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A Broader Perspective**

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CONCENTRATION AND PRODUCTIVITY: A BROADER PERSPECTIVE.

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Abstract

Zitzewitz's suggestion, in a *Journal of Industrial Economics* March 2003 article, that Britain's pre-World War One lead over the USA in tobacco manufacturing productivity was due to its more competitive market cannot be sustained. A larger country sample shows a positive relationship between concentration and productivity, while accurate measurement of US and UK concentration shows similar concentration levels until 1911. The later US lead, though plausibly induced by antitrust-enforced competition, was due to tougher labour management rather than to stronger technical innovation.

Concentration and Productivity: a Broader Perspective.

by Leslie Hannah, Department of Economics, University of Tokyo

Eric Zitzewitz rightly emphasizes the potential of using international comparisons to understand the dynamics of productivity change (Zitzewitz 2003).¹ He reports that, over sixty years around the turn of the nineteenth century, in both the UK and the USA, the tobacco industry did best in periods of competition, whereas labour productivity stagnated in periods of monopoly. This note suggests that some of his findings cannot survive an accurate measurement of the concentration variable, nor an expansion of his country sample from two to eleven. Nonetheless, his dummy variable could be capturing an alternative, and often neglected, behavioural explanation of the US-UK productivity divide.

Zitzewitz identifies the one-firm concentration ratio as the appropriate measure of the degree of monopoly (2003, Figure 3). He then interprets his detailed observations of this ratio for five tobacco sectors over 21 years as a dummy variable showing the US industry as monopolized in 1890-1911 (the former being the date of the merger of 90% of US cigarette production into American Tobacco and the latter the date of the antitrust break-up of that company), while the UK industry is described as monopolized from 1902-1939 (that is, from when the dominant UK firm, Wills, merged with its main competitors to form Imperial Tobacco in 1901-1902, until 1939, the terminal date of his study). The

¹ I am grateful to Eric Zitzewitz for constructive discussion of an earlier version, though that does not implicate him in any remaining errors.

essence of his econometric results is that the UK took the productivity lead in the first period, when it was more competitive than America, but that antitrust action (the 1911 break-up of the US trust) then led to greater technological progress and higher labour productivity in the USA.

Stigler (1966) preferred the Herfindahl index to the one-firm concentration ratio in his earlier Anglo-US cigarette industry comparison for 1900-1960, but it would be pedantic to insist on this more comprehensive measure. In the tobacco industry, the dominant firms in both countries soon became very dominant and the difference boils down to whether one firm or several controlled a very large share of output: the one-firm concentration ratio is actually perfectly targeted on capturing that (Hannah and Kay 1976). However, Zitzewitz appears to have been misled in his classification by the contemporary American habit of dividing its large manufactured tobacco industry into five or more sectors (for, example, cigars, snuff, cigarettes, plug/twist and smoking tobacco, Zitzewitz, 2003, but see Commissioner of Corporations 1909, 1915 for finer classifications). By contrast, the British sources, dealing with a more highly-taxed and hence much smaller industry, typically quote the dominant firm's market share for cigarettes only (a new product which rapidly rose from 4% of the UK manufactured tobacco market in 1890 to 42% in 1912) or for the whole tobacco industry (Monopolies Commission 1961, Alford 1973). Generally the finer the product definition the higher the average recorded market share, but it is a simple matter to convert the figures to a common basis.² Table I shows the share by weight in all domestic manufactured tobacco

² All tobacco outputs in both countries are measured in pounds avoirdupois, except US cigar and cigarette output, which is reported in numbers of sticks. I have used the standard industry assumption that one

Table I. One-firm concentration ratios in the US and UK tobacco industries.

	USA	UK
	%	%
1890	3	7
1895	13	8
1900	47	11
1905	70	52
1910	68	58
1913	21	na
1915	na	63
1919	14	na
1920	na	74
1934	20	75
1948	na	79

Source: see Statistical Appendix

sales of American Tobacco in the USA and of Wills (from 1901, Imperial) in the UK.

