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Adam Smith's use of multiple references for his pin making example*

Jean-Louis Peaucelle

1. Introduction

'It has been said of the first chapter of the *Wealth of Nations*, which deals with the division of labour, that it is beyond all comparison, the most popular chapter of the *Wealth of Nations*; no part of the work has been so often reprinted . . . no part of it is so commonly read by children, or so well remembered by them.' This phrase comes from the beginning of Salim Rashid's 1986 article where the author cites E.G. Wakefield's commentary in the 1843 edition of *The Wealth of Nations*.

In this first chapter, Adam Smith uses the example of a pin maker to describe the division of labour. The chapter's construction, generalizing from an example, is particularly striking.

This brilliant introduction however requires closer inspection. One question arises as to the origins of the example. Did Adam Smith personally observe the factory or did he develop his example from contemporary writings of his time? The questioning of Smith's sources is made difficult by the loss of his handwritten notes after his death on 17 July 1790. John Rae (1965 [1895]) wrote of this deliberate destruction: 'A week before his death, he expressly sent for them [Black and Hurtton] and asked them then and there to burn sixteen volumes of manuscript to which he directed them. This they did without knowing or asking what they contained. [. . .] When the sixteen volumes of manuscript were burnt Smith's mind seemed to be greatly relieved.' What did these 16 volumes contain? Why would Adam Smith want to keep part of his work secret?

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Adam Smith used the pin maker example to advance his theory that the division of labour results in productivity improvements. The organization of work within the small pin making industry was considered sufficiently convincing that it was used to defend an economic law. The division of labour is at the beginning of *The Wealth of Nations*.

While the study of pin making has been examined and commented on at length, it still remains unclear as to where Adam Smith acquired his understanding of the pin industry. One hypothesis is that Smith himself collected the data in the field. However, we can say neither when nor where he would have done so. A second hypothesis is that his data come from his readings. To prove that, it is necessary to identify the original work, or works used.

We suggest that Adam Smith based his work on several French texts. In the second half of the 18th century, Diderot's *Encyclopédie* and the Académie des Sciences de Paris explained pin manufacturing in detail. These texts were later copied, commented on and synthesized. A large number of readings were thereby available to Adam Smith. Our thesis appears reasonable. It still remains to be shown however how these texts were used by Smith to construct his work.

Theories, past and present, explaining the origins of Smith's pin making example are first presented. They are then examined in the light of the texts themselves. We notably highlight a number of weaknesses in the most often cited thesis, that of the use of the article 'Épingles' from the *Encyclopédie*. We complete this thesis with three other documentary sources. We then show how Smith's writings are developed from these four sources.

2. Ferguson's French source

Adam Ferguson was a colleague and friend of Adam Smith. They taught the same subject, moral philosophy, in Glasgow. In 1767 he published *An Essay on the History of Civil Society* (Ferguson 1966 [1767]). The division of labour was considered in the fourth chapter: 'Of the separation of Arts and professions'. He wrote: 'a people can make no great progress in cultivating the arts of life, until they have separated, and committed to different persons, the several tasks, which require a peculiar skill and attention'. Progress comes not without division of labour. Such a division enables the simultaneous improvement of quality and productivity. 'Every undertaker in manufacture finds, that the more he can subdivide the tasks of his workmen, and the more hands he can employ on separate articles, the more are his expenses diminished, and his profits increased'. 'By the separation of arts and professions, the sources of wealth are laid open'

(Ferguson 1966 [1767]: 180–1). Profit and wealth result from the division of labour.

One of Adam Smith's theses was exposed by his colleague before the publication of *The Wealth of Nations* in 1776. Adam Ferguson's approach was more a sociological one however. Excessive division of labour strains social ties. 'The separation of professions, while it seems to promise improvement of skill, and is actually the cause why the productions of every art become more perfect as commerce advances; yet in its termination, and ultimate effects, serves, in some measure, to break the bands of society' (Ferguson 1966 [1767]: 218). This sociological thesis, opposed to the division of labour, would later be made famous by others, notably Karl Marx.

When Adam Smith discovered his colleague's writings, he immediately saw his own ideas. He accused Ferguson of copying. Ferguson denied any plagiarism. Both were inspired by the same source: 'some unnamed French source "when Smith had been before him"' (Hamowy 1968: 249 citing John Rae 1965 [1895]). Ferguson's defence leads us towards the French origins of Smith's ideas.

It may seem strange that Smith, who himself published in 1776, complained of plagiarism in 1767. Edwin Cannan (1896) provides an explanation. Notes taken in class by Smith's students were published. Cannan actually found the published text that had been sold to students in Glasgow. Smith spoke in class of the division of labour as early as 1763. This same subject could easily have been discussed with colleagues.

Adam Ferguson had the opportunity to copy Adam Smith. The question is whether he did or not. Was his reference to a common French source simply a way of hiding his own plagiarism? Cannan (1896) believes so and in so doing defends the originality of Smith's work. Others advance different hypotheses. Hamowy (1968: 255) argues that between 1780 and 1785 Adam Smith questioned draft texts from Adam Ferguson's book that would later be published after Smith's death (Ferguson 1792). He notably gave the example of pin making.

In any case, the theory that French sources were used should not be discounted. What could this text have been? Many authors have debated this question.

August Oncken (1909) has no doubt that the French source was Montesquieu: '... kann nicht wohl ein Zweifel darüber obwalten, dass er unter der älteren gemeinsamen Quelle Montesquieu verstanden wissen wolle, niemand anders'. Oncken however, did not directly refer to the texts. He based his reasoning on Ferguson's acquaintance with the French author. Charles de Secondat de Montesquieu (1689–1755) was known throughout Europe for his 1748 work *L'Esprit des lois* (The spirit of laws). As no description of pin making appears in this text, we abandon this theory.

Contemporary experts favour the article 'Épingles' (Pins) from Diderot's *Encyclopédie* as the French source of Smith's work.

