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Industrial Revolutions and Consumption: A Common Model to the Various Periods of Industrialization

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Abstract

What was the role of consumption structure evolution in the industrialization phases of the Western world since the 18th century? To answer this question, we first ask the économical ad histoical literature. We idetify the main phases of consumption structure evolution and establish a plausible link between consumption structure evolutions and industrial revolutions. In particular, we show that an industrial revolution starts with a "smithian growth process", which is demand driven, and a "schumpeterian growth process" which is supply driven, one the new techniques adopted. We then model the role of consumption habits evolution in the schumpeterian growth process. Finally, we show that consumption habits evolutions can be endogenously explained if we introduce, in an original way, the concept of "commercial revolution", which appears to be mainly linked to schumpeterian growth processes..

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1 Introduction

Was consumption patterns evolution a key aspect in the various phases of industrialization of the Western world since the 18th century? The debates about this question in economic history are relatively recent but they only deal with the first industrialization, ignoring larger periods, including the following "revolutions". However, it seems worth studying the link between the evolution of consumption habits and industrialization over longer periods in order to distinguish what makes the specificity of the first industrialization from possibly recurring mechanisms.

In this article, we defend the thesis that the evolution of consumption patterns plays a major role not only in the emergence of new techniques but also in the adoption of a new growth regime, once these new techniques are available. We also claim that the evolution of consumption habits can be largely explained by mechanisms that we will identify as "commercial revolutions".

Our approach starts by exposing briefly the related literature: we show in Section 2 that economic history has not been able to propose definitive and consensual conclusions and we exhibit the main questions that are addressed in this paper. We propose, in Section 3, to consider, in a qualitative way, a plausible dynamic that links consumption evolutions and the development of technical and productive systems. To this purpose, we identify the various consumption revolutions since the 18th century and the context in which they emerge and develop. We highlight the role played, at each period of industrial revolution, by a "Smithian" growth process (demand driven and based on the "old" techniques) and by a "Schumpeterian" growth process (supply driven, the new techniques being then available and progressively adopted). In Section 4, we model the link between consumption evolutions and the adoption of a growth regime, within a "Schumpeterian" process of growth. Finally, in Section 5, we show that the evolution of consumption habits can be endogenously explained if we introduce, in an original way, the concept of "commercial revolution".

2 Problem statement

The main debates about the role of consumption in the industrial revolutions are particularly recent¹: the historiography is indeed largely dominated by the supply side approaches [Verley, 1997a]

¹[McCracken, 1987] underlined the absence of a real history of consumption.

and this fact remains true if we consider the most recent economic researches that aim at modeling growth over long periods. These works are trying to build a unified theory of growth [Lucas, 2002], explaining the transition from a "Malthusian" to a Solowian" growth regimes [Clark, 2003, Crafts, 2005]. They wonder about the mechanisms subtending the first industrial revolution, its ineluctability and the reasons of its advent in the Western world (and particularly in England).

To answer these questions, the models are generally based on the following difference between "malthusian" and the "solowian" growth regime: The first is defined by a weak growth together with a systematic increase in population that cancels any progression of living standards. The second one is characterized by productivity rise and natality fall. To explain the transition between those two regimes, two approaches have been considered. The first approach is based on exogeneous growth models: For example, the work of [North and Thomas, 1973] or [Jones, 2001] explains the emergence of the industrial revolution in England by a specific and exogeneous evolution of the institutions (property rights, in particular intellectual property...). This approach is also used in the models of Becker *et al.* and of Lucas ([Becker *et al.*, 1990] and [Lucas, 2002]) which consider an exogeneous shock leading to human capital accumulation (where marginal productivity is not decreasing). This accumulation makes then possible the "great escape" from the Malthusian growth trap. A second approach of the transition between Malthusian and Solowian regime rests on endogenous growth models. Following this way, [Kremer, 1993] considers that knowledge grows with the population size and its density. [Galor and Weil, 1990] preserve this idea as well as the one of the non decreasing marginal productivity of human capital but introduce the growing (and cumulative) interest, for the population, to invest in education and to reduce natality: the "quality" of the children is then preferred to their "quantity"². Contrary to the previous works, [Hansen and Prescott, 2002] claim that the transition from a Malthusian regime to a Solowian one does not depend on natality matter but on the comparison of marginal productivities of a land-using sector and of a land-free sector. [O'Rourke *et al.*, 2005] make finally a kind of synthesis by proposing a model in which two types of technologies coexist: labor-intensive technology and knowledge-intensive one. For them, the first one incites to high natality while the second incites to invest in the children's human capital.

This recent and intense work of modeling the changes occurred during the first industrial revolution. However, the models are debatable (cf. [Clark, 2003, Crafts, 2005]). But the most surprising fact is that these models, as well as their criticisms, do not care (or very little) about the role of consumption changes in the transition from a growth regime to the another, although the techniques often preexisted to the industrial revolution and their diffusion was relatively free. As far as we know, among recent work, only the one by [Voigtländer and Voth, 2005] takes this aspect into account. It shows that industrialization results from the existence of a critical mass of sufficiently rich consumers, able to afford goods of mass consumption. Following this analysis, the advance of England during the industrial revolution could be explained by the existence of a generous enough welfare state system (Poor Law, in particular). The income distribution is then a key variable which is however not sufficient to explain a possible divergence between two countries having comparable income distributions.

Except the article of [Gilboy, 1932], the oldest articles about the role of consumption during the industrialization have been written at the end of the 1960's (see [Boserup, 1965]) and especially in the 1980s and 1990s. A seminal thesis for a demand side approach of the industrial revolution is the one of "creative pressure", proposed by [Boserup, 1965], in response to the Malthusian view. For her, demographic growth is favorable to technical and economic progress: indeed, demographic growth would lead to a more intensive use of land and to the adoption of new agricultural

²[Galor and Moav, 2002] propose a comparable model in which technical progress is not any more a function of the population size. In their model, the engine of the industrial revolution is the evolution of the parents' preferences for their children's human capital, through a natural selection mechanism.

techniques. In turn, this adoption of new techniques results in an increasing productivity of the agricultural sector [Bairoch, 1997]. It would then generate a decrease in the agricultural relative prices [Hudson, 1992] and an evolution in the global income and in its distribution, favorable to industrial goods consumption³. The innovation can then be interpreted as an answer to the limits of the productive system. The size of the population, and thus the needs for consumption, would then determine the level of wealth and not the contrary: A too low demographic density would prevent the economy from adopting new techniques. However, [Lindert, 1983] points out that this theory should also explain the reasons of the increase in population: if it is possible to consider an exogeneous reduction in the death rate, then the industrialization can be regarded as demand driven. If, on the contrary, the death rate evolution is directly related to economical and technological progress, then the validity of Boserup conclusion is not guaranteed. Moreover [Mokyr, 1993] underlines that, if technology are fixed, growth theory shows that an increase in population implies a decrease in the per capita income, which is, due to Engel law, unfavorable to industrial goods consumption. [Crafts, 1985] also underlines, for similar reasons, that a demand driven approach of the industrial revolution is not very plausible.

A few recent empirical studies also contribute to challenge the idea of a demand driven industrialization. Indeed, [Horrell, 1996] underlines that the consumption of industrial goods remained largely (but not completely⁴) limited by the unsatisfaction of vital needs. Therefore, according to her, the rise of the agricultural productivity had a limited impact on the working class. Thus, agricultural progress and capital accumulation appear to be key issues in order to overcome the nutritional constraints [Toutain, 1971] and to allow a development of industrial goods consumption [Bairoch, 1963, Komlos and Artzrouni, 1990, Komlos and Artzrouni, 2003]. The industrial revolution could thus be interpreted as the definitive escape from the Malthusian trap thanks to an exogeneous increase in the saving rate and thanks to a reduction of the mortality crises. However the (very few⁵) empirical studies on consumption habits do not allow drawing any convincing conclusion to the various debates: [Clark *et al.*, 1995] support that food expenditure increased relatively slowly compared to the real wage: the evolution of wage would have been mainly favorable to industrial products. On the contrary, [Horrell, 1996] supports the opposite thesis, also using budgets of households. Several studies even concluded to the absence of a significant increase of agricultural real incomes and of productivity. And even the trend of relative prices is not consensual [Mokyr, 1985]. Lastly, although agricultural progress but also new techniques for transportation (cf. [Szostak, 1991]) led to an increase of the demand favorable to industrialization, technical progress and supply sides factors would remain in fine the source of the economic changes that generated the first industrial revolution [Mokyr, 1985, Mokyr, 1993].

Another debate concerning the link between consumption and industrialization rests on the impact of a possible evolution of income distribution: even if industrialization induced rising inequalities⁶, [Verley, 1997b] considers that a larger development of middle classes in England and in the United States provides an explanation of the dynamism of these economies while others (like the French one) were characterized by a stronger bipolarism between rich and poor people. However, empirical results appear to be contradictory [Lindert and Williamson, 1983] and authors like [Hudson, 1992, Feinstein, 1988, Feinstein, 1998, Horrell, 1996] contest a large part of these conclusions. Nevertheless, [Horrell, 1996] recognizes that while the evolution of working class

³See, for example, [Eversley, 1966, Williamson, 1985, Berg, 1991], contested by [Mokyr, 1985, Feinstein, 1988, O'Brien, 1985]. This idea can be compared to the one of Engel's law [Engel, 1857] (see also [Zimmerman, 1932]) which results from the following empirical observations: households with higher incomes have a lower share of their consumption budget dedicated to food.

⁴See [de Vries, 1993], p.114-121.

⁵We are talking here about recent historical researches. For older works, see [Stigler, 1954].

