

# BETWEEN CONSTRAINTS AND OPPORTUNITIES: BIG ITALIAN BUSINESS AND AUTARKY, 1934-1943

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**Abstract:** The review of the evolution in the 1930s of some of the country's most prominent industrial sectors, namely the nitrogen, the aluminium and the man-made fibres industry, serves here the purpose of assessing the impact of autarky on technology and long-term industrial development. One suggestion of this article is that the received narrative has overestimated military and ideological considerations in economic self-sufficiency, downplaying, first, the weight of persistent balance of payments problems in its development and, second, the pragmatic nature of autarky. One important conclusion here is also that, as with import-substitution policies in emerging economies in the post-World War II era, autarky offered a shelter behind which big Italian enterprises could fast develop a large domestic market, *per se* the *sine qua non* for massive new investment, technological innovation and greater productivity. Whether those firms were able to seize that unique chance depended on many variables, including the sector where they operated, their management and their bargaining power *vis-à-vis* the *regime*.

**Keywords:** big business and autarky, autarky and long-term development of industry, aluminium industry, nitrogen industry, rayon industry

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The theme of autarky, i.e. economic self-sufficiency, economic planning and import controls characterising the 1930s, has received a good deal of attention within the ambit of the studies about Fascism. The reasons for this are, after all, unsurprising. Autarky was undeniably influenced by the country's broader military and geopolitical strategy.

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Of this we should mention Italy's aggression of Ethiopia and the ensuing economic sanctions in 1935-1936, the participation in the Spanish civil war in 1936-1939, the military occupation of Albania in 1939, and, last but not least, the entry along with Nazi Germany into the Second World War in 1940. Important as they were in shaping autarky, military and strategic considerations should not however be overemphasised. One point here is that these proved after all less important than persistent balance of payments problems in influencing policies of economic self-sufficiency. Significant trade imbalances and a huge outflow of gold encouraged Fascist policymakers to introduce exchange controls as early as December 1934. It is tempting to conclude that there were in effect two visions of autarky living side by side, one which was characterised by a strong ideological and populist emphasis, and another which had a much more pragmatic approach to the country's stringent economic problems. The latter strand of autarky saw the increase in foreign currency reserves – in their turn essential to import essential raw materials – and the creation of a domestic market, which would restore corporate profits and would reduce the risks of new investments, as major policy targets. The central tenet of what follows is that autarky that way ended up offering an opportunity or incentive to technological and strategic change that however not all giant Italian firms managed to grasp to the same extent. Autarky, moreover, undeniably represented a radical departure in economic policy. As Toniolo put it, «if we want at all costs individuate the originality of a 'Fascist economy', then we should investigate the period 1934-1942» (Toniolo 1980, p. XIII). Backing this point is also the consideration, as an authoritative source suggested long ago, that a new technocratic *élite* became most influential during autarky (Petri 2002). Influenced by Francesco Saverio Nitti, an *ante litteram* technocrat and a towering figure in Italian politics before 1914, that *élite* thought that the country should be put in the condition to start the mass production of high-tech intermediate goods (from fertilisers to iron and steel, to engineering, to electricity production) which would allow a leap forward in productivity and a radical change to the country's industrial structure (Nitti 1905; De Cecco 1997; Petri 2002).

After a massive financial crisis and the end of the gold standard in 1931, many countries adopted innovative economic measures, including exchange controls and discrimi-

natory barriers to trade, which brought about the rapid fragmentation, the regionalisation and finally the collapse of the international trading system which had been restored soon after the Great War. It was against that background that the industrial economies began to experiment with reflationary economic policies, abandoning willy-nilly *laissez-faire*. In relation to the international economy, autarky in Italy also had an impact on technological elaboration and on the technological catching up of the country. The Italian economy, which was still small and fragile in relation to other industrial economies in the early 1930s, was heavily dependent on international trade, while the country's high-tech and capital intensive industrial sectors had experienced sustained growth only during and after the Great War, often selling most of their output in export markets. In the early 1930s, Italy showed all the peculiarities of an emerging market, such as a small domestic market and an industry the competitiveness of which largely rested on low wages and huge scale economies. The collapse of the global economy in the early 1930s had put in jeopardy that economic model as cheap labour was no longer enough to allow huge exports in global markets and the balance of payments problems made it very difficult to import essential raw materials.