3. The 'Épingles' (Pins) article from the *Encyclopédie*

Volume V of Diderot's *Encyclopédie*, published in 1755, included an eight-column article by Delaire entitled 'Épingles' (Pins). The similarities with Adam Smith's text indicate that this is the French source of his work.

Germain Garnier adopted this point of view in his 1802 translation into French of *The Wealth of Nations*. This translation is still that used by French economics students. The technical terms used by Delaire to describe the process are reintroduced in italics. The first stage is 'a man draws out the wire'. Garnier boldly translated this phrase as '*un ouvrier tire le fil à la bobille*' (see Table 1). In French the word *bobille*, derived from *bobine* (reel), is rarely employed. No dictionary suggests this same translation. Garnier chose to do so as he read Delaire's text at the same time as he translated Smith's. He extrapolated. In his text, he added an additional step from the *Encyclopédie*, '*piquer les papiers*' (to pierce the papers). He did more than simply translate.

Hamowy (1968) also identified the *Encyclopédie* article as the French source of Smith's work. His main argument is that Adam Smith and Delaire both cite 18 pin making operations. The concordance of dates reinforces his thesis. We also know that Smith was in charge of purchases for the University of Glasgow library. He subscribed to Diderot's *Encyclopédie*. His colleagues criticized him as he used up their credits in doing so. Other works could not be purchased. Moreover, Smith reviewed the *Encyclopédie* quite favourably in the 1756 *Edinburgh Review*.

Groenewegen (1977) offers a variant. 'The famous pin example, probably derived from his observations of nail making in Kirkcaldy and his reading of the article, "Épingles", in Volume V of the French *Encyclopedie*.' Adam Smith was born in Kirkcaldy. He lived there until the age of 14. He returned for two years at the end of his studies. It is quite possible that he observed the town's nail making activities. A possible rebuttal is that he would have looked up the word *clou* (nail) in the *Encyclopédie* instead and in so doing he would have found a different seven-column article. It is not so simple to pass from nails to pins.

Murray Rothbard (1995: 443) also defends this thesis. 'There is strong evidence that the "French source" for both writers was the article *Épingles* in the *Encyclopédie*'.

The famous article 'Épingles' (Pins) was written by Alexandre Deleyre¹ (1726–97). A student of the Jesuits in Bordeaux, Deleyre worked as a

Table 1 Extracts from book 1, chapter 1, *Recherches sur la nature et les causes de la richesse des nations*, Adam Smith, 1802, Paris: Agasse, translated into French by Germain Garnier (italics as per the original text [1991] Paris: GF-Flammarion)

<p>One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, . . .</p>	<p>Un ouvrier <i>tire le fil à la bobille</i>, un autre le <i>dresse</i>, un troisième <i>coupe la dressée</i>, un quatrième <i>empointe</i>, un cinquième est employé à <i>émouder</i> le bout qui doit recevoir la <i>tête</i>. Cette <i>tête</i> fait elle-même l'objet de deux ou trois opérations séparées: la <i>frapper</i> est une besogne particulière; <i>blanchir</i> les épingles en est une autre; c'est même un métier distinct que de <i>piquer</i> les papiers et d'y <i>bouter</i> les épingles; enfin l'important travail de faire une épingle est divisé en dix-huit opérations distinctes ou environ . . .</p>
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poorly paid freelance journalist for diverse journals such as that of Diderot. He published several unremarkable works. His first on Francis Bacon was full of errors. The *Critical Review* reported 'Our analyst has established absolute contradictions...The analyst has confounded and obscured' (1757, 1st semester, p. 465). Deleyre ended his career as a member of both the Convention and the Institute.²

This is today's official and largely accepted version of Smith's sources. There are however several weaknesses to this theory:

- Adam Smith's first stage is that of wire drawing. 'One man draws out the wire'. The first stage in the *Encyclopédie* is 'to yellow the brass wire'.³ Wire drawing, *tirer à la bobille*, takes place at the second stage. The texts differ on this first stage, yet they both refer to 18 stages in all.
- Adam Smith is unsure of the number of stages required to make the pin head. Is it two or three? 'To make the head requires two or three distinct operations.' The *Encyclopédie* clearly describes three.
- Adam Smith describes a strange fifth stage: 'a fifth grinds it at the top for receiving the head'. Why grind the pin head? The rounded end would be flattened. According to the *Encyclopédie* the points are finely reworked. These activities are completely different.
- Adam Smith estimates production at 4,800 pins per person, per day. The *Encyclopédie* doesn't estimate production rates.

The *Encyclopédie* appears a difficult reference to use as it covers so many subjects. Why would Smith have thought of looking through the *Encyclopédie* for such a minor article? One rarely thumbs through a dictionary.

A dictionary is typically used for a more deliberate inquiry about a precise topic. Why then was Smith so interested in pin making?

In the light of this discussion, Germain Garnier's evidence appears relatively weak. The article 'Épingles' from the *Encyclopédie* was no doubt influential but it is unlikely to have been the only source. Other texts may have come between Adam Smith and the *Encyclopédie*. This is the hypothesis we defend here.

4. The multiple references hypothesis

While Adam Ferguson only spoke of one French reference that he shared with Adam Smith, the latter may have used several texts. He may only have shown one to his friend and gathered others as he worked on the subject.

The multiple references hypothesis is suggested by the following parts of his work:

- 'The division of labour has been very often taken notice of, the trade of the pin-maker'. Today's reader may be surprised by this remark. Were pins so often spoken of at the time? What does 'very often' mean?
- 'Making a pin is divided into about eighteen distinct operations'. Why is he uncertain as to the exact number of activities involved? The *Encyclopédie* clearly spoke of 18 operations.