⁶By using the people's height as an indicator of economic welfare, [Fogel *et al.*, 1983] as well as [Steckel and Floud, 1997] confirm Kuznets's results, i.e. an increase in inequalities and a significant decrease of incomes for the poorest people during the first stages of economic growth of the modern time.

living conditions was not favorable to industrialization, the one of middle class was favorable to industrialization

In fact, many indices let think that it would be a mistake to ignore the social and cultural dimensions while studying the mechanisms that governed the first industrialization. Indeed, they represent an important basis of consumers choices [Berg, 2004] that many authors considered as a fundamental key in the industrialization [McKendrick, 1974, McKendrick *et al.*, 1982, Brewer and Porter, 1993, de Vries, 1993, de Vries, 1994]. McKendrick *et al.*, for instance, consider that the 18th century was, even before the industrialization, at the heart of important changes in consumption habits: the "consumer revolution" appears moreover to be a phenomenon both relatively independent from supply side and necessary to industrialization. De Vries considers that a revolution in people's minds led to higher labor supply, and particularly women and children labor supply. This induced higher consumption, mainly favorable to manufactured goods. However, whereas McKendrick *et al.* locate these changes "together" with the industrial revolution, de Vries locates them before (1600-1750)⁷. The "industrious revolution" appears to be a key element of the [Mendels, 1972]'s proto-industrialization. But this thesis is also challenged [Clark and Vand Der Werf, 1998]. While it remains difficult to establish a consensus on the link between domestic consumption and industrial revolution [Mokyr, 1985, Mokyr, 1993], it is also difficult to contest the fact that social emulation highlighted by McKendrick *et al.* cannot be denied: as we pointed out, [Horrell, 1996] (and other authors⁸) recognizes the possible role of middle class demand for the industrial goods in industrialization.

Even Mokyr, who is convinced by a supply side approach, recognizes that the evolution of the preferences and the "industrious revolution" could have played a significant role in industrial dynamics. The evolution of the preferences is in fact an essential aspect of industrialization since it provides keys to understand the important choices between close substitutes: this aspect is very important since many goods cannot integrate new techniques (linen and wool, for example) while others (like cotton) can. [North, 1990] also stressed that technical innovations and changes are initially determined by the size of the market⁹. It is thus a mistake to set the demand side approach against the supply side one as well as not taking into account the impact of the evolution of individual and social behaviors: the absence of outlets is obviously a handicap for innovation and industrialization. Moreover, consumers' behaviors can play an "active" role in the economic process as well¹⁰. Since [Crafts, 1996] shows that the industrial revolution is not characterized by a high growth rate but by in depth structural changes, we believe that part of the explanation of the slow growth can also be explained by the inertia of consumption behaviors. This is at least an hypothesis that we make after this presentation of the controversial debates.

3 The evolution of consumption structures: a key aspect of industrialization phases

3.1 The main ruptures in consumption since the 18th century

In contrary to [Mukerji, 1983] or [Shammas, 1993]'s works which locate the ruptures in consumption habits respectively in the 15th and 16th centuries and in to the 16th and 17th centuries¹¹, our research will focus on the period starting with the 18th century. We identify three phases of

⁷See also [Voth, 1998] about the 1750-1800 period.

⁸See also [Crafts, 1985] and [Verley, 1997b, Verley, 1997a].

⁹[North, 1990], p.75.

¹⁰[Berg, 2004] stresses that theoretical ([Bianchi, 1998], Becker, 1991) and empirical (Bowden & Offer, 1990, [Bresnahan and Gordon, 1997]) progress show the active role of the consumer.

¹¹Between 1650 and 1750, for example, tobacco, products derived from sugar (see [Mintz, 1991]) or coffee based drinks reached a level of wide consumption, if we put aside disparities among the population.

deep changes in consumption patterns in the Occident: the "consumer revolution"¹², the "consumer goods revolution"¹³ and the "mass consumption revolution"¹⁴. This work constitutes a first contribution. It allows us to exhibit on the one hand a plausible link between these ruptures and the industrial revolutions (Section 3.2) and, on the other hand, plausible mechanisms that could explain the ruptures in consumption (Section 5).

3.1.1 The consumer revolution (18th century)

The first significant evolutions of consumers spending habits can first be met in the United Kingdom and in the Thirteen Colonies but also, to a lower extent, in France and in a few Germanic regions, between the end of the 17th century and the end of the 18th century. These changes concern the market homogeneity, the nature of goods on the market and the volume of sales.

Several authors contribute to support this view ([Rule, 1992], p.252). For many of them, these changes can be seen as a consumer revolution that happens before and during the industrial revolution: According to [Eversley, 1966] or [McKendrick *et al.*, 1982] it took place within the last quarter of the 18th century in England and in the Thirteen Colonies (see also [Brewer and Porter, 1993]). The revolution involved initially a few goods answering to the most elementary needs (feeding and clothing, of course, but also housing goods), involving the development of industries concerned.

The main improvements concern food, with qualitative changes (diversification)¹⁵. They also concern the expenditure for house comfort (mirrors, curtains, earthenware and porcelain (instead of metal) and culinary hardware) that significantly increase as shown by after death inventory lists. As for clothing, the kitchen goods constitute a part of the qualitative changes favorable to demand growth: expensive and resistant goods are replaced by breakable and less expensive ones, replacing progressively the second-hand market by renewing market. We can note that, at that time, "consumption evolves from a stocking durable goods mentality to a flow of purchase of less durable goods, which is very favorable to the industrial mass production"¹⁶.

The expansion of the textile industry (for clothing but also housing) is undoubtedly the most spectacular one¹⁷ (Table 1). The case of clothing is particularly interesting since it is one of the most important symbols of social distinction and it rapidly concerns all the social classes: indeed, Indian textile (colored cotton tissues) is lighter and, above all, much less expensive. It thus incites people to renew and to diversify their clothes [Chapman and Chassagne, 1981]. Fashion is not then any more very far and it became possible for textile producers to exploit people's attraction for modernity renewing rather fastly the design and colors of the tissus.

Period	1700-1760	1760-1770	1770-1780	1780-1790
Annual growth rate (%)	1.4	4.6	6.2	12.8

Table 1: Annual growth rate in the English Coton industry in the 18th century. From Verley (1997a), p.176.

Finally, mostly the sectors of food products, textile, furnishing and dwelling goods benefit from this consumer revolution. They will play a central role in the first industrial revolution.

¹²[Brewer and Porter, 1993, McKendrick *et al.*, 1982, Eversley, 1966, Thirsk, 1978] (Thirsk dates back the "consumer society" to the 17th century). See also [Verley, 1997b], p. 114.

¹³See [Lévy-Leboyer and Bourguignon, 1985, Caron, 1985, Verley, 1996, Fraser, 1981, Musson, 1978], chapitre 13.

¹⁴See, for instance, [Marseille, 1996, Babeau, 1991]. Seen also [Baudrillard, 1970].

¹⁵Cf. [Toutain, 1971], for the French case.

¹⁶[Verley, 1997a], p.31.

¹⁷Cf. [Roche, 1981, Roche, 1988, Roche, 1989, Roche, 1997] and [Verley, 1997b].

3.1.2 The revolution of consumer goods (1850-1950)

In the middle of the 19th century, consumption patterns already changed a lot. The 1850-1914 period, in spite of the Great depression¹⁸, constitutes a second phase of more or less vigorous changes of consumption habits, depending on countries¹⁹. The period which precedes the Great depression is a continuation of the consumer revolution while the period after the Great depression is a new period of change of consumption patterns, characterized, particularly in the United States, by the emergence of the second industrialization goods. In France, the transition between the two periods occurs about 1885, when feeding constraints of sedentary populations weaken, allowing income increases to determine new consumption habits²⁰. Indeed, prices decrease and innovations keeps accelerating, consumer credit develops²¹ and real wage increase for people who kept their job during the crisis of 1880-1895²². The progressive transition from a seasonal work to more stable jobs also contributes, despite the chronic unemployment, to transform consumption patterns.

The end of the century is then characterized by better housing conditions and by a new phase of development of clothing consumption [Roche, 1981, Roche, 1988, Roche, 1989, Roche, 1997], second hand market being largely replaced in the 1880's and 1890's²³. It is also characterized by a better education and the development of leisures. New consumption habits are born: traveling becomes easier thanks to the train (the number of passengers takes off after 1840-1850 in France [Toutain, 1971]). Among countries which benefit from these changes, the United States appear to be more and more in advance: In the United States, the car is already a mass market in the 1920's whereas France will only reach this consumption level in the 1960's. After 1895, the end of the crisis is distinguished by much higher living standards and by the development of half-luxury for the middle class that wants to imitate higher standards of consumption even if it cannot afford real artisanal luxury goods²⁴.

3.1.3 The mass consumption revolution (1950-1980)

The time of consumption industries descibed by [Marseille, 1996] is the one of the major changes in consumption habits. These changes happen after World War II in Europe and between World War I and World War II in the United States²⁵.

¹⁸Neither Germany nor the United States were really touched by the economic crises that we could observe in England and France during the 1880's, for example.

¹⁹See [Verley, 1996], p.99-106 and [Verley, 1997b], p.128. [Le Play, 1857]'s work already shows how important are the changes happening between 1850 and 1862: the coefficient of feeding in French craftsmen households budgets decreased from 64,7% to 53,7%, the one of textile increased from 17,5 to 19,5% (despite a significant decrease of prices in this sector). The other expenditure also increased from 5,5 to 14,1%. See also [Dauphin and Pezerat, 1975].

²⁰[Lévy-Leboyer and Bourguignon, 1985], p.37. See also [Crafts and Mills, 1994] for England: if the index is 100 in 1900, they show that real wages are 44 in 1840, 67 in 1870, 89 in 1890 and 102 in 1910.