There can be no debate that America was less concentrated after the 1911 break-up, but suggesting that “the US and UK were monopolised at different times” (Zitzewitz, 2003, p.

cigarette weighs a gram (or, less conveniently, 15.4 grains avoirdupois), applied this also to little cigars; but adopted Zitzewitz’s estimate (63.0 grains avoirdupois) of the weight of a big cigar. I suspect that the latter is high for this early period, but the trust specialised in cheaper (and presumably lighter?) cigars, so the biases may be self-cancelling in a concentration ratio, and any plausible adjustment of these assumptions would not change the measured concentration by more than one percentage point. Calculation of concentration ratios by value added or sales revenues rather than weight requires more assumptions, but, given that most US value-added and sales were in (low concentration) cigars and most British value-added in (high concentration) cigarettes, it would likely result in higher British than US concentration levels.

12) is putting a rather strong interpretation on the pattern shown for the pre-1911 benchmark years in Table I.³ For both countries the striking reinforcement of market power is around the turn of the century and concentration levels are quite similar in all benchmark years, except 1900; and that year differs only because the key mergers that achieved dominance were spread over 1898-1902 in the USA (and half completed by 1900) but in Britain were bunched in 1901-1902, hardly a critical difference in competitive conditions. It is moot whether the correct industry boundary is the tobacco industry as a whole, rather than just cigarettes, but, since cigarettes were of rather minor (and not consistently increasing) importance in the American tobacco market (peaking at 6% of domestic leaf tobacco use in 1896 and 1911, but falling below 3% in 1901-1905, Commissioner of Internal Revenue, 1892-1912), the frequently quoted one-firm concentration ratio in cigarettes alone is wholly inappropriate when the dependant variable is the entire tobacco industry.⁴ Moreover, although the US tobacco market was more traditional and took up cigarettes much more slowly than the UK, there were, in this period of rapidly evolving tastes, high price cross-elasticities of demand between alternative smoking products, so Zitzewitz's decision to treat the tobacco industry as a whole seems the right one.⁵

³ From the dummy variables in the equations it appears that the precise meaning of this is that the USA was monopolised in 1890 and the UK in 1902

⁴ Even in cigarettes alone the differences are not overwhelming: for example, in 1895 Wills' share was 53% and American's 86%. Zitzewitz's discussion of Ogden's competition with Wills suggests he may also have had in mind contestability of markets. Again, however, the quantitative indications do not support this: Wills' share in cigarettes, removing the market share effects of the 1901-02 mergers, declined from 53% to 48% during the turn-of-the-century period of competition, whereas, with similar adjustments for mergers, American Tobacco's core cigarette market share fell from 86% to 56% (Alford 1973, Commissioner of Corporations 1909). But, of course, contestability thus measured is a function of monopoly pricing or product positioning mistakes, as well as real barriers to entry, so this may simply reflect the managerial incompetence or bad luck of American Tobacco, not inherently high contestability (though it is not clear how the latter can otherwise be measured).

⁵ During the Spanish-American War, for example, when US cigarette taxes were increased by 200% but cigar taxes increased by only 20%, the number of cigars smoked rose from equality with American

It is not obvious that these two economies with only mildly differing concentration levels before 1912 are the right places to look for evidence of performance differentials deriving from variations in market concentration. A strikingly larger range of variation is observable in the manufactured tobacco industries of other major industrial economies. Exceptionally, the long-term effect of pure monopoly is observable in France, Italy and Austria (where there were state-owned, statutory monopolies) and the shorter-term impact in Japan (which had nationalized its competitive, and hitherto private, tobacco manufacturing industry in 1904). Private ownership, as in the US and UK, was the norm in all other large markets, though in Spain the private monopoly took over a 100% market share by franchising a previously criticised state monopoly. Canada and Australia were also even more concentrated than the US and UK, since Imperial and American Tobacco had subsumed their interests there in joint local subsidiaries of BAT (Cox 2000, Wilkinson 1914). Germany and Russia experienced the most consistently competitive regimes in the private sector: their one-firm concentration ratio probably stayed around 10% even after the turn of the century, when Table I shows both the US and UK becoming significantly more concentrated.⁶

cigarettes to three times their level, implying high cross-elasticities (Commissioner of Corporations 1909). It seems intuitively plausible that there were lower cross-elasticities between chewing tobaccos on the one hand (largely confined to dockers and miners in Britain, but a more widespread addiction in the USA) and all smoking modes on the other; but omitting all chewing tobaccos, and calculating concentration in a combined smoking sector, including cigars, cigarettes and loose, cut smoking tobacco (used for pipes or roll-your-own), would actually decrease US concentration, as would the hiving-off of snuff, in which the trust's monopoly was strongest of all and which had about the same share of the US tobacco market as cigarettes.