The multiple references hypothesis is also suggested by the differences between the texts of *The Wealth of Nations* and that of the notes taken between 1762 and 1764 by his Glasgow students (*Lectures on Jurisprudence* in Scott (1937)). He already spoke in class of the division of labour and pin making. We have a written trace of Adam Smith's thinking prior to *The Wealth of Nations*. The differences between these texts suggest that he collected new data between the two publishing dates.

In his 1763 lectures, he estimated productivity at 2,000 pins per day and per person. In 1776, the level of production was 4,800 pins per day and per person. This difference could be explained by the collecting of new and better information in the interim. He implies that the data were collected personally. 'I have seen a small manufactory of this kind'. He may also have uncovered a new written reference. Another hypothesis is now developed.

What could these references have been? The French were also interested in pins at this time. As early as 1723, Savary included an article 'Espingles' (Pins) in his *Dictionnaire du Commerce* (Trade dictionary). He mainly detailed the organization of the pin maker's guild. The major texts on the pin making process were published in the *Encyclopédie*, Deleyre's 1755

article, 'Épingles', and an article by Perronet, 'Épinglier' (Pin maker), in the 1765 volume of plates.

The Académie des Sciences de Paris also wrote on the subject in 1761. Duhamel du Monceau published *L'art de l'épinglier* (The art of pin making), an 84-page collection of writings to which Réaumur, Perronet and Chalouzières each contributed. The texts were interwoven, with each describing a different stage of the production process. The credit given to each author showed the emerging concern for intellectual property rights. Given each contributor's renown, Duhamel probably had no alternative but to identify the source. While Réaumur was no longer alive at the time, his manuscript had been widely read. Perronet on the other hand was very much alive. In charge of the engineering school, he was an influential figure in the administration of the Ponts et Chaussées (roads and bridges).

Pin making was the subject of these three important texts, published in 1755, 1761 and 1765. A great number of minor works were also published. Many periodicals included book reviews. *L'art de l'épinglier* was reviewed several times. The volumes of the *Encyclopédie* were mentioned and its articles were reviewed from time to time. Journalists generally preferred philosophical articles. They were not really interested in pins.

Another minor text was the pin making article in technical dictionaries. The *Encyclopédie* had opened the dictionary market. As the *Encyclopédie* remained expensive, publishers filled the segment with cheaper, more specialized dictionaries. These small 'portable' dictionaries were actually compilations of more voluminous works otherwise inaccessible to the general public.

All the French texts are not cited here. Many could not have been used by Smith: the publishing dates do not match, the texts differ too widely, or they were not available in Glasgow. The French texts tended to copy one another. A detailed study shows that all the publications are based on two main handwritten studies in Normandy in 1717 and 1739. This subject will be examined in a forthcoming article.

In order to explore the multiple references hypothesis all the texts were collected and examined to determine how they could explain Adam Smith's writings. Four major texts were identified. They will now be presented individually.

4.1. Dictionnaire portatif des arts et métiers by Macquer

Adam Smith owned a large collection of books (Bonar (1966) [1894], Mizuta 1967). He had bought many different works during his travels in France. One purchase is particularly important here. The *Portable dictionary of Arts and Crafts including a short history, description and policy of the Arts and*

Crafts, of workshops and of factories in France and abroad,⁴ by Philippe Macquer, published in 1766 in Paris. This dictionary contained an article entitled 'Épinglier' (Pin making).

Philippe Macquer was the brother of Pierre-Joseph Macquer (1718–84), member of the Académie des Sciences, famous chemist, and Lavoisier's teacher. The Macquer family was of Scottish roots. The *Dictionnaire portatif* was a two volume abridged edition. It was based on *La description des Arts & Métiers* (The description of arts and crafts), a series edited by Duhamel in 1761. His article 'Épinglier' is derived from part of this same series, *L'art de l'épinglier* (Art of pin making). He mainly used Perronet's text.

Macquer described in a succinct fashion the same activities as Deleyre. The first stage, as in Adam Smith's text, is to draw out the wire. 'The pin makers buy reels of wire; they pass it through the drawing plate to obtain the thickness of the pin'.⁵

Macquer is more precise and concise than the *Encyclopédie*. He gives work rates for eight workstations: 120,000 pins per day for the straightener (*le dresseur*), 30,000 for the putter (*la bouteuse*), and between 8,000 and 9,000 for the head maker (*l'entêteur*) (average of 8,500). The rhythms are different for each stage. We can complete those given by assuming that the grinder works at the same rate as the pointer. Adam Smith deduced an average production rate. Two calculations are possible: inverse the total of all inverted rhythms, or calculate the total of each execution rate. Both approaches are identical.

Execution rates are the inverse of the rhythms. Assuming a 12-hour day, we have $12 \times 60 \times 60 = 43,200$ seconds. Using Macquer's figures, we arrive at an average execution rate of 9.06 seconds per pin. If we round this result downwards to 9 seconds, the production rate is 4,800 pins per day and per person (see Table 2). This result doesn't depend on the labour time.

The other calculation, which involves inverting the rhythms, requires no assumption as to the length of the working day.

$$4768 = \frac{1}{\frac{1}{120,000} + \frac{1}{72,000} + \frac{1}{72,000} + \frac{1}{190,000} + \frac{1}{144,000} + \frac{1}{8,500} + \frac{1}{96,000} + \frac{1}{30,000}}$$

Adam Smith may have rounded up this result to obtain 4,800 pins per day and per person.

This calculation is straightforward. Two operations are omitted however: 'to white pins in the boiler' (*blanchir les épingles dans la chaudière*) and putting them through the rubbing machine (*frottoire*). Macquer didn't give the rhythms for these stages. We hence have ten stages. This may explain why Adam Smith spoke of ten workers in *The Wealth of Nations*: 'I have seen a small manufactory of this kind where ten men only were employed'.