This contribution attempts the question as to whether autarky was an experiment in economic planning and even a form of development policy. The inference here (which is rather a confirmation of previous studies) is that the possibility of improving the balance of payments, by stimulating those high-tech sectors which allowed greater exports and major savings in imports, represented a driving factor behind autarky, although it may be conceded that the results were often ambiguous as balance of payments constrains not always stimulated innovation in all sectors. Mussolini and the powerful minister Guarneri, a major protagonist in Italian autarky, often underlined that autarky was not meant to coincide with total insulation of the national economy from external influences, i.e. economic self-sufficiency. Against that background, it remains however to be seen how concretely the new policy regime stimulated change and how giant firms responded to the new opportunities offered by the new policies. Autarky showed strong pragmatism, and, little surprise, it did not aim to subvert the economic system with forms of centralised economic planning. The state did not substitute private initiative, in other terms. It however gave

indications that some firms managed to interpret more readily and with greater efficacy than other firms, as the vicissitudes shown here seek to demonstrate. An element of some interest is that firms in the same line of business reacted in different ways to the same incentives offered by autarky because their corporate strategy could not be easily adapted to the new macroeconomic context.

This ambivalence seemed to surface in all key sectors. Here we will show the vicissitudes of synthetic nitrogen, the development of which would have made the country less dependent on imports in the crucial fields of agricultural fertilisers and explosives, of aluminium, which was key to rearmament and to aviation, or man-made fibres, the growth of which would reduce more than other sectors the dependence of the country on foreign currency. Those sectors became the focus of specific autarkic plans. These plans rested on the possibility of adopting and developing alternative technologies and the outcome of their application was often below expectations. Was this an intrinsic failure of autarky or the outcome of the complex interaction between corporations and the state?

This contribution is organised as follows. After a review of autarky and the ways in which plans were arrived at, we will examine the autarkic plans in the above-mentioned sectors, i.e. nitrogen (Section 2), aluminium (Section 3) and man-made fibres (Section 4). Those were key sectors in relation to the pragmatic autarky described above. In all cases, the regime offered incentives for the creation of a domestic market and for technological innovation, but the end-results were not always positive in all sectors and for all firms.

### 1. *The autarkic plans: Means and objectives of economic policy*

After 1931, just as the disillusion with the market economy reached a new height in the country and abroad, Italian Fascism began to take on board various and often contradictory requests, which sometimes even proved incompatible with private monopolies. Against that backdrop, it comes as little surprise that the *Regime* claimed to pursue the control and the *disciplinamento* (disciplining) of the national economy while trying to narrow down state intervention only to those sectors where «private initiative lacked or

was insufficient». <sup>1</sup> In some sectors, Fascism actively pursued state control and an entrepreneurial state which saw major building blocks in the 'Istituto per la Ricostruzione Industriale' (IRI), namely the state owned agency controlling large stakes in industry which was launched in 1933, and in various state-owned firms. In other sectors, by contrast, the government only gave some policy prescription. That was the broader political and economic context in which autarkic plans were drawn between 1936 and 1937. Those plans only defined national requirements of certain essential products while offering some incentives to increase investments. The government resorted to tax breaks and similar instruments to stimulate new capacity without becoming directly involved with the management of firms. Important exceptions were of course the state-owned enterprises, which however the government came to own willy-nilly before the implementation of autarky. Under autarky, moreover, although state intervention implied some limitations to ownership rights, private ownership rights survived totally unscathed. The autarkic plans postulated that output should be considered as a single unit from a national standpoint (Confederazione fascista dei lavoratori dell'industria 1937, p. 11). In order to implement production targets, these plans envisaged a hierarchical structure of leadership to which the existing managerial hierarchies within corporations were subordinated. This should avoid waste and duplication while promoting, along with controls over investment and foreign currency, a tight control over imports and exports, voluntary and compulsory cartelisation, which later (i.e. during the Second World War) even evolved into private monopolies granted by law (Di Fenizio 1942).

The autarkic plans then offered corporations a unique chance, especially through an expanding domestic market and tax breaks, of investing and making huge profits. According to Toniolo (1980), in most cases those plans and autarky in general gave risea «more to a shrewd and cynical exploitation of a unique situation than to a formulation – let alone the implementation – of a strategy of revival and development of Italian capitalism». While holding some truth, conclusions of this sort probably underestimate the weight of opportunism in business strategy as well as the unique

<sup>1</sup> See Section IX of the *Carta del lavoro*, in Confederazione fascista dei lavoratori dell'industria (1937, p. 13).

economic climate of the 1930s, when the national and global market economy were on the verge of collapse. In the difficult context following the economic depression initiated in 1929, autarky offered a life buoy to corporate Italian capitalism and a new chance of starting or concluding investments which had begun before 1929. It should be taken with a pinch of salt, but in relation to this latter point, it may safely be concluded that, while shrewdly exploiting a unique chance of making monopolistic profits, big Italian business also seized the chance of implementing a new cycle of investments which proved crucial in the economic miracle of post-war Italy (Zamagni 1997, pp. 7-11). This fact also emerges when attempting a comparison with Spain, where autarky failed to stimulate the growth of high-tech industries (see for instance Puig 1998, pp. 319-320).