²¹In 1907, consumer credit concerns 57% of Parisian households in their recurring expenditures [Gelpi and Julien-Labruyère, 1994].

²²Even in France, consumption doesn't seem to slow down during most part of the second half of the 19th century: per capita consumption increased from 245-290 F before 1850 to 335 F in 1850-1859 and to 450-455 F in the 1860's ([Lévy-Leboyer and Bourguignon, 1985], p.23. See also [Fraser, 1981]). Paid work widened within the family but more in higher income employees' families than in working class families according to [Halbwachs, 1921]. See also [Lévy-Leboyer and Bourguignon, 1985], p.39-41. Real prices of the most current textiles dropped by 60 to 75% between 1826 and 1874 and still by 30% between 1901 and 1906. Only the house rents increased, tripling between 1841 and 1891. On the whole, the living cost drops and the incomes increase, offering a greater freedom to consume ([Lévy-Leboyer and Bourguignon, 1985], p.37-38). See also [Verley, 1996].

²³The evolution is particularly important in the working class that suffered of the "cotton famine" and of the 1870 war. Cf [Lévy-Leboyer and Bourguignon, 1985] and [Verley, 1996], p.104-107.

²⁴Galvanoplasty allows, for example, to manufacture costless gildings and other bronze-like products, allowing middle classes to imitate the consumption of the richer people.

²⁵The mass consumption development occurred in the United State in the 1920's and accelerated after World War II.

In the thirty years following the Second world war, the GNP increased as much as in the whole 19th century and the purchasing power was multiplied by five, thus allowing a big rise of the households demand and a diversification of consumed goods and services²⁶. This revolution of consumption patterns is also characterized, for many goods, by a convergence of spending patterns, independently from the living standards: it is the case for feeding, health, car, heating or lighting. On the contrary, cultural expenditures, leisures and traveling remain largely dependent on the incomes convergence: only people with the same income have the same habits for these specific goods or services [Babeau, 1991].

In addition to the increasing consumption of commercial goods and services, the period is also characterized by the wide increasing consumption of non-commercial services related to collective services (administration, health, culture, education...). The ways of life changed (women paid work increased), leading to new habits such as the replacement of self production by purchased consumption. In all those changes, durable goods (car, television and electric household appliances²⁷) play a crucial role. It is also the case of leisure that now takes an important place in people's habits and that can be regarded as a real innovation in the people's way of life. But, contrary to the generally accepted ideas, increase in services consumption is slow (in volume), even if they progress a lot in the household budget. In fact, a part of the services grew a lot (those related to housing and to health or financial services) whereas others grew weakly and sometimes decreased. It is the case when durable goods consumption is a substitute of previous existing services²⁸.

Finally, even if it is not the case for the whole consumption (such as clothing or holidays consumption), the mass consumption revolution can be characterized by an important convergence of living standards and thus a significant homogenization of consumption patterns.

3.2 Three productive regimes, three consumption revolution: what do we learn?

3.2.1 Three productive regimes between the 18th century and today

We identified historic phases in which the evolution of consumption habits accelerated. In a similar way, it is possible to put to the fore major phases of industrialization and of technical progress²⁹. The delimitation of those phases is of course inevitably debatable. It is helpful however to highlight regularities and to formulate a few useful assumptions. In this article, we decide to follow the delimitation proposed by [Dockès, 2002]. In his work, he proposes first to adopt another terminology than "industrial revolution", replacing it by "productive regime" which indicates *"the relative consistency between an economic system (with its technical features), the labor division patterns, the social relations (type of capital accumulation) and its "governance" processes"*³⁰. The productive regime is thus consistent with the technical system³¹ and with the economic and social organization.

According to Dockès, we can distinguish three productive regimes (and not five as suggested in the Schumpeterian analysis of the economic cycles): 1) the one of steam (railway included), 2) the one of electricity, new chemistry, steel metallurgy, gas engine and telephone and 3) the one of Information and Communication Techniques (ICT). Thus the three revolutions result in

²⁶[Babeau, 1991], p.425. See also [Lévy-Leboyer and Casanova, 1991], p.7.

²⁷Cf. [INSEE, 1981] for French consumption. Note that the number of classes in products national classifications took off at that time.

²⁸Theaters regressed with the advent of television, just like the laundry and dyeworks expenditure when electric household appliances developed or just like collective transport expenditure with the emergence of the individual car.

²⁹See, for instance, [Maddison, 2001, Caron, 1997, Mokyr, 1999, Dockès, 2002].

³⁰[Dockès, 2002], p.82-83.

³¹See [Gille, 1978].

the transition from the old economic organization to the "manufacturing capitalism" (1770-1873), then to the "organized capitalism" (1873-1970) including the "fordism regime", and finally to the "neocapitalism". The latter productive regime was born from a wave of innovations (ICT) which emerged in the 1940's and developed until forming a technical system in the 1980's³². Finally, redefining the temporal limits of industrialization leads to three plausible productive regimes (that we will also keep calling industrial revolutions), partially overlapping but each one representing a particular form of economic, institutional, technological and social organization.

3.2.2 Lessons learnt

At each industrialization phase, changes have been stronger in the countries characterized by significant the evolution of consumption habits on a particular range of goods³³. But if we suggest here much more than a simple correlation between industrial and final households consumption dynamics, we must also take into account the historical chronology of the observed evolutions: the changes in consumption habits happen before and during the adoption of the new productive regimes. Indeed, if we put aside the case of railway which is between two technical systems and whose role was initially to homogenize the national markets, we can note that 1) in the 18th century, the consumption of clothes (particularly indian clothes) increased before Watt's patent about steam machine; 2) in the middle of the 19th century, an acceleration in consumption changes can be observed before the adoption of the "new" technical system related to the wave of innovation that emerged at the end of the century; 3) in the middle of the 20th century, mass consumption started before the emergence of the key features of the technical system characterized by electronics, communication, data processing and new ICT.

This observation appears to be particularly significant since recent historiographic work weaken the old view concerning the industrial revolution: the adoption of mechanization and of steam machine was slow, even in England, and initially (until the middle of the 19th century), the industrial revolution happened largely without modifying dramatically the old labor organization. Therefore the reinterpretation of [Wrigley, 1988]'s thesis by [Verley, 1997b] appears particularly interesting. Moreover, this reinterpretation is, in our opinion, generalizable to all the identified phases of industrialization. For [Wrigley, 1988], the British economy initially developed improving the existing productive system. This "organic" (or "Smithian") growth process would have encounter its limits around 1760. Reaching a "stationary state", the nature of growth would have changed, leading then to the adoption of innovations, of new labor organizations and of new types of energy (mineral energy). This "Schumpeterian" growth process would be the period of the adoption of the modern industry in England. Due to chronology reasons, this thesis is very debatable. But the existence of two "successive" processes of growth remains relevant if we consider another point of view: the Smithian growth process would be demand driven whereas the Schumpeterian growth process would find an explanation on the supply side factors.

According to this assumption, the industrial revolution would not thus originate in the conjunction of a technical revolution, a minimum level of capital accumulation, a labor availability and of new energy and raw material sources. It would result first from the emergence of new (interior and external) outlets and from a better use of the existing techniques and organization³⁴. As this process reaches its limits, the economy would have switch from the "Smithian" regime to the "Schumpeterian" regime. This new "Schumpeterian" regime is characterized by a supply driven process: autonomous technical progress development, profit reinvestment, management rationalization to take into account the increasing size of the firms (more regular work but less directly

³²See also [Freeman and Louca, 2001] on the particular importance of ICT for industrial dynamics.

³³See [Lévy-Leboyer and Bourguignon, 1985, Verley, 1996] and [Davis, 1956, Davis, 1962, Rosenberg and Birdzell, 1986, Verley, 1997b, Verley, 1999].

³⁴[Verley, 1997b], p.107. Concerning the demand driven revolution, see also [Grenier, 1996], p.77.

related to the demand side). And the transition between the Smithian and the Schumpeterian regimes results in the adoption of innovations that solves a problem concerning the production capacities and the increase in prices of production factors (raw material, energy, labor...). It was the case in the industries like chemistry, iron and steel or textile, in which the fast growth of the demand side led to many innovations. Then, growth is not anymore demand driven (as in the Smithian regime) but supply driven. The increasingly important supply side becomes thus limited by the size of the markets. Therefore the firms are looking for foreign trade: the second half of the 19th century is, for instance, characterized by a wide globalization of the markets in England and France, supporté by the development of the rail.

The existence of these two processes (Smithian and Schumpeterian) allows us to propose an interesting interpretation of the main historical phases of industrialization and provides a plausible explanation of the differences between countries in terms of development. A stronger pressure of the demand for Indian style textiles contributed to explain the English advance, compared to France. Indeed, the French society of the 18th and the beginning of the 19th century appeared strongly bipolarized when compared to the English society: On the one hand the high society, very rich but sparse (characterized by a strong propensity to save and by conspicuous and not very elastic consumption), and on the other hand the very large part of the population, very poor, consuming mainly food. The middle class, favorable to the development of a "middle range" consumption (half-luxury goods— cf. [Verley, 1996]), was very reduced. It is however the most important one for industrialization. Conversely, at the time of the electrification, during the second industrialization, England suffered from its advance in the gas diffusion: The electricity demand was indeed less elastic to prices than in other countries³⁵.