Table 2 Execution time for each pin making operation according to Macquer's (1766) rhythms

Operator	Rhythm (pins per day)	Execution rate
Straightener (<i>dresseur</i>)	120,000	0.36 seconds
Point maker (<i>empointeur</i>)	72,000	0.6 seconds
Grinder (<i>repasseur</i>)	72,000	0.6 seconds
Cutter (<i>coupeur de hanges</i>)	190,000	0.23 seconds
Head cutter (<i>coupeur de têtes</i>)	144,000	0.3 seconds
Head maker (<i>entêteur</i>)	8,500	5.08 seconds
Paper piercer (<i>percer les papiers</i>)	96,000	0.45 seconds
Putter (<i>bouteuse</i>)	30,000	1.44 seconds
Total	4,800	9.06 seconds per pin rounded off to 9 seconds

Probably he hadn't seen this manufactory, he had seen this text about a manufactory with ten workers.

In conclusion, Adam Smith is likely to have used Macquer's text as a reference for *The Wealth of Nations*. He personally owned a copy. One can use this text to calculate the production rate of 4,800 pins per day and per person. The rhythms differ per operation. Smith averaged these differences out. This reference was published in 1766. It explains the difference between *The Wealth of Nations* published in 1776 and Smith's 1763 lectures. It remains to be shown why Smith referred to pin making in his 1763 Glasgow classes.

4.2. L'art de l'épinglier (*Art of pin making*) by Duhamel

Following on from Réaumur, Duhamel du Monceau, a member of the Académie des Sciences de Paris, was in charge of publishing the scientific work about the arts and crafts. This work had been dragging on since the end of the previous century. The Académie was embarrassed by its non-scientific nature. Diderot had access to all the Académie's documentation from the beginning of the century onwards. He notably consulted the illustrations. The success of Diderot's *Encyclopédie* changed things for the Académie. It regained interest in its publishing project. *La Description des Arts & Métiers* was first published by the Académie des Sciences in 1761. One of the first texts was *L'art de l'épinglier*. It was held by the University of Glasgow library.

Adam Smith could have read this text. We can link this work to the expression 'division of labour'. The concept was known to other authors

although different words were used to describe it. Smith was the first to employ the expression 'division of labour'.

Ancient Greek authors spoke of the division of labour as did English authors at the end of the 17th century and the beginning of the 18th. We now examine the terms they employed.

First, in *The Republic* Plato explains the gains through trade specialization. 'All things are produced more plentifully and easily and of a better quality when one man does one thing which is natural to him and does it at the right time, and leaves other things' (Plato, *The Republic*, Book II, translated by Benjamin Jowett).

Xenophon goes even further. He speaks of the division of labour within the one trade, shoe making. It was an important trade for the city of Athens that imported skins and widely exported the shoes it produced.

In the great cities, owing to the wide demand for each particular thing, a single craft will suffice for a means of livelihood, and often enough even a single department of that; there are shoe-makers who will only make sandals for men and others only for women. Or one artisan will get his living merely by stitching shoes, another by cutting them out, a third by shaping the upper leathers, and a fourth will do nothing but fit the parts together. Necessarily the man who spends all his time and trouble on the smallest task will do that task the best.

(Xenophon, *Cyropaedia, The Education of Cyrus*, Book VIII, translated by Henry Graham Dakyns, edited by F.M. Stawell, Project Gutenberg Release)

Task specialization occurred in major industries and in large towns. It depended on the market. On the other hand, 'in a small city the same man must make beds and chairs and ploughs and tables, and often build houses as well; and indeed he will be only too glad if he can find enough employers in all trades to keep him. Now it is impossible that a single man working at a dozen crafts can do them all well' (ibid.).

Adam Smith probably knew of these texts. His writings are similar:

Country workmen are almost everywhere obliged to apply themselves to all the different branches of industry that have so much affinity to one another as to be employed about the same sort of materials. A country carpenter deals in every sort of work that is made of wood: a country smith in every sort of work that is made of iron. The former is not only a carpenter, but a joiner, a cabinet-maker, and even a carver in wood, as well as a wheel-wright, a plough-wright, a cart and waggon maker.

(Smith 1976 [1776]: Book 1, ch. 3)

Through the ages task specialization has been associated with high production volumes and quality. The term 'division of labour', however, had never been employed.

Smith's English predecessors spoke of this same concept (cf. Schumpeter 1986 [1954]: 56, 214, 373–6, Rashid 1998). They identified and named it in various ways. Table 3 lists some of the terms employed.

Each author described the concept in his own way but all lacked a concise term. The verb 'to divide' was often employed in two derived forms, 'divided' and 'dividing'. The substantive form was close. Adam Smith employed 'division of labour', a term that refers both to the result (work is divided and everyone has their own speciality) and to the action itself (work is divided again and again, with more and more workstations created).

Smith may have been influenced by Duhamel du Monceau who employed an equivalent expression. He wrote in the introduction to the *L'art de l'épinglier* (Art of pin making): 'The low cost of pins is of no great surprise, however the surprise is no doubt greater when one learns of the

Table 3 The terms employed to describe the concept of the division of labour prior to Adam Smith's work

Author	Book	Term employed to speak of the division of labour
Plato	<i>The Republic</i>	To have only one occupation
Xenophon	<i>Cyropaedia</i>	Small tasks
William Petty	<i>Political Arithmetick</i> , 1690	A man shall make the wheels, another . . .
Bernard de Mandeville	<i>The Fable of Bees</i> , 1714	Labour: the usefulness of dividing it and subdividing it
Hume	<i>Political Discourses</i> , 1752	By the conjunction of forces, our power is augmented; the partition of employments, our ability encreases
Thomas Mortimer	<i>A New and Complete Dictionary of Trade and Commerce</i> , 1766, article 'Pin maker'	The work, for the greater dispatch, is carried on different hands
Adam Ferguson	<i>An Essay on the History of Civil Society</i> , 1767	the separation of Arts and professions separated, and committed to different persons
Josiah Tucker	<i>Four Tracts</i> , 1774	In the richer country, where the demands are great and constant, every manufacture that requires various processes, and is composed of different parts, is accordingly divided and subdivided into separate and distinct branches.

number of activities, most of which are very delicate, that are required to make one good pin. We will briefly go over these activities so as to stimulate the desire to learn more; this listing will give us a number of parts that make up the division of this labour'.⁶

The French expression *la division de ce travail* (the division of this labour) could be interpreted as meaning 'the division of the labour of pin making'. Within the context of the sentence, this expression could also refer to the work schedule 'the division of this work'. The French word *travail* (labour, work, job, occupation) is polysemous. It can be interpreted both ways. Duhamel's expression, *division de ce travail*, may have inspired Smith's own expression, 'the division of labour'.

