for comparative purposes for a very wide range of reasons.

First, these estimates have all been drawn up by different people: one of the most remarkable aspects of the social saving literature is that no author has constructed social saving estimates for more than one country. Different authors make different assumptions which can have a very large effects on the final result. There can be no doubt that both Fishlow and Fogel are talented and conscientious researchers, and that both put forward strong reasons for the assumptions that they make. But their estimates of the extent of the social saving of railways in 1890 differ considerably: Fogel believes that the final answer is no greater than 5%, while Fishlow believes that it is double that amount, a difference of around $0.6bn. If two of the finest economic historians to study the problem cannot get closer than this, then we have to be aware that we cannot take any of the numbers in this table as being authoritative. The best estimates should be seen as legitimate, but we should recognise that other scholars of equal ability may well have chosen different but equally legitimate assumptions, and correspondingly come up with social saving estimates that differ by amounts that cannot be regarded as historically unimportant. The assumptions that matter here are largely in the treatment of data. In particular, estimating the cost using alternate modes of travel will never have an unambiguous answer. Counterfactual history is like that, particularly if we are considering a long period of time. Different scholars could make perfectly legitimate different estimates of the cost of non-rail freight in Brazil in 1913, for example. Indeed, Summerhill notes that there are different legitimate estimates of such costs, which is why he provides two different estimates himself. These two estimates are sufficiently different that his second social saving estimate is only half that of his first.

The second issue, which is equally important, relates to the fact that these numbers all come from separate research projects and were all designed to answer individual if related questions. Almost without exception the authors concerned have decided to answer the question "how valuable were railways in a particular country?". None of them were trying to answer the question "were railways more valuable in country a than in country b?". This means that none of the studies have been designed to facilitate international comparison. We can see this in any number of ways. As we have mentioned, different authors have made different assumptions about all sorts of different issues. In addition, the studies do not all relate to the same date. Thus we find a social savings estimate for Belgium 1846, and one from China for 1933. Nor is it the case that there is a convention that scholars estimate the social saving of railways at some particular point in a country's railway history. For example, it would be possible to have devised a convention that said that the social saving of railways would be measured once three-quarters of the final railway mileage was built. Or when a majority of interregional freight transport used the railway. Or 50 years after the first railway line was opened. We could argue about the merits of any of these proposed conventions, but the fact is that without any form of convention our discipline has developed a set of estimates for different dates that are not readily comparable. Even were two studies to use exactly the same assumptions, if the results are that railways in one country were worth 5% of GDP in 1860, and they were worth 7% of GDP in another country in 1880, we cannot say in which country railways were more important, since we know that the effect of railways grew over the 19th century.

There are honourable exceptions. First, Summerhill estimated the social saving for railroads in Brazil for 1913, which is conveniently close to the date that Coatsworth had used earlier for his estimate of social savings for Mexico for 1910. Both are high-quality estimates of social savings, and it is reasonable to compare these two results at headline level. Second, Herranz-Loncan provides a high-quality estimate for social savings the Spanish railways for two separate dates, while Leunig provided estimates for the social savings of passenger railways for the United Kingdom for every single year between 1843 and 1912. Providing estimates for a long series of dates facilitates comparisons with estimates of passenger social savings in other countries, since it dramatically reduces the chance of having unaligned dates.

Were we to have two estimates, for two countries, for the same date and which use the same set of assumptions we could then compare the headline social savings estimates. Let us imagine for simplicity that we have such numbers, and that they relate simply to freight, and let us imagine that the results 5% are for one country and 10% for the other. We could conclude correctly that railroads had the larger effect in the second country, but we would still not know much about *why* railroads had a greater effect in the second country than in the first. There are many possibilities. It might be, for example, that the railways had the same effect per mile of track built, and that the only difference was that one country had built a much more extensive network than the other. Or it might be that both had the same networks, but that one was used less because of the existence of a better canal network, or perhaps because smaller differences in climate by region reduced the need for inter-regional transport of agricultural products. Or it might be that the country placed restrictions on internal trade, so that railways were little used (or not built). Social savings estimates, even at their finest, to some extent only define the historical question more accurately, rather than explain the historical reasons why railways were or were not important.

We can see this by looking at the numbers in the table above. Broadly speaking, the estimates for more developed countries look similar to Fogel's original estimate. Recall that Fogel's estimate for the social saving of US freight railways was 4.7% in 1890. Hawke estimated 4.1% for British freight for 1865, and the estimates for other Northern European countries – which are generally of lower quality – did not diverge from this sort of level. Herranz-Loncan estimated 7.5% for Spain for 1878, rising to 11% by 1912, while Coatsworth and Summerhill's estimates were around 20-40% for Mexico and Brazil, depending on the exact assumptions used.