However an interesting difference exists between the first, the second and the third productive regimes: The adoption of new goods is much more complex when it creates radically new use: the price-elasticity can become sufficiently strong only if the prices are decreasing under a given threshold that allows a broad access to the product for large population. The large adoption of a product also requires the creation of new desires through the social and the commercial system (or through consumer self experiences). As the (often radical) innovations of the second industrialization became adopted, they contributed to transform the consumption structures and to produce a new demand. It is the case with transport as a product (traveling, also for tourism...), but also as an homogenization factor of the markets (consumer goods and consumption habits diffusion). The train also contributed indirectly to favor car consumption (a key aspect of the second industrialization) since it strongly developed transportation habits during the second half of the 18th century [Toutain, 1967]. In the same way, electricity, for example, appears to answer demand for several products [Cardot, 1987]: Lighting the cities, urban transportation, engines in the factories or communication. Directly or indirectly demand driven, electricity is also the synonymous of amusements and passions for a significant part of the population. It is another way for technics to influence consumers behaviors and thus to produce a new demand. Finally, electricity satisfies needs, even if those needs were not initially expressed. The technical development, with its strong social and cultural contents, thus contributes to the production of the expression of new needs, especially when the social environment is curious and receptive. When the consumers desires are finally expressed and the electricity diffusion on the network becomes possible thanks to technical progress, electricity benefits from a strong price-elasticity and from a significant and durable productivity gains. Its consumption can thus take off and become mass consumption. Indeed, techniques can produce the conditions of the development of a mass consumption.

It seems thus that the important role of the evolution of consumption habits in the advent of a productive regime is not of the same type throughout the considered periods. In many phases of the industrialization process, techniques are consumption patterns driven. In others, the evolution of

³⁵Cf. Mustar in [Cardot, 1987].

consumption habits is partly technology driven, contributing to produce a new demand. However, this analysis of this dialectical relation that can be applied to the various phases of industrialization, should be completed: on the one hand by identifying the macroeconomic mechanisms and on the other hand by stressing the respective roles of technical and commercial revolutions in the production of a new demand.

4 Growth, consumption structures and products integrating new techniques: a model for Schumpeterian growth process

In this article, we model the role of the consumption structures evolution within a Schumpeterian growth process, since we suppose that techniques are available for all the countries. In the model, we define a growth regime by the "main" macroeconomic variables, i.e. economic growth rate, employment growth rate as well as the "attitude of the economy" concerning innovation, that we will define below.

When an existing technical system is destabilized by the introduction of new techniques [Gille, 1978], the economy is in front of what we will call a technical shock. This shock can induce various growth regimes. For example, the introduction of steam machine in the 18th and in the 19th centuries was not done in the same way in England and in France and these two countries were not characterized by the same prosperity. They do not adopt the same growth regime at that time. We could also note that the United States and Europe do not adopt the same growth regime either during the 20th century.

4.1 The model

4.1.1 The consumption function of a product "p"

As in macroeconomic tradition, we model a consumption depending on the current income. However, we take into account many criticisms related to this approach (in particular the life cycle hypothesis). We suppose indeed that consumption evolution does not depend directly on the evolution of the total income (\dot{Y}_t ³⁶) but of its components: the evolution of the income depends on the one of created jobs (\dot{L}_t^c), suppressed jobs (\dot{L}_t^s), of wage ($\dot{\omega}_t$) and of the profits generated by the capital ($\dot{\widehat{c_t Y_t}}$ ³⁷). For a budget coefficient, we thus write:

$$\dot{C}_{p,t} = p_L^c \left(\omega_t \dot{L}_t^c \right) + p_L^s \left(\omega_t \dot{L}_t^s \right) + p_\omega \left(\dot{\omega}_t L_t \right) + p_p \dot{\widehat{c_t Y_t}} \quad (1)$$

where $C_{p,t}$ is the consumption of a product "p" and $p_L^c, p_L^s, p_\omega, p_p$ are the propensities to consume the product "p" when the income varies respectively because of job creations, job suppressions, wage rise or profit increase. Indeed, the originality of our assumption is to consider that the various components of the global income do not have the same impact on consumption evolution of a given product.

Two justifications can be argued about this assumption. The first one is a "sociological" argument, related to people's "preferences": it is not surprising that consumption depends on the differences between people. In our model, we do not take into account directly the traditional

³⁶If X_t is a variable depending on t , we denote $\dot{X}_t = \frac{dX_t}{dt}$.

³⁷ $c_t = \frac{Y_t - \omega_t L_t}{Y_t}$ indicates the profit share, L_t being the level of employment.

differences between social classes [Duesenberry, 1949, Veblen, 1899] but the agents' position regarding "works" (which is a social activity³⁸). The second argument is an economic one since the agents, by optimizing their intertemporal consumption, can change their consumption habits depending on the evolution of their anticipations. Thus, an agent anticipating the lost of his job will be probably less laid out to spend its income in products integrating the new techniques than an agent anticipating to get a job or anticipating an increase of its income due to wage rising. Each one of these agents can be regarded as if they were in a different phase of their "life cycle": the agents getting a job at period t are often young people or people who recently received educational training. Their consumption behavior must thus be different from that of agents loosing a job and which are generally older or owing a lower education training³⁹. Let us note finally that propensities to consume also reflect (partly and indirectly) the level of the inequalities regarding the income distribution in the considered country: it seems indeed reasonable to think that a country creating little paid and unskilled jobs does not have same propensity to consume products integrating the new techniques than a country creating only very skilled and well paid jobs.

Lastly, since propensities to consume can be interpreted as the sensibility of a consumer category (for instance, regarding p_L^c , consumers finding a job at period t) to use an increase in his income for the purchase of the product p . Therefore we can consider that propensities to consume are good indicators of the preferences of the various consumers categories for the considered product.

4.1.2 industrial revolutions and products integrating new techniques

We propose to distinguish now, using the previous assumption, the products integrating the new techniques from the traditional goods through the three following assumptions.

1. We suppose that the various population categories will adopt significantly different attitudes concerning products integrating new techniques.
2. The consumption share, in the production, of the goods integrating the new techniques increases with time because prices are decreasing (as for cotton in the 18th century) or because of the emergence of radically new techniques (like electricity at the end of the 19th century). This is expressed by:

$$\frac{\dot{C}_{p,t}}{C_{p,t}} = \frac{\dot{Y}_t}{Y_t}$$

3. When an agent who is getting a job and when an employee receive one additional euro, the first one spends a larger part of this euro in order to purchase goods integrating the new techniques than the second one:

$$p_L^c > p_\omega$$

This last point can be explained by considering the two following cases.

- 1st case: the industrial revolutions for which the new techniques are integrated into the production of traditional goods (for example textiles, in the 18th century). In this case, when a new job is created, it can be given to an agent which had already a job, to an

³⁸Let us note that some research [Herpin and Verger, 1999] shows with another point of view that, at microeconomic level, the impact of work status on consumption.

³⁹With a a radically different model, our approach has thus a remote link with the Ando, Modigliani and Brumberg's life cycle theory.

agent which never had a job or to an agent which already had a job but who lost it. In the first case the essential motivation of the agent is the improvement of his welfare level (and thus an increasing consumption of products integrating the new techniques). In the second case, following the life cycle hypothesis, the agents are getting equipped in products integrating the new techniques. In the third case, we can suppose that the mechanisms of social imitation lead to an acceleration of products integrating the new techniques consumption [Duesenberry, 1949, Veblen, 1899]. Finally, let us note that a significant number of job creations correspond to female work at the time of the first industrial revolution (cf. [de Vries, 1993, McKendrick, 1974]) but also during the following ones. They largely contribute to develop the new products consumption. Finally, in each case, we can suppose that an additional unit of money will be the more consumed for products integrating the new techniques by people getting a job than by the average employee, already equipped and/or saving for its old days. This reasoning leads us to conclude that: $p_L^c > p_\omega$;

- 2nd case: the industrial revolutions characterized by complex and radically new goods (as in the case of electricity [Cardot, 1987]). Assuming that the employee's average income is higher than the one of households getting a job, we should deduce from Engel's law that the consumption of less essential products, and thus the one of radically new products, is reserved to the richest households. The average employee should then consume more products integrating the new techniques than people getting a job. However, it seems reasonable to suppose that radically new and complex products needs specific consumer skills depending on age of people or of the last educational training. For instance, young people are more able to use ICT because they are trained to use these tools than the average employee. Thus, assuming that the agents finding a job in period t are better prepared to consume products integrating the new techniques (because they are young or because their educational training is recent), we thus have: $p_L^c > p_\omega$.

4.1.3 Consumption structures and other hypotheses

Let $\theta_t = \frac{C_t^N}{Y_t}$ be the consumption structure (where $C_t^N = \sum_p C_{p,t}$ - The sum is taken over all the products integrating the new techniques). We thus have⁴⁰:

$$\dot{C}_t^N = p_L^c \left(\omega_t \dot{L}_t^c \right) + p_L^s \left(\omega_t \dot{L}_t^s \right) + p_\omega \left(\dot{\omega}_t L_t \right) + p_p \dot{c}_t \hat{Y}_t$$

where $p_L^c, p_L^s, p_\omega, p_p$ are the propensities to consume the products integrating the new techniques related to the various income sources.

Hypothesis 1 *consumer preferences are mainly changing in the long run [Braudel, 1979a, Lévy-Leboyer and B. We assume thus that the propensities are constant.*

Hypothesis 2 *products integrating the new techniques are not inferior goods. Thus: $p_L^c > 0, p_L^s < 0, p_\omega > 0, p_p > 0$.*

Hypothesis 3 *agents loosing their jobs anticipated their income decrease and thus reduce, as Engel's law prediction, non essential expenditures. We thus have: $p_L^c > |p_L^s|$. The justifications concerning the " $p_L^c > p_\omega$ " hypothesis are also justifications of this claim.*

⁴⁰Since we will not use anymore $C_{p,t}$, we use the same notations ($p_L^c, p_L^s, p_\omega, p_p$) for the propensities to consume related to C_t^N .

4.1.4 Growth regimes and industrial revolutions

Using [Villemeur, 2004]'s framework, we distinguish two types of investments according to their macroeconomic properties.