Duhamel's text went on to list the 17 numbered parts. The first 16 are steps in the production process. Duhamel concludes (p. 3) 'All these operations are executed at a truly astonishing rate'.⁷

In addition, Duhamel refers to the rapidity of work. Adam Smith develops this same idea as the 'productive power of labour'.

We have now identified two sources, Macquer and Duhamel du Monceau. These texts do not explain however why Adam Smith was so interested in pin making. What event triggered his interest? A periodical may have set off his interest. The hypothesis here is that it was the *Journal des sçavans*.

4.3. *The Journal des sçavans (Scientists' Journal)*

The *Journal des sçavans* was a monthly magazine, published from 1665 onwards in Paris. During the 18th century it was closely associated with the Académie des Sciences. It reported on the Académie's publications and published the minutes of the Académie's meetings. The University of Glasgow library held a subscription.

In its November 1761 edition, the *Journal* reviewed Duhamel's *L'art de l'épinglier* (pp. 745–8). The text was based on Duhamel's introduction. The author listed the steps in the production process. 'The first operation involves passing the brass wire through the drawing plate so as to calibrate it'.⁸ This was the first stage listed by Adam Smith in 1776.

Eighteen steps in all are given in this text: to draw (*passer à la filière*), to clean (*décaper*), to straighten (*dresser*), to cut (*rogner*), to point (*empointer*), to point again (*repasser*), to cut the sections or 'shanks' (*couper les tronçons*), to turn the head (*tourner les têtes*), to cut the head (*couper les têtes*), to put on the head (*brocher la tête*), to punch the head (*l'assujettir*), to yellow (*jaunir*) and to whiten (*blanchir*), amount to 13 activities. The author continues with five more operations: the iron pins (*les épingles de fer*), the black pins (*les*

épingles noircies), the two-headed pins (*à deux têtes*), the hairpins (*en pincettes*) and finishes with putting pins on the papers 25 at a time (*l'arrangement des épingles par quarteron sur le papier*). The 18 steps of the pin making process were thereby available elsewhere than in Deleyre's text.

The *Journal des sçavans* widely cites Duhamel's work, and in particular the production rates. 'All these operations are executed at a truly astonishing rate'.⁹ The text is a summary full of details, all of which would have interested Adam Smith. It is reasonable to assume that he took notice of this text.

5. Hypothesis on the way Adam Smith wrote up his texts

Having examined how each text may have contributed to Adam Smith's writings, we can now piece together their sequence of use. To begin with, Smith knew of the concept of the division of labour through his readings of classical Greek authors and past English scholars. It is likely that he regularly read scientific journals as they were published. He would have discovered the description of the production process in the *Journal des sçavans*. The example would stand out given his previous readings. He may then have spoken about it with Adam Ferguson. Smith would have sought additional references on the matter. In Duhamel's text he would discover the term *division de ce travail*. In Diderot's *Encyclopédie* all 18 activities were clearly set out. He would have all the information he needed to prepare his Glasgow lectures. During a later trip to Paris he may have found and purchased Macquer's *Dictionnaire*. The pin making article would have been of great interest. He would now be ready to write *The Wealth of Nations*.

5.1. Prior work on labour specialization

Adam Smith knew his classics well. He most certainly would have read Xenophon's work on the division of labour by Athenian shoe makers. He would also have read previous British scholars. He would have known that Petty, Mandeville, Hume and Tucker all discuss the division of labour and that each uses examples to help explain the concept. Petty gave three examples of the division of labour (Hull 1899):

Tailoring:

cloth must be cheaper made, when one cards, another spins, another weaves, another draws, another dresses, another presses and packs; than when all the operations above-mentioned were clumsily performed by the same hand.

(Petty 1690, in Hull 1899: vol. 2, 473)

Watchmaking:

if a man shall make the wheels, another the spring, another shall engrave the dialplate, and another make the cases, then the watch will be better and cheaper, than if the whole work be put upon by any one man.

(Petty 1690, in Hull 1899: vol. 1, 260)

Sea transportation:

Dutch are enabled to convey goods cheaply by sea because they specialise each ship for a specific function, [...] they can afford a particular sort of vessel for each particular trade.

(Petty 1690, in Hull 1899: vol. 1, 261)

These examples were later used by other authors. Smith's previous readings no doubt motivated him to look for other examples of work division. His childhood in the nail making town of Kirkcaldy may have influenced his choice of a metallurgical activity. After all, his family name does signify 'metal worker'.

5.2. Interpretation and use of the *Journal des sçavans*

The multiple references hypothesis starts with these preliminary activities. Adam Smith regularly read periodicals and the *Journal des sçavans* was one such publication that would have regularly published articles of interest. In 1761 he could have discovered the review of Duhamel's *L'art de l'épinglier* (Art of pin making). The numerous steps in pin making would have interested him. The description was original. Neither Petty nor Xenophon had used this example.

Adam Smith would have spoken to Adam Ferguson about this text. His colleague would perfectly understand the economical implications. He would even draw a number of sociological conclusions. The text itself begins this same analysis. 'We also make several observations on the pin maker's trade... This trade is very dirty and unhealthy. The brass rust, a greeny grey colour, affects workers differently depending on their role in the factory. The point makers are not robust, and die young of pulmonary ailments'.¹⁰ The local lawyer Chalouzières, consulted by Duhamel, gave a sympathetic eyewitness account of the factory workers' toil. It would be the catalyst for Adam Ferguson's sociological analysis.