⁶ In Germany Jasmazi (BAT) was the second largest cigarette producer, and not far behind the leader, for much of the period, but had about 10% of the market: it was not until further acquisitions in 1912 that BAT's cigarette market share rose to 25%, and that still left it below 10% of the whole tobacco market (Bormann 1910, Cox 2000, Wolf 1918). The Russian merger of thirteen companies, giving the new Russian

Table II. Productivity in manufactured tobacco, ca.1912.

	Output per person employed (lbs. per year)	Estimated one-firm concentration ratio
France	5,030	100
Australia	3,283	89
UK	3,212	60
Canada	2,852	80
USA	2,721	21-68+
Italy	2,412	100
Japan	2,404	100
Austria	2,277	100
Spain	2,023	100
Russia	1,811*	10
Germany	1,337	10

*cigarettes only.

+before and after divestiture

Source: see Statistical Appendix

Tobacco Company 75% of cigarette output and 56% of other tobacco products, was not completed until 1914, and the largest firm before that had only 20% of cigarette output, less of tobacco (Kopylov 1976).

Table II shows physical productivity measures for these eleven countries in 1912, when trust control in the US was terminated. The extreme observations show good performance is compatible with monopoly (France) and weak performance with competition (Germany), but the productivity results for the other countries, including the US and UK, are more striking for their similarities, irrespective of concentration level, than their differences.⁷ It should be recalled that at this time the typical American manufacturing worker produced twice as much as the average British or German worker, three times as much as the French, ranging up to nearly nine times as much in the case of Japan, so the similarities are even more striking relative to what was happening in the rest of their economies (Broadberry 1997). Given the quality of the data, too much should not be read into small differences in either this or Zitzewitz's measure, as opposed to the extremes in this table or his very large 1930s US lead in tobacco productivity.⁸ For cigarettes, at least,

⁷A linear function would suggest a positive correlation between concentration and productivity, but Zitzewitz draws on the theoretical and empirical literature to suggest an inverted "U" relationship. If that function were fitted, the top of the inverted "U" would still be at a significantly higher concentration level than previously suggested by the studies he cites. It would be interesting also to look at rates of change in productivity as well as levels (as Zitzewitz does for the US and UK). While there is evidence in the sources cited of extremely rapid productivity increase in the first decade of the twentieth century under both competition (Russia) and monopoly (Japan), reliable time-series data is not available for all the countries concerned.

⁸ I have preferred physical productivity measures on grounds of data reliability and availability (Zitzewitz's value added weights for 1896 depend on the cost accounts of two products with perhaps 5% of the market). Zitzewitz's estimates of the British productivity spurt may be too high for pre-1900 when they are based on Wills alone, which probably improved its efficiency more rapidly than the other British tobacco firms, which still accounted for around 90% of output. One might expect more divergence between our two estimates if one country's output had a greater value-added to weight ratio, though this seems unlikely, from the detailed US data on relative productivity levels in cigars, cigarettes and other tobacco, and their relative shares in these. I also use the same industry definition for the denominator and numerator of the productivity measure, from the 1912 census, while Zitzewitz uses Todd's higher estimate of output (which incorporates an allowance for products missed by the census), but makes no corresponding allowance for the workers who produced that output. Zitzewitz also applies Rostas's 1930s adjustments for stemming labour and cigar weights, whereas I have taken note of contemporary indicators that such adjustments may be inappropriately high (Madsen 1916, Alford 1973). He also uses wage-earners only as the denominator (whereas I use all labour, including the self-employed), though this leads him to a lower estimate of the British productivity advantage: the US had many thousands of small family tobacco firms, with self-employed (and often hand-working) owner-managers, particularly in its important cigar sector. The central point is not that my estimates are better, but that for all historical data of this kind, we would be