The obvious intuition is that later developing countries derived greater benefit from the railways because they had not constructed significant canal networks earlier on in the development process. Indeed, Fogel estimated that had there been no canals, so that railroads had replaced wagons in the US, then railroads would have had a value of the order of 30% or more of US national income, in line with the later Coatsworth-Summerhill estimates for countries with limited canals. Presumably we would find that countries that did not invest in railroads gained more from the construction of the road network, and so on.

But in that context what do we make of the estimates for Russia (4.6%, 1907), Colombia (4.8%, 1924), and China (0.5%, 1933)? In the light of the Latin American results, we might expect high values for all three countries. Let us assume for a moment that these numbers are perfectly accurate, and that the methodology and assumptions are in line with those of Coatsworth and Summerhill. There are many alternative explanations. First, these countries may not have built a sufficient quantity of railroads. There may have been other routes that would have passed social (or even private) rate of return calculations but which were not built for a variety of reasons. Had those additional lines been built, then it is possible that the social savings result would have been in line with the Coatsworth-Summerhill figures. Second, it could be that these countries had particularly fine coastal shipping, river and canal networks, reducing the value of railways. Even if they did not, a flat country will enjoy lower wagon costs than a mountainous one. Third, the railway network may be run much more efficiently in one country than another, assessed either by cost or by speed and reliability. Fourth, one country may engage in much higher levels of internal or external trade than another country. Climatic variation, for example, increases potential gains from trade, in turn raising the potential level of social savings from improving transport links. Government regulations can reduce the incentives to trade, internally and externally. In this context as we have noted radically different social saving numbers can help us to define a question, as much as to answer it. It would be helpful were the convention to be that social savings results are expressed not only as a percentage of GDP but also in terms of their value (in absolute terms) per mile of track or per ton mile of freight carried. Were we to find not only that Russian railroads in total were worth less as a percentage of GDP than Mexican railroads, but that the difference was much less when we compare the value per track mile, we would then know that differences in the extent of railways explain at least part of the difference in the overall result. In short, there is much more work to be done, using existing studies as a starting point.

4: The application of social savings to non-railway situations

The majority of social savings estimates relate to railways, and railways are the only technological improvement that have been extensively analysed using the social savings methodology. Nevertheless, there are examples of the application of the social savings methodology to other sectors.

One of the earliest and most important examples of the application of social savings to a technological improvement other than railways is von Tunzelmann's 1978 study of the effect of steam power on British industrialisation prior to 1860. This contains a chapter that sets out to evaluate the importance of steam engines using the social savings methodology. In that chapter, von Tunzelmann assesses the value of steam engines in 1800. As such, what is being evaluated are stationary steam engines since neither the railway nor the steamship had been invented by this date. von Tunzelmann assesses both steam technology as a whole, and the improvements made by James Watt relative to earlier atmospheric engines. He finds that by 1800 steam engines, taken as a whole, were worth approximately 0.2% of GDP, with the improvements made by James Watt being valued at approximately half that total. (von Tunzelmann, 1978, pp.149, 157). what stands out from this study is the remarkably small figure that the social savings methodology places on the invention of steam engines. Against that, it is worth remarking that the date chosen for the study, 1800, is very early on. There are only 12,000 hp of Watt engines by that date (von Tunzelmann, 1978, p. 148) . Clearly, assessing the social saving at a later date would give a much larger figure, both because there would be more engines installed by that date, and because the cost of operating steam engines will have fallen much faster than the cost of alternate technologies. This is particularly true once we get to the point at which there is sufficient steam power that it is no longer feasible to have replaced it all with water power. Wind power, and animal power are considerably more expensive than water power in the British context.

Much more recently, Dan Bogart has used the social savings methodology to value the effects of turnpike trusts in 18th-century England. He finds that turnpikes raised property income by around 20%. Given that a little over half of parishes had a turnpike by 1815, he therefore concludes that turnpikes increased total property income by 11%. This represents about 22% of the rise in real land rents between 1690 and 1815. On the basis that property income represents about 15% of national income, this implies that turnpike trusts “generated a social saving of at least 1.65% of national income in 1815" (Bogart, 2009, pp. 149-150).