Adam Smith also recognized the negative social consequences of the division of labour. 'The man whose whole life is spent in performing a few simple operations... has no occasion to exert his understanding... He... generally becomes as stupid and ignorant as it is possible for a human creature to become... His dexterity at his own particular trade seems, in

this manner, to be acquired at the expense of his intellectual, social, and martial virtues' (Smith 1976 [1776]: Book V, ch. I, part 3, article II).

On the division of labour's more technical aspects, Smith erroneously described the point sharpening on double headed pins. The French journal described this step rather ambiguously. The 'point makers form the points using a grinder . . . The grinders or finishers soften them with a finer grinder. When the wire sections are pointed at both ends, they must be cut at pins' length.'¹¹ 'Pointed at both ends' could be understood as meaning that the pin was sharpened at both ends. Yet the text referred specifically to the *tronçons*, or sections, of two pins. The labourer worked on longer pieces of metal that he could more easily hold between his fingers. He then cut the section into two separate pins.

Adam Smith ignored the difference between the sections and the pins. He wrote 'a fifth grinds it at the top for receiving the head'. He never mentioned the cutting of the section into two pins (the *Encyclopédie's* 7th activity). Maquer's text was just as confusing and no doubt comforted Smith in his interpretation.

After reading this first text he then read either the *Encyclopédie* or Duhamel du Monceau. The order is of no particular importance.

5.3. Interpretation and use of the article 'Épingles' (Pins) in the *Encyclopédie*

Once he had become interested in pin making Adam Smith consulted Diderot's *Encyclopédie*. He found Delaire's article, 'Épingles'. The second paragraph spoke of 18 stages. 'A pin has undergone eighteen operations before going on sale'.¹² The rest of the text was numbered 1 through 18. This would have no doubt reassured Smith that there were 18 stages in all.

At the end of the text he read: '18° *putting the pins*. They are put on the paper. One takes a handful and arranges them a dozen at a time: there's no choice if one must put up to 36 thousand pins per day; even when one excels, one earns but a pittance'.¹³ No other production rate is given. Adam Smith probably believed this to be the production rate he was looking for, 'the productive power of labour'. If 36,000 pins 'must' be put into paper each day, then the workshop has to produce 36,000. With 18 people working, one at each workstation, Adam Smith calculated the productivity rate at 2,000 pins per day and per person.

5.4. Interpretation and use of *L'art de l'épinglier* by Duhamel

Adam Smith acquired the text reviewed in the *Journal des sçavans*. He read it before, after or at the same time as the *Encyclopédie*. He read through Duhamel's *L'art de l'épinglier*. He began with the introduction. During his

readings he picked up the expression *division de ce travail* (division of this labour), so close to that used by Mandeville ('the dividing of labour'). He noted the number of stages now to be 17.

He saw the illustrations. The plates showed the tools, the machines, the labourers at work. The Académie des Sciences' illustrators, as those of the *Encyclopédie*, grouped the workers in one relatively large and tidy room. The labourers appeared to work in one workshop. Smith adopted this same view.

Smith used these three texts to document his *Lectures on Jurisprudence*. He would complete his documentation with the purchase of Macquer's *Dictionnaire* in France.

5.5. Reading of the *Dictionnaire portatif des arts et métiers* by Macquer

In this new text, Adam Smith found understandable production rates. Macquer grouped together and simplified Perronet's figures that had previously been published by Duhamel. There are eight distinct work rates. Smith would have been looking for a global production rate. He would have worked with the figures and found a production rate of 4,800 pins per day and per person.

Adam Smith presented these results in a strange way. He took the weight into account. 'They could, when they exerted themselves, make among them about twelve pounds of pins in a day. There are in a pound upwards of four thousand pins of a middling size? Those ten persons, therefore, could make among them upwards of forty-eight thousand pins in a day. Each person, therefore, making a tenth part of forty-eight thousand pins in a day.' The production was weighed daily: 12 pounds of 4,000 pins.

Smith's use of weight in his measure of production is difficult to understand. There were pins of different sizes. While the number of pins was not affected by size, the total weight of the pins was. Production time does not vary with pin size whereas it does with weight. According to Perronet there were 13,000 number V pins per pound, 4,000 number X pins, and only 1,350 of the biggest size, number XXII. According to pin size, weight may vary tenfold, while work time varied little. Smith's idea of a pin 'of a middling size' is imprecise. The most sold pins were the smaller sizes, number IV or V.

Why did Smith measure production rates based on weight when production time depended on the number of pins and not on their weight? One possible hypothesis is that he may have done so to hide his use of the French texts. This is difficult to verify. In any case he gave a production rate equivalent to that of the French texts, 4,800 pins per day and per person.

5.6. Summary of Adam Smith's references

Adam Smith had access to four French texts, the *Journal des sçavans*, the *Encyclopédie*, Duhamel and Macquer. These texts are coherent with the evolution of the different versions of his writings. We can match his ideas with those developed in these texts. Tables 4 and 5 compare Smith's descriptions of pin making with the French references we presented previously.

The multiple references hypothesis is a feasible one. The references were accessible to Smith, the dates match and the ideas are similar. Does this suffice? Any further proof was lost with the destruction of Smith's personal notes.

If we accept the hypothesis that Smith found inspiration in the four French texts, one question still remains unanswered. The texts are very rich. They provide a great deal of detail that was not exploited. For example, in Duhamel's text, Perronet identified only 14 steps in the production process. This figure was never cited by Smith. Other details are also omitted. Why? There are two possible answers. First, these details are not required to illustrate the phenomenon under study. Secondly, the complicated vocabulary used made these details difficult to understand.