there is convincing supplementary evidence that both our measures are right to show British factories as the more efficient. When American and Imperial merged their overseas subsidiaries and exporting interests into the British American Tobacco Company (BAT) in 1902, this did more than eliminate the main international competition in cigarettes for both countries' bonded export factories (incidentally reinforcing the point that their competitive regimes were similar and, to a degree, endogenous). The new BAT (which until 1911 was two-thirds owned - and hence controlled - by the American trust and one-third owned by Imperial) froze its hitherto growing US cigarette exports and sourced its rapid increase in exports to third countries (principally to China) from the UK (Cox 2000). It is not obvious why it should have done this unless the bonded British factories it took over in Bristol and Liverpool had lower manufacturing costs than its factories in North Carolina and Virginia.⁹

Clearly the USA was failing to forge ahead in this period, but if this is not related to national concentration levels, what was driving this exceptional, early, but short-lived global convergence of productivity levels? This is not the place to discuss the engineering professionalism of state managers in Japan or France, the contrasting (and counter-stereotypical) national degrees of product standardisation or of fiscal discrimination against cigarettes, or the technical and sales skills of American and European cigarette

wise not to over-interpret small differences in measured productivity levels. It is striking that our results show a very similar US productivity gap in 1912.

⁹All British leaf was imported, mainly from Virginia. The Panama Canal was not completed until 1914, but it was still presumably cheaper to ship cigarettes from Virginia to Shanghai, than leaf tobacco from Virginia to Bristol, then cigarettes from Bristol to Shanghai (a longer route with more transshipment).

machinery manufacturers.¹⁰ But what is clear in the two countries discussed by Zitzewitz is that, while they had similar (initially low, and then - for this industry – middling) levels of concentration, there were striking differences in business conduct in the USA, which initially were driven by business culture or corporate finance, rather than market structure.

This is seen most clearly in the contrasting methods by which the dominant market shares were built up. In Britain, Wills constantly expanded demand for cigarettes by offering lower prices, growing almost entirely internally, both before and after the exceptional 1901 merger.¹¹ By contrast, after the initially impressive performance of its constituent companies in the 1880s, American Tobacco's cigarette sales to the domestic market were constrained (its sales actually fell after 1896) and prices raised, in order to rack up profits to finance the "long purse" required to win predatory price wars against manufacturers of other tobacco products at home and overseas, and to support the new stock issues necessary to fund a rapid increase in size through, often contested, acquisitions (Commissioner of Corporations, 1909, 1911, 1915, Burns, 1982, 1986, 1989). The combination of pugnacity with professional incompetence in American Tobacco's management is hinted at, for example, in Zitzewitz's comments on overpayments for exclusive technology licences and his suggestion of managerial overload is more plausible than the hagiographic tone of much other writing on the trust. American Tobacco was highly profitable, but its profits increasingly came from objectionable

¹⁰ I am currently undertaking a series of quantitative and qualitative international comparisons of these issues, in a wider range of industries, under a Kojima Foundation grant to the Department of Economics at the University of Tokyo

¹¹ Sweet Caporal, the dominant turn-of-the century brand in the USA, was very similar to Woodbine, the dominant British brand made with imported Virginia tobacco (though it was maybe 20% larger), but cost 75% more ex-tax, see Alford 1973, Commissioner of Corporations 1915.

behaviour: rather than creating value through innovative commercial and technical contributions, it was more often playing zero-sum or negative-sum games with rivals and partners. Its head, James B Duke, avoided the criminal prosecution that some American civil servants favoured, but there is evidence of insider dealing at the expense of shareholders, union-bashing, economy with the truth bordering on perjury, secret fighting companies, attempted bribery of witnesses and other crimes and misdemeanours, arguably too numerous to be written off as partisan muckraking journalism (Commissioner of Corporations 1911, Moody 1933, Kolko 1963). Of course, various interpretations of such evidence are possible. Yet, so egregious was the trust's behaviour that in the decade or so before the First World War it lost its social "licence to operate" not only in the USA through the antitrust suit, but also, on account of its overseas activities, in Japan and came close to it in the UK, China, Germany, Canada and Australia (Anon 1980, Blaich 1975, Cox 2000). Getting up the noses of one set of nationalistic politicians and their local business clients in one or two countries could be a badge of honour (or of bad luck), but doing the same in seven or more varied countries begins to smack of something more seriously amiss, even if not on a scale to match Enron. It is unfashionable, despite such recent parallels, to characterise trusts in the way American progressives did in the first decade of the century, or to believe that politicians bashing business may sometimes be right, but American Tobacco must be a leading contender for the title of a "bad trust." It could be this behavioural characteristic, rather than the supposed structural one, that Zitzewitz's dummy variable for the US between 1890 and 1911 is picking up: it is difficult to think of an alternative explanation of its significant role in the equation.