The growth investments (I_t^N) are characterized by production increase and job creations, modeled by Equations 4 and 6 (see below). We suppose that growth investments are mainly the investments for products integrating the new techniques and for traditional products for which demand is growing.

The rationalization investments⁴¹ (I_t^R) are characterized by capital/labor substitution, production being constant. These investments destroying jobs are modeled by the Equation 7 (see below)⁴².

The distinction between the two categories of investment is close to the one between capacity investments and process investments⁴³: by definition, capacity investments aim at producing new products and/or to increase the production of existing goods. Process investments are characterized by an improvement of the production process. They aim at improving products quality and productivity and at reducing costs. Rationalization investments are thus primarily process investments whereas growth investments can both contain capacity and process investments (particularly when new processes contribute to increase significantly the production or its quality).

In our model, the growth regime will be defined by x_t^N . The larger this value is (tending towards 1), the more the economy adopts innovations, the more it is industrializing, and the more it is growing and creating jobs. The intensity of an industrial revolution depends of the country's growth path: does the country reach the highest possible growth regime and does the country remain a long time at the same regime.

We then model the representative producer behavior by a firm minimizing the production cost increase ($\widehat{Cost}_t = \omega_t \dot{L}_t + \omega_t^r \dot{L}_t + q_t^r I_t$) per produced unit, under limited rationality constraints. At each time t , a decision is taken concerning two variables: x_t^N which describes the investment structure and ε_t^c which describes the economy's policy effectiveness regarding employment. We suppose that, due to imperfect information, producers consider that the following variables are exogenous ones: the investment rate (i_t), the profit share (c_t), the wage growth rate ($\frac{\dot{\omega}_t}{\omega_t}$) as well as the anticipated cost of the job creations per unit of capital (taking into account the shareholders required profitability, q_t^r ⁴⁴). The optimization program is thus:

$$\text{Min} \left[\frac{\widehat{Cost}_t}{Y_t} \right] \text{ under constraints: } \begin{array}{lll} i_t = c_{1,t} & c_t = c_{2,t} & \frac{\dot{\omega}_t}{\omega_t} = c_{3,t} \\ \frac{\omega_t L_t \varepsilon_t^c x_t^N i_t q_t^r}{c_t Y_t} = c_{4,t} & x_t^N \in]0, 1] & \varepsilon_t^c \in]0, \varepsilon_c^{\max}] \end{array} \quad (2)$$

where the $c_{k,t}$, $k \in \{1, 2, 3, 4\}$, are exogeneous variables (i.e. depending only of time).

⁴¹The emigration from Europe during the 19th century is a symptom of job destructions and of not enough job creations.

⁴²To simplify the model, instead of writing $\frac{\dot{L}_t}{L_t} = \varepsilon_t^s (1 - x_t^N) i_t$ where (ε_t^s) is the job destructions coefficient, we will suppose that there is a maximum coefficient of job creations (ε_c^{\max}) and that coefficients ε_t^c and ε_t^s vary in a symmetrical way: a policy favorable to employment also contributes to limit the jobs destruction. We thus pose $\varepsilon_t^s = \varepsilon_c^{\max} - \varepsilon_t^c$.

⁴³This distinction is proposed or studied, more or less directly, in [Van Duijn, 1979, Mensch, 1979, Schumpeter, 1935, ?, Lorenzi and Bourlès, 1995, Villemeur, 2004]. Capacity investments result from a product innovation or an increasing demand for existing products. The process investments correspond to process innovations leading to the production of the same goods (or substitutes).

⁴⁴The anticipated cost of job creations per unit of capital is thus written, according to the equation 6, $\frac{\omega_t \dot{L}_t}{K_t} = \frac{\omega_t L_t \varepsilon_t^c x_t^N i_t q_t^r}{c_t Y_t}$.

In particular, we deduce from that optimization the Equation 9 (see below), which establishes the relation between the evolution of consumption structures and the adopted growth structures. In the following, we will also suppose that producers' anticipations concerning the demand for products integrating new technologies influences the adoption of a growth regime.

$$\dot{C}_t^N = p_L^c \left(\omega_t \dot{L}_t^c \right) + p_L^s \left(\omega_t \dot{L}_t^s \right) + p_\omega \left(\dot{\omega}_t L_t \right) + p_p \dot{c}_t \dot{Y}_t \quad (3)$$

$$\dot{Y}_t = p_c I_t^N = p_c x_t^N I_t \quad (4)$$

$$\frac{\dot{Y}_t}{Y_t} = p_c x_t^N i_t \quad (5)$$

$$\frac{\dot{L}_t^c}{L_t} = \varepsilon_t^c x_t^N i_t \quad (6)$$

$$\frac{\dot{L}_t^s}{L_t} = (\varepsilon_c^{\max} - \varepsilon_t^c) (1 - x_t^N) i_t \quad (7)$$

$$\frac{\dot{L}_t}{L_t} = \frac{\dot{L}_t^c - \dot{L}_t^s}{L_t} = (\varepsilon_t^c x_t^N - (\varepsilon_c^{\max} - \varepsilon_t^c) (1 - x_t^N)) i_t \quad (8)$$

$$\varepsilon_t^c = \varepsilon_c^{\max} x_t^N \quad \text{avec } \varepsilon_c^{\max} > 0 \quad (9)$$

Variable name	Definition
Y_t	Production (GDP)
I_t^N	Growth investments
p_c	Productivity of growth investments.
$x_t^N = \frac{I_t^N}{I_t} \in [0, 1]$	Share of growth investments in total investment
$I_t = I_t^N + I_t^R$	Total investment
I_t^R	Rationalization investments
L_t^c	Created jobs
L_t^s	Suppressed jobs
L_t	Level of employment
$i_t = \frac{\dot{Y}_t}{Y_t}$	Investment rate
$\varepsilon_t^c > 0$	Created jobs coefficients (associated with I_t^N)
ε_c^{\max}	Suppressed jobs coefficient (associated with I_t^R)
ω_t	Wage rate
c_t	Profit share
$p_L^c, p_L^s, p_\omega, p_p$	Propensities to consume goods integrating new techniques related to the various income sources (job creation and suppression, wage, profits)

4.2 Results

4.2.1 Consumption structures and growth regimes

Assuming that the investment rate and the profit share are independent of time, we obtain, from Equations 3 to 9, that:

$$\frac{\dot{C}_t^N}{\dot{Y}_t} = \underbrace{p_L^c \frac{(1-c)\varepsilon_c^{\max}}{p_c} x_t^N}_{\frac{\dot{C}_t^{N,Lc}}{\dot{Y}_t}} + \underbrace{p_L^s \frac{(1-c)\varepsilon_c^{\max}}{p_c} \frac{(1-x_t^N)^2}{x_t^N}}_{\frac{\dot{C}_t^{N,Ls}}{\dot{Y}_t}} + p_\omega (1-c) \left[1 - 2 \frac{\varepsilon_c^{\max}}{p_c} + \frac{\varepsilon_c^{\max}}{p_c x_t^N} \right] + p_p c \quad (10)$$

Noting $e = \frac{p_c}{\varepsilon_c^{\max}}$ (it can be proven that $e > 1$ ⁴⁵), we obtain:

$$\frac{\dot{C}_t^N}{\dot{Y}_t} = \left[\frac{(1-c)}{e} \frac{1}{x_t^N} (p_L^c + p_L^s) (x_t^N)^2 + (ep_\omega - 2(p_\omega + p_L^s)) x_t^N + (p_\omega + p_L^s) \right] + p_p c \quad (11)$$

This equation means that the consumption structure depends on:

1. the growth regime (x_t^N);
2. the propensities to consume the products integrating the new techniques ($p_L^c, p_L^s, p_\omega, p_p$), that is to say consumers' preferences.

We thus identified a relation between historical observations concerning consumption structure evolution and economic theory.

Since relation (1.10) involves consumer's preferences (via propensities to consume), we propose to consider two cases:

- in the first one, preferences are fixed. This corresponds to a short or medium term analysis of Schumpeterian growth regimes,
- in the second one, we analyse the impacts of possible shocks on the preferences.

Thus, with fixed preferences, we show that consumption structures vary as indicated in Table 1.

<i>Conditions concerning propensities to consume products integrating the new techniques</i>	x_t^N	0	x_0
<div style="display: flex; justify-content: space-between;"> Si $p_L^s + p_\omega \leq 0$ </div>	α_t	$\alpha_t(x_1) = 1$	$\alpha_t(x_0) >$
<div style="display: flex; justify-content: space-between;"> $p_L^c + p_L^s > 0$ </div>	α_t	$\alpha_t(x_2) =$	$\alpha_t(x_0) >$
<div style="display: flex; justify-content: space-between;"> $p_L^c + p_L^s = 0$ </div>	α_t	$\alpha_t(x_2) = 1$	$\alpha_t(x_0) >$

Figure 1: Variation table of the consumption structure

In this table⁴⁶, we denote:

⁴⁵It results from the positivity of the productivity growth rate, using equation $\frac{\dot{L}_t}{L_t} = \frac{1}{e} \frac{\dot{Y}_t}{Y_t} - (\varepsilon_c^{\max} - \varepsilon_t^c) i_t$ (resulting from Equations 5 and 8).