Both von Tunzelmann and Bogart are excellent scholars who produce work of a high quality. In this case both have applied the methodology correctly, and both have used data carefully. Of course, each has made assumptions, but neither set of assumptions appear at all unreasonable. And yet there is a sense in which the results are implausibly different to each other, since Bogart finds that turnpikes were worth 8 times as much to Britain as the invention of the steam engine.

Again, we have the problem that we had with the railways: individual studies have been produced, for one thing, in one country, at one point in time. This makes it hard – and perhaps meaningless – to compare them. What would be more useful, once more, would be to have social savings estimates for a range of dates. Then we could see, for example, when – if ever – there was a sufficient mass of steam engines, or sufficient improvements in the steam engines, for the steam social saving number to exceed that of road improvements. The steam engine may not meet Rostow’s definition of a breakthrough capable of changing the trajectory of the economy, but it seems unlikely that the social saving of stationary steam engines remained at just 0.2% as the nineteenth century progressed.

Social savings have been used for more novel goods as well. Bakker, for example, uses the social savings methodology to assess the value of cinema in the interwar era. Here the counterfactual is the previous technology, that is, live entertainment. He finds that, in 1938, social savings were 2.3%, 0.32% and 1.37% of GDP in the US, UK and France respectively (Bakker, 2008, p. 381). These are radically different figures, but the advantage here – and the rationale for including it in this survey – is that all three estimates are constructed by the same author, for the same dates, using the same methodology, and the same assumptions. As such it is legitimate to compare them and to ask how it can be that social saving estimates are so radically different in the three countries. Although Bakker does not provide an explicit decomposition of the social saving figures, he notes earlier that live entertainment was much cheaper in Britain (Bakker, 2008, p. 142), which would lead to Britain having a lower social saving from cinema – “(c_{t-1} – c_t)” is much lower in Britain than in either other country. Although the relative price of cinema to live entertainment was similar for the United States and France, live entertainment at a much higher market share in France. That French people’s "taste" for live entertainment at the same price ratio was greater than that of Americans should not surprise us: live entertainment in France would have been performed in French, but the vast majority of the world's films were in English. As such, cinema was a much worse substitute for live entertainment in France than it was in either Britain or the United States. Bakker argues that while 60% of the difference in cinema consumption between the United States and Britain can be explained by differences in relative prices, with only 40% to be explained by taste, the entire difference between cinema expenditure in France and the United States can be explained by differences in taste (Bakker, 2008, pp. 146-7). In this context therefore, the lower rate of social savings in France relative to the United States should be seen as stemming primarily from differences in taste for cinema, which in turn stem from the relatively limited selection of films that were available in French. In contrast, as we have noted, a large part of the difference between the social savings estimates for the United States and Britain comes from the fact that live entertainment was dramatically cheaper in Britain than it was in the United States, although part of the difference is explained by a greater preference to live entertainment in Britain, taking into account differences in relative prices.

As well as social savings estimates that have been prepared, it is easy to think of social savings estimates that would be relatively straightforward to prepare. There are, for example, many other technological improvements which could be analysed in this way. We know, for example, the costs of purchasing and operating civilian jet aircraft in both the 1960s and 1980s. In 1963 a Boeing 707 and Douglas DC-8 both cost around 1.2c per seat mile, including depreciation, by 1988 the costs of operating their successors, the Boeing 737 and McDonnell Douglas MD-80 were around 3c per passenger mile, which equates to around 2c per seat mile, in current terms (Sutton, pp. 463, 467). Even assuming implausibly that costs have not fallen since 1988, the current social saving from the Boeing 737 compared with predecessor aircraft is, as an order of magnitude, around $30bn per year, or around 0.2% of GDP (mileages from http://www.b737.org.uk/sales.htm). With more detailed data it would be perfectly feasible, and perhaps interesting, to document the rise in the social savings estimate for different types of aircraft over time.

We could also use the social savings methodology to assess the value of process as well as product innovations. Hounshell records that Ford was able to cut the price of the Model T Ford from $960 to $360 between 1909 and 1916, a $786 fall in 1916 real dollars (Hounshell, 1984 p. 224). Ford sold 577,036 Model Ts in 1916 (Hounshell, 1984 p. 224), giving a social saving estimate for that year of $453m, or about 1% of US GDP in that year, with steady growth in the intervening years. That the application of the concept of the production line by one car firm to the production of only one model of car can have a value of 1% of GDP in less than a decade is at one level quite remarkable. Yet the methodology is straightforward, and the data unambiguous. There are no issues connected with alternative technological trajectories, or of counterfactual canals or similar. We know what it cost to make a car in 1909 just prior to the implementation of the production line, and we know what it cost in 1916, just after the implementation. There is no reason to think that the 1909 figure would have changed in any meaningful way by 1916 had the production line not been invented, and the data on the number of cars sold in 1916 is clearly recorded. The social saving really is 1%, and that really is a large number. This sort of result reminds economic historians that interesting though railways and steam engines may be, the application of new production processes is also important, and should not be neglected. In particular, a new production process appears to have had rapid implications, whereas as the von Tunzelmann work shows, new products can take a long time to have a significant effect.