What about the massively de-concentrating 1911 antitrust break-up, the displacement of the toxic leader primarily responsible for the earlier policies,¹² the effective prohibition of predatory pricing and large mergers, the facilitation of new entry, and the onset of oligopolistic competition, in short what of the *exception américaine*? After 1911, Zitzewitz is on firmer ground. Not only does Table I confirm a widening concentration differential, but Broadberry's comprehensive study confirms his finding that American tobacco productivity moves rapidly ahead of Britain, and even further ahead of (then monopolised and cartelised) Germany also (Broadberry 1997).

By the middle decades of the twentieth century, no major industry in the world had such extreme forms of nationally polarised industrial structures as the tobacco industry, or (as it increasingly became everywhere) the cigarette industry. Russian competition was substantially extinguished in 1913-1914, when the leading producers in Moscow, St Petersburg and Rostov-on Don merged to create what was probably the world's largest cigarette firm, leaving only a little further consolidation to Lenin and Stalin. The Germans in the 1920s also established a private, unquoted cigarette monopoly, orchestrated by Deutsche Bank and the Reemstma family, with 90% of the market. In Britain, Imperial Tobacco continued to raise its market share, and in 1933 signed a cartel agreement with its remaining domestic competitors. BAT, the industry's only major

¹² Duke found a more congenial home for a serial monopolist in London and became chairman of BAT (whose American-owned shares were floated on the London stock exchange in 1912) until 1923. This appears to have involved a further remarkable secret insider deal at the expense of shareholders, involving paying himself share options worth nearly two-thirds of BAT's 1911 profits, but he was an increasingly absentee chairman after 1914, so it would be unfair to blame him for the increasing relative British inefficiency documented by Zitzewitz (which takes no account of the distributional consequences of insider looting of shareholder funds) for that period. (Cox 2000)

multinational, and British-controlled from around 1912, also built a dominant market position in many other countries, including Canada, Australia, India, China and a number of Latin American and African nations. There were a few small industrial countries, like Belgium, where industrial concentration levels (as formally measured) resembled America's, but this was misleading: unlike in the USA, cartels there explicitly divided markets. Already in 1912, there was little international trade outside Asia, and there was even less import competition later, so only America by the 1930s experienced consistent and effective competition in its domestic market. (Cox 2000)

Given the positive correlation between concentration and productivity before the First World War, one might reasonably remain sceptical about the statistical significance of a post-war negative correlation which necessarily is driven by one observation of low concentration: the only possible one, that for the USA. At the very least, there may still be other unexplored variables also determining relative performance. One mechanism emphasised in the literature can, however, be ruled out: that competition led to greater, US-generated technological innovation after 1911. The American Machine and Foundry Company (a subsidiary of American Tobacco until 1912) was in the early twentieth century the leading supplier to the global market of the cigarette machinery that represented a large part of the tobacco industry's future. However, by the 1930s technical leadership had passed to the British firm, Molins, founded by Cuban-American immigrants to London, financed (and significantly controlled by) the British-owned, arch-monopolists of the period, Imperial Tobacco and BAT (Hall 1975, Monopolies Commission 1961). Despite having entered the US domestic market through the

acquisition of Brown & Williamson in 1927, BAT decided to allow sales of the Molins machines to its US rivals, successfully competing in the US cigarette market on price and brand, not on its technological lead. The competitive and highly productive American cigarette industry thus substantially relied on imports of British technology, until in the 1960s technological leadership passed to the German firm, Hauni. This supports Zitzewitz's emphasis on tighter labour management and rationalisation of sub-scale production in America as the likely source of the emerging US productivity lead, but is hardly disproof of the view that monopoly sometimes encourages investment in innovation.¹³