⁴⁶We did not put in the table a limit case: if $p_L^s + p_\omega = 0$ then $x_0 = 0$.

$$x_0 = \sqrt{\frac{p_L^s + p_\omega}{p_L^c + p_L^s}}$$

$$L = +\infty \text{ if } p_L^s + p_\omega \neq 0 \text{ and } L = (1 - c_t)p_\omega + p_p c \in [0, 1] \text{ if } p_L^s + p_\omega = 0$$

$$\alpha_t(x_0) = \frac{(1 - c)}{e} \left[2 \left(\sqrt{(p_L^s + p_\omega)(p_L^c + p_L^s)} - (p_L^s + p_\omega) \right) + ep_\omega \right] + p_p c > 0$$

$$\alpha_t(1) = \alpha_t^{\max} = \frac{1 - c}{e} [p_L^c + p_\omega(e - 1)] + p_p c \in [0, 1]$$

Note that α_t cannot be durably negative or above 1.

Using the notations introduced in Equation 10, we can explain the variations summarized in Table 1. Its interpretation is given in Table ??⁴⁷.

	Variation when x_t^N varies in $[0, 1]$	Interpretation
$\frac{\dot{C}_t^{N,Lc}}{\dot{Y}_t}$	Increasing	An intensification of the industrial revolution induces an increase in the number of created jobs, which is itself more favorable to the development of products integrating the new techniques.
$\frac{\dot{C}_t^{N,Ls}}{\dot{Y}_t}$	Increasing	An intensification of the industrial revolution induces a decrease in the number of destroyed jobs, which is itself more favorable to the development of products integrating the new techniques.
$\frac{\dot{C}_t^{N,\omega}}{\dot{Y}_t}$	Decreasing	An intensification of the industrial revolution induces a decrease in the wage rate growth, which is itself less favorable to the development of products integrating the new techniques.

Table 2: Evolution of the various components of the consumption structure evolution.

This table shows the effects of the adoption of a higher growth regime (i.e. of an intensification of the industrial revolution) on the consumption of goods integrating the new techniques: the increase in the number of created jobs and the reduction of destroyed jobs appears to be favorable to the consumption of products integrating the new techniques while a decrease in wage growth rate is unfavorable to new consumptions. The evolution of consumption structures then results from this opposite effects and thus depends on consumer's preferences, as shown in Table 1.

When the propensities to consume vary, Equation 11 shows that $\frac{d\alpha_t}{dp_X} > 0$, $X \in \{p_L^c, p_L^s, p_\omega, p_p\}$. This means that the consumption structure is involving more products integrating the new techniques if consumer's preferences move in favor of these goods. However, these relations do not allow us to consider the evolution of the growth regime, after a shock on the preferences. It is what we will study now.

⁴⁷An intensification of the industrial revolution means an increase of growth investments and thus stronger growth of the production and of employment. That means that x_t^N grows.

Equation 11 allows us to calculate the variation of x_t^N at the time of a shock on the propensities to consume: $\frac{dx_t^N}{dp_X} > 0$, $X \in \{p_L^c, p_L^s, p_\omega, p_p\}$ except when both $p_L^s + p_\omega > 0$ and $x_t^N \in]0, x_0[$ ⁴⁸.

We showed that for a given growth regime, propensities evolution in favor of products integrating the new techniques has an impact on the evolution of consumption structure (α_t). Similarly, we just checked that a shock on consumers' preferences has an impact on the growth regime itself.

4.2.2 Interpretation

To conclude with this model, let us stress the two possible cases of countries:

1. The first case corresponds to an economy in which the employees preferences for the products integrating the new techniques are relatively strong ($p_L^s + p_\omega > 0$) and in which the share of growth investments is weak ($x_t^N \in]0, x_0[$). We consider in this case that the economy did not still truly enter the Schumpeterian growth regime (no real important technical shock⁴⁹). Then:

- Surprisingly, if the preferences (i.e. propensities to consume) do not vary, the ratio between the consumption growth rate of products integrating the new techniques and of the economic growth rate decrease as firms devote a larger part of their investments to growth investments (and thus to these products). It corresponds to the cases in which new jobs are not sufficiently numerous to develop new consumption habits. The firms are thus not stimulated to reach a higher growth regime (which would have favored employment and thus the consumption of new goods). This situation can be interpreted as a weak growth trap.

This situation looks like the one of Europe's crisis at the end of the 19th century (in which the wage evolution allowed a category of consumers to purchase more goods integrating the new techniques but in which employment also declined). This period was also the one of investments in the new technical system that had been useful to Europe to escape the weak growth trap;

- A shock on the preferences on the one hand can make the growth regime (x_t^N) evolve and on the other hand can modify the threshold which defines the weak growth trap (x_0).
 - Similarly as in the previous case (in which preferences were fixed), the growth regime (x_t^N) becomes lower as the preferences evolve in favor of the products integrating the new techniques. This situation is thus unfavorable to the adoption of the new optimal growth regime ($x_t^N = 1$).
 - Concerning the threshold regime (x_0), we note that an increase in the preferences for the goods integrating the new techniques of the agents getting a job (p_L^c) is favorable to the economy insofar as it reduces the size of the weak growth trap (i.e. the interval $[0, x_0]$). On the other hand, an increase in the employees preferences for these products is unfavorable to the adoption of a higher growth regime. However, this case is interesting only for countries which economy is close to the threshold (x_0), because, in this case, the evolution of consumer's preferences can push the country either above or under the threshold.

⁴⁸ Since $\frac{dx_t^N}{dp_X} = \frac{dx_t^N}{d\alpha_t} \frac{d\alpha_t}{dp_X} = \frac{1}{\frac{d\alpha_t}{dx_t^N}} \frac{d\alpha_t}{dp_X}$.

⁴⁹ Let us recall that, for us, a technical shock, in accordance with the [Mokyr, 1993] approach, is a period of innovations diffusion and expansion (via microinventions) that results from radical innovations (macroinventions). We thus suppose here that the technical shock is largely related to the escape of the weak growth trap.

2. In the second case, the economy invests sufficiently in the goods with strong growth potential and thus in particular in the new techniques. We consider that in this case, the economy faces a technical shock $\left(\left\{ \begin{array}{l} p_L^s + p_\omega > 0 \\ x_t^N \in]x_0, 1] \end{array} \right\} \text{ or } \left\{ \begin{array}{l} p_L^s + p_\omega \leq 0 \\ x_t^N \in]x_i, 1], i \in \{1, 3\} \end{array} \right\} \right)$:

- If preferences do not vary (which is generally the case in the short and medium term), a higher growth regime results in a consumption structure evolution in favor of products integrating the new techniques. This results in an increase of the ratio between the consumption growth rate of products integrating the new techniques and of the economic growth rate.

To reach the new (optimal) growth rate (i.e. the one for which the economy's production growth and employment growth is maximum, for a given investment rate), the consumption structure must evolve in direction of the products integrating the new techniques in order that the ratio between the consumption growth rate of these products and the production growth reaches a minimal value.

In this case firms are incited to encourage consumption of products integrating the new techniques, which is also favorable to the adoption of the optimal growth regime. Let us see now the impact of a shock on the preferences.

- A shock on the preferences can impact the growth regime (x_t^N) and it can modify the threshold (x_0) that defines the weak growth trap:
 - x_t^N gets closer from the new optimal growth regime when preferences become more favorable to the consumption of products integrating the new techniques. This situation is thus favorable to the adoption of the new mode: Firms will thus promote actively new consumption habits⁵⁰.
This case remembers us the history of electricity⁵¹: housewives, for instance, were trained by the companies to use the new devices. This stimulation of the consumers, as other promotional tools, even before the great time of electric household appliances, were important aspects of firms involvement in the evolution of consumer preferences. In this sense, we can note that the second industrial revolution had been also demand driven: consumers' choices were crucial elements in the orientation of the industries.
 - The study of the threshold regime (x_0) evolution (which defines the weak growth trap), shows that it is preferable to favor the propensity increase of people getting a job rather than the one of the other types of consumers. Once again, this remark is only interesting for the economies located close to the threshold (x_0). We still note the importance of the consumer's choices evolution in the adoption of a growth regime.

However this model has many limits (microeconomic bases of the consumption function are missing, as well as a system of explicit prices; the role of trade in building demand, the possibility to test the validity of the model are also limits of this work...). It is one of these limits that we will try to study, considering qualitatively, from a historical point of view, the role of trade in the "demand production".

⁵⁰Such evolutions should be endogeneized. However they remain probably very slow.

⁵¹See [Cardot, 1987, Flacher, 2003] for a more complete review about consumer and electricity.

5 An hypothesis concerning the causes of consumption changes: the "commercial revolutions"

We showed, within a brief historical approach, the importance of consumption structures evolution, highlighting the succession of Smithian and Schumpeterian growth processes. Our model put to the fore a few mechanisms operating during the Schumpeterian growth regime. We now examine the causes of consumption patterns evolution.

5.1 Commercial revolutions and the "demand production"

5.1.1 Definition of the commercial revolution concept

Trade is the heart of the economy. But surprisingly, very few studies addressed the whole complex trade patterns, although they may explain how can supply and demand match. This question has been addressed by [Braudel, 1979a] with a particularly interesting and original point of view: he describes the economy through its three main "levels" each of them corresponding not only to trade patterns and geographical localization, but also to distinct historical temporalities. The "infrastructure" of the economy (or "infra-economy") corresponds to the very elementary side of the economy (self-sufficiency and very short distance barter). It evolves very slowly over long period. The second floor, the "economy" (or market) corresponds to the institutionalized trade. Its evolution scale is the scale of a life. Finally, the "superstructure" of the economy (or "supra-economy") corresponds to the macro-economic policies, whose changes can occur very fastly, over short term periods.

The regulation of the economy and the infra-economy through the superstructure (the "capitalism") impacts the main changes in the long run. The market thus appears as a strategic position between the infrastructure and the suprastructure. Precisely during the 18th century, with the industrial revolution that we can identify in a few countries (and particularly in England) changes at the three levels together, for the first time in history. Paradoxically, the long distance trade (i.e. macroeconomic changes) developed before the unification of the market and that was particularly important for daily patterns evolution [Polanyi, 1957].