Adam Smith sought to demonstrate that the division of labour improved production rates. He used the French texts only to describe the extent of the division of labour, expressed as the number of steps (17 or 18 depending on the reference), and the daily production rate per person (2,000 or 4,800 depending on the reference). He narrowed his reading of these texts as only these details counted.

Another reason that may have led him to narrow his reading was the deliberately esoteric technical vocabulary employed. Diderot chose this writing style and Duhamel copied him. The *Journal des sçavans* and Macquer, on the other hand were more readable. It's quite possible that Smith only read parts of these texts and skimmed over the more complicated sections. This assertion however cannot be proven.

6. The implications of the multiple references hypothesis

The comparison of the French and the English texts tends to confirm our hypothesis. It is highly likely that Adam Smith used the *Journal des sçavans*, the *Encyclopédie*, Duhamel and Macquer to write up his pin making example to illustrate the division of labour.

This hypothesis is consistent with the way Adam Smith worked: wide general knowledge, interest in a variety of disciplines, open to opportunities

Table 4 Similarities between Smith's previous texts (prior to *The Wealth of Nations*) and the French references

	Original text	Reference
<i>Lectures on Jurisprudence</i> , Monday, March 28, 1763 (pp. 341–2)		
'The division of labour amongst different hands can alone account for this'	'cette énumération nous fournira autant d'articles qui feront la division de ce travail'	<i>L'art de l'épinglier</i> de Duhamel, 1761
'an instance frivolous indeed, but which will illustrate it; this is the pin making'	Description of pin making	<i>Journal des sçavans</i> , 1761
'one cutts the wire'	'4° On coupe la dressée'	<i>Encyclopédie</i> , Delaire, 1755
'another sharps the one end for receiving the head'	'les fils des tronçons sont ainsi appointis par les deux bouts'	<i>Journal des sçavans</i> , 1761
'another sharps the one end for receiving the head'	'Il faut former des pointes aux deux bouts de ces tronçons de fil'	<i>L'art de l'épinglier</i> de Duhamel, 1761
'3 or 4 are employed in making the head'	'8°. On tourne les têtes. 9°. On coupe les têtes. 10°. On amollit les têtes.'	<i>Encyclopédie</i> , Delaire, 1755
'one puts it one, another forms the point, another gilds and another papers them.'	'11° on frappe les têtes, 5° on empoite 13° on blanchit les épingles, 18° on boute les épingles.'	<i>Encyclopédie</i> , Delaire, 1755
'So that in the making of a pin there are about 18 persons employed. These in a day will make about 36000 pins, and this comes to the same thing as if each one made about 2000.'	'une épingle éprouve dix-huit opérations' 'il le faut bien pour piquer 36 000 épingles par jour'	<i>Encyclopédie</i> , Delaire, 1755
<i>Lectures on Jurisprudence</i> , Report dated 1766 (p. 490)		
'the pin maker therefore divides the labour among a	'4° On coupe la dressée, 5° on empoite,	<i>Encyclopédie</i> , Delaire, 1755

(continued)

Table 4 (continued)

	Original text	Reference
great number of different persons, the cutting, pointing, heading, and gilding are separate professions.'	11° on frappe les têtes'	
'Two or three are employed in making the head'	'8°. On tourne les têtes. 9°. On coupe les têtes. 10°. On amollit les têtes.'	<i>Encyclopédie</i> , Delaire, 1755
'one or two in putting it on, and so on, to the putting them in the paper'	'11° on frappe les têtes, 18° on boute les épingles.'	<i>Encyclopédie</i> , Delaire, 1755
'... being in all eighteen. By the division every one can with great ease make 2000 a day.'	'une épingle éprouve dix-huit opérations' 'il le faut bien pour piquer 36 000 épingles par jour'	<i>Encyclopédie</i> , Delaire, 1755
<i>Lectures on Jurisprudence</i> , Report dated 1766 (p. 539)	17 parts of the text	
'This must be much more the case when a person's whole attention is bestowed on the 17th part of a pin'		<i>L'art de l'épinglier</i> de Duhamel, 1761
<i>Lectures on Jurisprudence</i> , Early draft (p. 566)		
'One man straightens the wire, another cut it, a third points it, a fourth grinds it at the top for receiving the head, there or four people are employed about making the head, to put it on is the business of a particular person, to gild the pins is the occupation of another, it is even a trade by itself to	'3° On dresse le fil, 4° on coupe la dressée, 5° on empoigne, 6° on repasse, 8°, 9°, 10°, 11° on frappe les têtes, 13° on blanchit les épingles, 18° on boute les épingles.'	<i>Encyclopédie</i> , Delaire, 1755

(continued)

Table 4 (*continued*)

	Original text	Reference
put them in the paper.'		
'When this small operation is in this manner divided among about eighteen persons, these eighteen will perhaps among them make upwards of thirty six thousand pin a day.'	'une épingle éprouve dix-huit opérations' 'il le faut bien pour piquer 36 000 épingles par jour'	<i>Encyclopédie</i> , Delaire, 1755

provided by current affairs, in-depth use of documentation, talent for interpreting and reworking available information. He worked hard on the pin making example. It was no doubt of great importance to him. He used it at the beginning of his book and in such a way that it could not be ignored.

One could criticize him, as we would an author today, for not citing his sources. Yet he behaved like many intellectuals of his time, often forgetting to cite his references. Was there any plagiarism? Given the extent of his personal contribution, it would seem not. The question is pertinent however as 'he was peculiarly excitable about the idea of plagiarism' (Hamowy 1968: 253).

Adam Smith's skill lay the way he used his different sources to construct an illustrative example of his thesis on the quantitative impact of the division of labour. He suggested the term 'division of labour', a well-devised term in view of previous scholarly work. The expression communicates both an idea of movement and that of ongoing specialization. This dual meaning rendered the term a versatile one, and in so doing made it easier for others to work with the concept.