This uncharacteristic slippage in cigarette machinery apart, the observation of American manufacturing forging ahead by the mid-twentieth century is not, of course, unique to the tobacco industry. It seems entirely plausible that the large continental market of the USA, with vigorous internal competition, reinforced by antitrust policies that were compatible (given large market size, and despite high levels of protectionism) with economies of scale, should have generated strong performance. European countries – all of them significantly smaller – for long denied themselves similar advantages through increased protectionism and continued legal promotion of or toleration of national champions, monopolies and cartels. The obvious hypothesis, identifying the vigour of competition as the source of the mid-century transatlantic forging ahead in productivity (only reversed by Europe-wide integration, effective anti-monopoly laws and global tariff reductions in

¹³ The capacity of Imperial Tobacco and its BAT associate to finance innovation should not be under-rated. Imperial was, in 1937, the second largest industrial firm by equity capitalisation, after General Motors, on the world's stock markets and BAT was twelfth, ahead of the largest US-based successor company to American Tobacco at twenty-third (Schmitz 1995). This is an impressive testimony to the power of monopoly over addictive goods, in the absence of antitrust laws, to generate super-normal profit.

the 1950s and 1960s) can be advanced only a little further by this excursion into one, exceptionally structured industry, which is not as unambiguously supportive of the case as Zitzewitz implied.

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STATISTICAL APPENDIX

Table I. The British concentration figures are from Alford (1973) and Monopolies Commission (1961). The US figures are the author's aggregation of data on market share and total sales of individual products in Commissioner of Corporations (1909, 1915) up to 1913, using the method described in footnote 2 above. Thereafter US firm market share data by weight is not available for all products, but in 1919 and 1934 American Tobacco's net dollar sales for all products are given here as a percentage of the census tobacco industry value of products figure. The largest firm is assumed to be American Tobacco for all dates in the USA (though this may not be correct for 1890, when a plug company may have been slightly larger, and in the 1930s when R. J. Reynolds vied with it for top position), and is correctly assumed to be Wills (after 1901 Imperial Tobacco) in the UK. Gallaher's sales (perhaps 5% of the market) are not included with Imperial's from 1934, despite the fact that the latter then secretly acquired a controlling majority of its shares. The share of Imperial in cigarettes is stated by the Monopolies Commission for 1920, 1934 and 1948, but for all tobacco manufactures only in 1920 and 1948: my estimate for 1934 depends on the assumption that the closing of the 18 point gap of 1920 between the two measures to 3 points by 1948 had largely occurred by 1934.

Table II. Data relate to calendar 1912 or the financial year beginning in March-July 1912, except for Spain, where they relate to calendar 1913. Productivity figures are calculated (using the figure for all employment in the denominator) for continental Europe and the British dominions from data in Madsen (1916, table facing p. 214, and pp. 222, 235, 243, 255.), with output taken to be consumption less imports plus exports. An allowance of 10% of insured employment is made for voluntarily insured and uninsured German

workers and also of 10% of wage-earners for non-wage-earner labour in Canada and Australia. The UK figure is from the 1912 Census of Production (Board of Trade, 1932, p. 218.) and Japan from Anonymous 1980, p. 683. The USA's output is Madsen's adjustment of the official data for the fiscal year ending 30 June 1913 (1916, table facing p. 214, domestic sales plus exports, making no deduction for imports, which were negligible, except in cigars), with employment from the 1914 census, less 2%. For Russia, employment data for the whole tobacco industry is not available and the productivity data relates to cigarettes only, with Nutter's (1962) output data divided by Mints' (1975) employment data, on the standard assumption that one cigarette weighed one gram. This probably flatters Russian physical productivity in that *papyrosi*, which dominated the Russian cigarette market, had hollow cardboard mouthpieces where the modern filter tip is and thus contained less than the standard amount of tobacco, but in terms of manufacturing they required similar inputs and in terms of consumers delivered similar value to a standard weight western cigarette. The concentration ratios are the author's estimates for 1912 from the sources quoted in the text, and are least securely based for Canada, Germany and Russia.