These two examples are given simply as illustrations that it is plausible to imagine that economic historians could create social saving estimates for a wide range of both product and process innovations, whose magnitudes might well generate at least further questions worth investigating.

5: Conclusion

Social savings represent a powerful addition to the economist and economic historians' arsenal of potential measures of the value of technological and other changes in the economy. The concept of social saving is of most use when data are too limited to allow a full assessment of consumer surplus. Since data on elasticity is not straightforward to calculate, and certainly never appear as data points in official or business records, the lower data requirements of social savings over consumer surplus offers considerable potential.

Social savings have been widely applied in the context of 19th-century railways. Nevertheless, that set of research has in some senses been disappointing. This is because the studies have been undertaken by different scholars, for different dates, which apply to railways at different points in their development. Furthermore there is no standard set of assumptions for authors to use to ensure that their studies are readily comparable. As such the economic history profession has created a wide range of estimates which cannot be readily compared with each other. As we have noted, the fact that scholars as imminent as Fogel and Fishlow, who agree on the validity of the methodology, do not agree on the size of the social saving available for the United States demonstrates the extent to which it is difficult to compare one study with another, or to take any one study as the authoritative judgement as to the social saving in any country at any given point.

We have noted that there are social saving studies of things other than the railways. Von Tunzelmann studied steam, which in some ways is a natural complement to studies of the railway. Likewise Bogart's study of the value of turnpikes in the British Industrial Revolution is also similar to the studies of railways in that turnpikes are also a form of transport. Once more, we note that although both studies are of high quality it is hard to put them into context. As we noted the value of turnpikes in 1815 is roughly an order of magnitude greater than the value of steam by 1800. It is must remain at least an open question as to whether turnpikes were really an order of magnitude more important for the British economy than steam at the start of the 19th century.

in this context Bakker’s study of the cinema is of considerable interest. By comparing the value of the cinema for three different countries at the same date he opens up the potential of saying something comparative. As we have seen, Bakker’s work suggests that both different prices and different tastes are important. Relative to the United States it is different relative prices that are most important in explaining the difference between the social savings valuation of the cinema in the United States and in the United Kingdom, whereas tastes are the biggest factor in explaining the difference in the social savings valuation of the cinema to France relative to the United States. Were these three studies to have been done by different people, using slightly different assumptions, and perhaps at slightly different dates we would not have the same confidence in our ability to compare the results, and thus to derive interesting conclusions.

This paper has also argued that there are many other technological changes that could be assessed using a social savings framework. We calculated order of magnitude figures for the improvements in shorthaul narrow bodied aircraft. Given that these were relatively small improvements, in that we were not comparing the pre-jet age with the post-jet age, it should not be surprising that the value was of a relatively small size. We also noted that the methodology could perfectly well be applied to process innovations. We gave as an example the application of the production line by Henry Ford at the start of the 20th century. Here we found that even over a small period of time the social savings results are quite large. This suggests that although new inventions may capture the imagination, economic historians should not underestimate the value of new methods of producing existing goods. The opportunity to increase welfare by making existing products more cheaply is potentially very large. In that context a social studies saving of the benefits of trade in existing low technology manufactured goods between more developed countries and, say, China in the last 20 years would be likely to yield a very high value indeed. It is not that the Chinese have, in the main, invented new goods of huge value, but they have demonstrated a consistent ability to produce a wide range of goods at much lower prices, freeing up money that consumers in developed countries are then able to spend on other welfare enhancing activities.

Given the limited interest and limited range of papers that use the social savings at methodology in recent years, it would be rash to predict a flurry of papers in the near future. If social saving studies are going to make a significant impact in economic and economic history in the future then it will be necessary for those who use the methodology to use it in a comparative setting wherever possible, or at least to facilitate comparison by producing studies that give figures for a wide range of dates, so that later scholars can more easily produce figures that are comparable. If that is done then it is certainly plausible that future social saving studies can hugely enrich our understanding of the past just as the original findings produced by Robert Fogel led to a dramatic reappraisal of the value of railroads to economic growth.

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