Contrary to the [Kindleberger, 1996] which defines a commercial revolution by a commercial expansion, we propose to define a "commercial revolution" through major changes in trading patterns. That means 1) new forms of distribution and intermediation and 2) their significant extension (at both geographical and social level). These changes which will be essential to define the concept of "demand production", also need 3) the emergence of new transportation techniques and 4) trade intensification (as in [Kindleberger, 1996]'s view). In other words, a commercial revolution is characterized by changes that happen together at the three floors of the Braudelian economy.

5.1.2 Hypothesis on "demand production" and its link with industrialization

We now consider the idea that a "commercial revolution" could be the necessary partner of each industrial revolution. Indeed, the commercial revolutions could be the core of the "demand production" which represents the way in which trading patterns influence consumption habits and preferences (just like they can influence production). This concept appears to be particularly important if we consider that each industrial revolution is characterized by the double rupture it generates: the advent of new production and organization patterns (new technical system), on the one hand, and the one of new consumption habits, on the other hand. This dichotomy is historically plausible but little studied: the chronology as well as the causality is not yet established between the two "under-revolutions" (the commercial and the technical one), of an industrial revolution.

An assumption should thus be considered: a commercial revolution is the change in the "demand production" paradigm which leads to the new consumption habits and thus new consumption structures.

These changes in the consumption habits can induce a new productive regime (it is the case in the Smithian growth phases) or they can be stimulated when the productive regime is changing (Schumpeterian growth phases). Technical, industrial and commercial dynamics are represented in Figure 2.

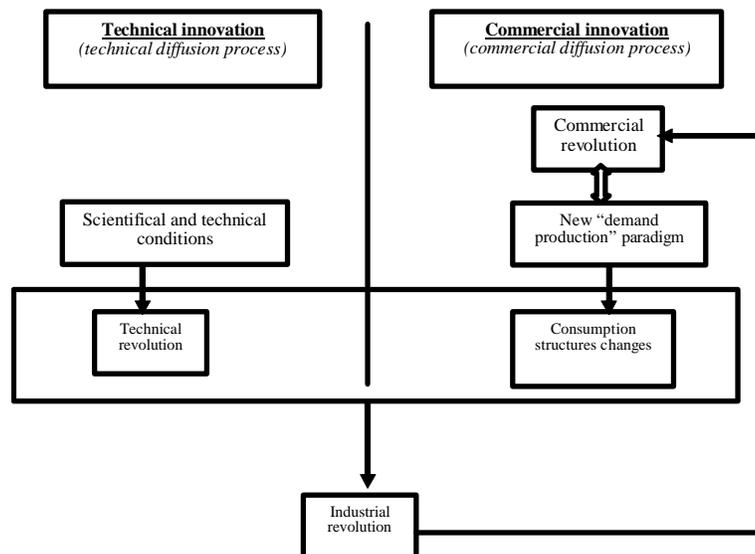


Figure 2: Summary of the assumptions on the link between commercial, technical and industrial revolutions.

5.2 Commercial revolutions and productive regimes in the 1700-2000 period

5.2.1 Oversea transportation and shops in the 18th century

Until the 18th century, commercial changes concerning the supra-economy and the infra-economy appear largely independent from each other. The commercial revolution, with our definition, is starting only in the 18th century, when long distance oversea trade develops a link with the local areas and shops⁵²: the stores progressively replace the fairs, the banks develop and compete with the stock exchanges, the travelling merchants revolutionize local trade⁵³ enhancing very short distance trade, as pointed out by Braudel. But why did the various levels of the economy evolve together since this time?

A first explanation is related to what Mendels calls the "proto-industrialization". On the one hand, proto-industrialization provides an additional purchasing power (favorable to the consumption of industrial products, like Indian textiles). On the other hand, it largely contributes

⁵² "The movement, beyond 1720, is undoubtedly concerning all the floors of the economy" ([Braudel, 1979b], Vol.2, p.113). See also [Braudel, 1979b], Vol. 1, p.12-13 and p.112-113.

⁵³ Indeed, fairs and markets, the networks of traveling shops and the other types of merchants contributed, with the help of credit sometimes, to create new needs. For [Roche, 1988], it is a true "vestimentary revolution".

to homogenize the national market thanks to transportation development and to generalize new spending patterns⁵⁴ thanks to the trade development between cities and campaigns. Thus proto-industrialization transformed trading patterns through all the levels of the Braudelian economy. It also developed key markets for industrialization (like the one of Indian textiles). Finally the cities played a crucial role in demand production since self production is necessarily limited, mainly since cities have "prescribed" new consumption habits and promoted fashion standards.

The other explanatory dimension of the 18th century commercial revolution is foreign trade with particularly strong intensification in England: the production for export increased by almost 550% in one century, whereas the production for the domestic market increased by "only" 52%⁵⁵. Foreign trade also provides a plausible explanation of the national differences regarding the industrial revolution [Kindleberger, 1996]: it can involve national industries (as in England) or not involve them (as in Holland, with warehouse trade). Contrary to Amsterdam, London was thus at the same time at the core of an important trade foreign network and at the core of a domestic economy. The three levels of the economy were thus involved together there.

The English industrial revolution appeared thus after a commercial revolution with two clearly visible components: the development of foreign trade and the creation of a more homogeneous domestic market. This is due to large cities, with a high density of shops and with fairs and markets higher frequency. The French behavior is located in an intermediate situation: trade dedeveloped quickly in the 18th century but mainly in the principal sea-ports: only the Rouen's trade has important links with the local industry and until the 18th century, Paris is a warehouse at the center of a centralized sales network. Lastly, Germany suffered from the great disparity of the regions development, a lack of homogeneity of the national market (at least until the development of the railroads), organisational heavinesses and geopolitical and historical problems.

This analysis shows the importance of the various components of our definition of the commercial revolution understanding demand production which is necessary to industrialization. These elements are summarized in Table 4.

5.2.2 Railway and department stores in the 19th century

Manufactured goods take more and more importance during the 19th century. The rise of transport and communications and the development of department stores contribute to unify much more the national markets. These evolution produces a new wave of demand for products of the first industrialization, preparing at the same time the population to mass consumption that is about to born, with the second industrialization.

The first important aspect of this revolution is transportation: It builds integrated markets from the local to the international level. Progresses are important since 1830 in the use of roads and in the use of travellers and goods coaches. It will be more significant with the railroads development. Indeed [Gervais, 1995] considers that the second phase of industrialization was born in the United States from a "transport revolution" and a "market revolution"⁵⁶ during the years 1820-1940. Industrialization would not thus be explained by the (only) technical progress but by more intensive cost cuttings and productivity gains, resulting from the "commercial revolution". This period is characterized by the collapse of many monopolistic firms which benefited from a regional specialization due to lack of transportation development.

When transports develop, they also revolutionize directly consumption habits, producing a new demand that nobody waited for during the second half of the 19th century, especially concerning

⁵⁴See [Roche, 1988], p.477-488. It is worth noting that textile consumption also induced the production for a related demand: the maintenance and cleaning of the textile goods which is not completely done inside the household when in the cities or big villages (development of laundry...).

⁵⁵[Braudel, 1979a], Vol. 3, p.503.

⁵⁶[Gervais, 1995], p.336.

leisures⁵⁷. Thereafter, this demand will be favorable to the car boom since cars appeared to be a good substitution product. The rise of consumer credit (in particular "hire-purchases") is another element of the commercial revolution which starts in the middle of the 19th century in Europe (a little behind the United States⁵⁸). It has been a significant help for retailing⁵⁹. But the development of department stores, in parallel with the one of transport and the communications, is probably the key changes characterizing this commercial revolution⁶⁰, born in the center cities, where fashion and consumption standards emerge.

This revolution does not bring very new things but the systematization of many commercial habits⁶¹. Thus, since 1852, with the "Bon marché", Boucicaut immediately introduces free entrance, fixed and displayed prices and the possibility for the purchaser to return goods if he is not satisfied⁶². Four great innovations were also largely developed⁶³ 1) a policy of low and discount prices (profits are sought through high volumes); 2) the creation of a single structure for various products, with entertainments (frequent and regular modifications of the departments structure, shows, places to meet people...) and putting to the fore the luxury and modernity of the store (elevators, electricity⁶⁴...); 3) advertisement was then understood as an essential tool for the diffusion of new mass consumption habits; 4) finally, the mail order business was one of the major aspects of the department stores development: department stores decided to go towards the consumer, in the campaigns and abroad. These changes are mainly characterized by new forms of intermediation where the relation "client/seller" is replaced by the less personal relation "client/products". They were quickly extended, in the following years, to the whole retailing. Therefore, department stores constitute a real commercial revolution that induced new consumption habits.

This revolution, that started in the middle of the 19th century, had thus a major impact on the creation of a new demand, necessary to the Schumpeterian growth regime of the first industrialization. It also had a major impact on the emergence of the second industrialization phase, at the end of the century.

5.2.3 Cars, supermarkets and malls in the 20th century

The third commercial revolution is associated to the Fordist growth regime identified by the regulation school. This regime is based at the same time on the advent new transport tool (the car) and of a new distribution institutions (supermarkets and malls). For [Galbraith, 1972] these changes can be associated to a new demand production paradigm: The firms now directly influence consumer's behavior (the specific demand) whereas the State plays a role in influencing the "total" demand.

The commercial revolution thus comes mainly from the supermarket and malls networks which emerge for several reasons: as for department stores during the 19th century, a fast demographic growth, a strong urbanization, a significant economic growth play a fundamental role. However, it is necessary to consider also, on the one hand, the migration from the center cities to the suburbs

⁵⁷See also [Toutain, 1971]. This element is capital since it constitutes an argument against the counter-factual methods of the New Economic History: it is indeed criticizable to evaluate passengers transportation cost without train since the train contributed to create new consumption habits closely associated with this means of transportation.