Adam Smith didn't use 'productivity' to describe the second key concept of his theory. He called it 'the productive power of labour'. He could quite easily have used the more modern term 'productivity'. According to the *Dictionnaire historique de la langue française* the latter term was invented in France in 1766.

The multiple references hypothesis does not help explain one important part of Smith's pin making thesis. The production rate of 1 to 20 pins per day of a polyvalent worker is not given in the French texts. This reference still remains a mystery. It will be the subject of further research.

Table 5 Similarities between *The Wealth of Nations* and the French references

<i>Inquiry into the nature and causes of the Wealth of Nations</i> , Book I, ch. I, 1776	Original text	Reference
‘The effects of the division of labour, in the general business of society’	‘Cette énumération nous fournira autant d’articles qui feront la division de ce travail’	<i>L’art de l’épinglier</i> de Duhamel, 1761
‘and those employed in every different branch of the work can often be collected into the same workhouse, and placed at once under the view of the spectator.’	The 7 illustrations show workers labouring in the same room.	<i>L’art de l’épinglier</i> de Duhamel, 1761
‘To take an example, therefore, from a very trifling manufacture; but one in which the division of labour has been very often taken notice of, the trade of the pin-maker;’	Multiple references exist	
‘One man draws out the wire’	‘la première opération consiste à passer le fil de laiton à la filière’	<i>Journal des sçavans</i> , 1761
‘another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on, is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper;’	‘3° On dresse le fil, 4° on coupe la dressée, 5° on empoigne, 6° on repasse, 8°, 9°, 10°, 11° on frappe les têtes, 13° on blanchit les épingles, 18° on boute les épingles.’	<i>Encyclopédie</i> , Delaire, 1755
‘and the important business of making a pin is, in this manner, divided into eighteen distinct operations’	‘une épinge éprouve dix-huit opérations’	<i>Encyclopédie</i> , Delaire, 1755
‘I have seen a small manufactory of this kind where ten men only were employed, and where some of them	‘Ils le passent à la filière [...] on dresse le fil [...] on la coupe en tronçons [...] l’empointeur leur fait	<i>Dictionnaire portatif des arts et métiers</i> , Macquer, 1766

(continued)

Table 5 (continued)

Inquiry into the nature and causes of the Wealth of Nations, Book I, ch. I, 1776

	Original text	Reference
consequently performed two or three distinct operations.'	une pointe à chaque bout [...] le repasseur [...] le coupeur de hanches [...] le coupeur de têtes [...] l'entêteur, on blanchit, la bouteuse' soit dix opérations	
'They could, when they exerted themselves, make among them about twelve pounds of pins in a day. There are in a pound upwards of four thousand pins of a middling size. Those ten persons, therefore, could make among them upwards of forty-eight thousand pins in a day. Each person, therefore, making a tenth part of forty-eight thousand pins, might be considered as making four thousand eight hundred pins in a day.'	Production rate calculated at 4 800 pins per day and per person.	<i>Dictionnaire portatif des arts et métiers</i> , Macquer, 1766

Notes

- * The author acknowledges the comments and suggestions provided by the referees of this journal.
- 1 The correct spelling of this name is 'Deleyre' and not 'Delaire' as is noted in the *Encyclopédie*.
 - 2 French Academy.
 - 3 'On jaunait le fil de laiton'.
 - 4 *Dictionnaire portatif des arts et métiers, contenant en abrégé l'histoire, la description et la police des arts et métiers, des fabriques et des manufactures de France et des pays étrangers*.
 - 5 'Les épingliers achètent le fil en bottes; ils le passent à la filière pour lui donner la grosseur que doit avoir l'épingle'.
 - 6 'Il n'y a personne qui ne soit étonné du bas prix des épingles; mais la surprise augmentera sans doute quand on saura combien de différentes opérations, la plupart fort délicates, sont indispensablement nécessaires pour faire une bonne épingle. Nous allons parcourir en peu de mots ces opérations pour faire naître l'envie d'en

connoître les détails; cette énumération nous fournira autant d'articles qui feront **la division de ce travail**' (p. 1).

- 7 'Toutes ces opérations s'exécutent, à la vérité, avec une célérité merveilleuse'.
- 8 'La première opération consiste à passer le fil de laiton à la filière pour le calibrer'.
- 9 'Toutes ces opérations s'exécutent, à la vérité, avec une célérité merveilleuse'.
- 10 'On fait aussi quelques remarques générales sur le métier d'épinglier... Ce métier est très-mal-propre & contraire à la santé. La rouille du laiton, qui est verd-de-gris, agit sur les ouvriers plus ou moins selon la place qu'ils occupent dans la fabrique... Les empointeurs ne sont pas robustes, meurent pulmoniques & de bonne heure'.
- 11 'Les empointeurs forment les pointes sur les meules d'acier... Des repasseurs ou finisseurs les adoucissent sur une autre meule plus fine. Lorsque les fils des tronçons sont ainsi appointis par les deux bouts, il faut les couper à la longueur des épingles'.
- 12 'Une épingle éprouve dix-huit opérations avant d'entrer dans le commerce'.
- 13 '18° *On bote les épingles*. C'est les placer dans le papier. On les prend à poignée, on les range par douzaine à la fois: il le faut bien, pour bouter jusqu'à 36 milliers d'épingles par jour; encore ne gagne-t-on, quand on y excelle, que trois sous.'

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Abstract

At the beginning of *The Wealth of Nations* Adam Smith describes a pin factory. It is widely accepted that this example comes from Diderot's *Encyclopaedia*, published in France in the 18th century. The details in the text together with the conferences previously given in Glasgow clearly show that this one reference cannot be the only source. Three other French publications on pin making may also have been used as references for Adam Smith's text. Phrase by phrase these texts are compared to Smith's to support the assertion that he based his work on four previous French publications. *The Wealth of Nations* unites and synthesizes these different sources and excerpts those parts that confirm his theory. Smith should have listed his sources.

Keywords

Adam Smith, pin making, division of labour, sources, encyclopaedia