⁵⁸See [Fraser, 1981].

⁵⁹See [Gelpi and Julien-Labruyère, 1994].

⁶⁰Two of the three main commercial ruptures are located, according to [Marseille, 1997], at this time. In France, the three ruptures he identifies are happening during the years 1820-1860 with the "magasins de nouveauté", during the time following the crisis (1880-1910) with the "department stores" and finally since the years 1960's with the supermarkets and malls.

⁶¹See [Bouveret-Gauer, 1997].

⁶²See [Miller, 1981].

⁶³Concerning all these aspects, see [Du Closel, 1989, Marseille, 1997, Miller, 1981].

⁶⁴See [Miller, 1981], p.156-157.

and, on the other hand, the availability of new goods to help the consumers to consume (particularly the refrigerator and more and more the cars). These factors contribute to the development of a distribution that is able to support the flow generated by the mass production⁶⁵. For this reason, the commercial revolution looks like an aspect of Fordism, adapting and systematizing commercial uses⁶⁶: 1) It takes the department stores idea of ordering concentration and of possible scale and scope economies; 2) it takes from popular stores the idea of labor saving organizations (in particular through "self-service" and through a minimum and standardized commercial service). Supermarkets and malls use these methods intensively and implement more "scientific" management methods and labor organization: The chain, the labor division by functions, a few managers designing the stores policies (advertisement, discount...).

Deeply linked to new types of transports, supermarkets and malls can be considered as a "commercial revolution": We can identify new forms of intermediation between supply and demand, trade intensifies and, finally, this revolution involves all the levels of the Braudelian economy. For these reasons, we can consider that supermarkets and malls took a major part in the evolution of consumption structures.

5.2.4 And now?

The question of the link between consumption structures and industrial revolutions is a key question for political economy also because it helps us to understand the recent economic changes. For instance, the diffusion of information and communications technologies in the last decade raises the question of the emergence of a new technical cycle, and of a new productive regime.

The "new economy" brought promising perspectives before an important crisis. Many economists and observers deduces from that crisis that ICT cannot be compared to the previous technical revolutions. They would be simple technologies of substitution, handicapped by their costs, not able to transform our societies.

However, as underlined by [Artus, 2000], the new economy is a complex phenomenon that must however be relativized for several reasons. Initially the new economy did not affect all the developed countries in the same way, the United States being more an exception than the general case. Then the impact of new techniques on the accumulation process and on trade organization remains fuzzy. Finally theorists of the new economy mainly studied the supply side when explaining this long period of strong and noninflationary growth in the United States. The evolution of consumption structure was not much studied. However information transport could induce a commercial revolution.

It seems thus necessary to look at consumption side and not only at supply side if we want to understand the current changes. Are technical changes able to meet or to induce consumers' desires and thus to deeply modify spending patterns? The commercial revolution that induces this evolution probably already began. But it will take more time than many analysts thought to influence people's consumption habits

5.2.5 Synthesis: industrial revolutions and demand production

History is characterized by three main phases of evolution of the spending patterns: the "consumer revolution" in the 18th century, the "consumer goods revolution" in the 19th century and the

⁶⁵A few data provided by [Du Closel, 1989], p.18: 1) French population grew of 15 millions people between 1946 and 1956. 2) While 54% of French people are living inside cities in 1946, they are nearly 80% in 1956. 3) Consumption is three times more important in volume in 1956 than in 1946. 4) Suburbs grew much more than center cities. 5) 1,7 millions of cars are used in 1946 but 22 millions in 1988. 7% of the families have a refrigerator in 1953 but 97% in 1987... Cars to reach the supermarkets and malls and refrigerators at home were two key aspects of the fordist era, which were fundamental for the rise for mass consumption.

⁶⁶See [Du Closel, 1989, Marseille, 1997].

"mass consumption revolution" in the 20th century. These three revolutions seem largely related to the emergence of "commercial revolutions". These commercial revolutions are characterized by major evolutions concerning transports and distribution that produce a new demand. The first commercial revolution rests mainly on oversea transportation and on shops, the second one rests on the advent railroads and department stores and the third one rests on the car and of supermarkets and malls.

If an important explanation of the evolution of consumption structure can be found in the commercial revolution concept, these evolutions are closely related to industrialization processes: the "Smithian" growth regime is demand driven; "Schumpeterian" growth regime is supply driven. This regime must then generate a commercial revolution to develop the necessary types of consumption that firms are waiting for. There would thus be, through the last three centuries, a dialectical sequence of "Smithian" and "Schumpeterian" growth regimes, of commercial revolutions and of productive processes, as summarized in Figure 3, Table 4 and Figure 5.

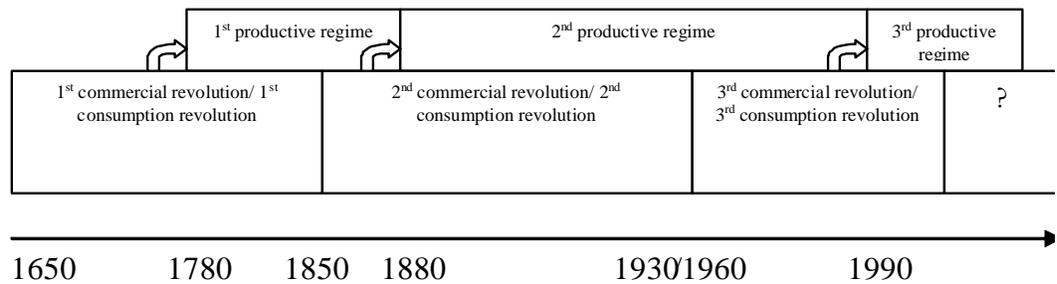


Figure 3: Chronology of industrial, commercial revolutions and productive regimes.

		1 st commercial revolution	2 nd commercial revolution	3 rd commercial revolution
Period		1700-1850	1850-1950	1950-...
Economy – Inter-mediation	Transport.	Oversea transportation	Railway transportation	Cars, plains
	Distribution	Shops, traveling merchants	Department stores	Supermarkets and malls
	Others	Proto-industrialization (links between cities and countries)	Development of communications	<i>A 3rd commercial revolution with the emergence of Internet?</i>
World and macro changes		Long distance trading	Homogenization of national markets	Homogenization of world markets
Changes in population habits		Textile, little objects for the house, new food stuff From a logic of stock to a logic of flow	Acceleration and geographical extension of social and consumption habits of the previous commercial revolution.	Mass consumption related to the 2nd IR goods and progressively to the one of the 3rd.
Industrial revolution			2nd IR (electricity, chemical industries, steel industry, explosion engine and telephone)	3 IR (ICT)
		1st IR (Steam, railway)		

Figure 4: Commercial revolutions productive regimes: a synthesis.

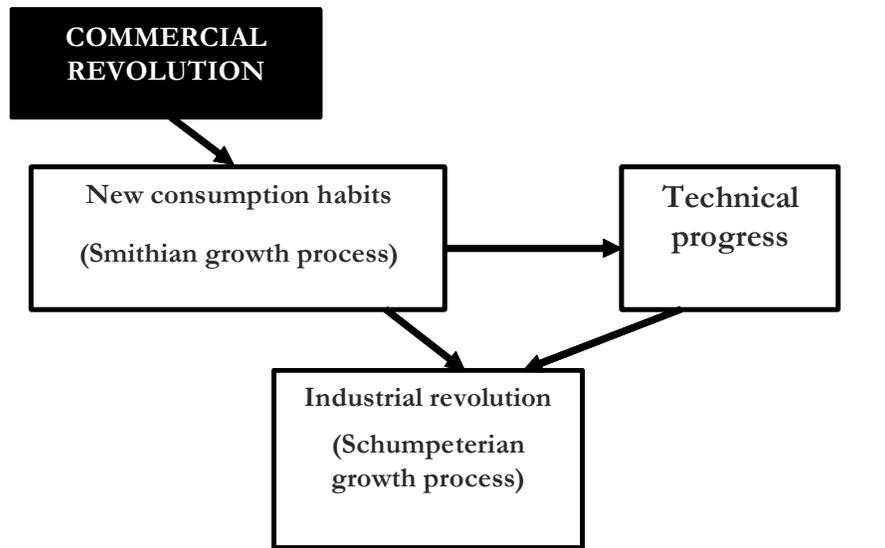


Figure 5: Diagram of the link between commercial revolutions, industrial revolutions, consumption and technical progress.

6 Concluding remarks

In this paper, we addressed the question of the role of consumption structure evolution in the industrialization phases of the Western world since the 18th century. We proposed a double answer to this question: This evolution plays initially a key role in the adoption of the new techniques. Indeed, at each period of industrialization, a "Smithian" growth process is characterized by a demand driven growth which stimulates the adoption of new techniques. A "Schumpeterian" growth process emerges from this adoption of new techniques. This is characterized by a supply driven growth, the demand side being a limitation to growth. However, as shown in our model, the evolution of consumption structures also plays a role in the Schumpeterian growth process since it contributes to define the growth path of the economy and thus the intensity of the industrial revolution once new techniques are available and accessible to all. Lastly, following a qualitative historical analysis, we also suggest that the commercial revolutions play a central role in the transformation of the spending patterns, and that they are largely determined (except for the first industrialization) by the Schumpeterian growth processes.

Perspectives for future work could be the improvement of the model by introducing a production function involving explicitly two sectors and a system of prices. We could also endogenize commercial variables: This could allow us to capture all the phases of an industrial revolutions. We could finally collect relevant data, if available, in order to validate the hypotheses and conclusions obtained with the proposed model.

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