Moreover, according to an important source, autarky allowed the reallocation of resources towards heavy and armament industries (Petri 2002, p. 135). Yet, while a definition of armament industry is not as straightforward, it seems that also firms operating in light industries, such as chemicals and man-made fibres firms, benefitted significantly from autarky. Those sectors were not directly involved in the war effort. As will be seen later, those sectors had an important ancillary weight in autarky and in the war effort inasmuch as they guaranteed the reduction of imports and the significant inflow of much needed foreign currency.

Going one step back to the already mentioned autarkic plans, we should mention that they were drawn between spring 1936 and autumn 1937. These set out domestic production targets to be met within 1941 (or 1940 for some agricultural goods). Historians (Gualerni in particular) underlined the impressive amount of bureaucracy in the formulation of plans which bizarrely saw the exclusion of the 'Consiglio Nazionale delle Corporazioni', an important body in the new Fascist state and the *trait d'union* between the various ministries, vested interests (industrialists in particular) and the Fascist party (Gualerni 1982). In relation to this, Castronovo maintained that big business played no role in the formulation of the plans (Castronovo 1980, p. 237). But this latter statement is – to be fair – simply untenable and unsupported by evidence. Recent works have confirmed the overwhelming role of big firms in the formulation of the plans and even in the supply and manipulation of statistical data sets (Petri 2002, pp. 125-135). Representa-

tives of all twenty-two ‘Consigli delle Corporazioni’, i.e. the institute representing both industrialists and trade unions since 1934. Industrialists, who represented an important component of those commissions, took regularly part in the meetings. Moreover, it should be mentioned at this juncture that the representatives of those ‘Corporazioni’ created 80 committees entrusted with the drawing up of the plans, which were then approved by ‘Consigli delle Corporazioni’, the ‘Consiglio Nazionale delle Corporazioni’ and the ‘Comitato Corporativo Centrale’. *Ça va sans dire*, the presence of big firms, and of the oligarchs of Italian industry, in those committees was overwhelming.<sup>2</sup> It also is worth noting that, as a leading technocrat and president of the IRI Alberto Beneduce mentioned to Mussolini in April 1936, one major principle of economic planning contemplated the ban of state intervention and limit it only to the case «in which private initiative is scarce or insufficient or in which at stake there are vital interests of the state».<sup>3</sup> While examining the key industrial sectors, Beneduce gave a leading role to state-owned firms in the case of iron and steel, electricity production, coal and mining, shipbuilding and armaments. He however excluded public intervention in chemicals where the IRI controlled important assets and where Montecatini, a wholly private undertaking, had a dominant position.<sup>4</sup>

In addition, it should be said that when looking at each single product output plans were fairly general. Detailed economic planning, with detailed data sets etc., only covered the most important agricultural products and some of the basic industries. As Table 1 shows, these included mining, metallurgy, oil and coal and some intermediate products. Moreover, the plans were fine tuned while in force with mixed results and complex methods. Vested interests (*Confindustria*, *Confagricoltura* and *Confcommercio*) were obliged to draw annual reports on the implementation of plans. These reports were taken on board by various corporations

<sup>2</sup> What follows is based mostly on archival material and that material which is most relevant to the them at hand. The archives include: Archivio Centrale dello Stato (hereinafter ACS), Fondo IRI, numerazione nera, b. 83, *Relazione riassuntiva dei piani autarchici*; AConf, Fondo Balella, b. 96, f. *Piani autarchici* and b. 97; Fondazione Einaudi, Archivio Thaon di Ravel (hereinafter ATdR), sez. 27 – varie.

<sup>3</sup> Archivio Storico della Banca d'Italia, Fondo Beneduce, *L'intervento dello Stato nell'attività economica, relazione del 20 aprile 1936*, n. 288, fasc. 10.

<sup>4</sup> Archivio Storico della Banca d'Italia, Fondo Beneduce, *L'intervento dello Stato nell'attività economica, relazione del 20 aprile 1936*, n. 288, fasc. 10.

and given to the technical committees of various ministries (that later also included representatives of business and trade unions). Despite this organisational effort, the absence of central planning, which could offer an overview of current developments and define the financial capital necessary to expand the productive capacity, weakened considerably the efficacy of that policy. The Italian case was nowhere near not just the Soviet but also the Nazi experience. The single or sectoral plans, moreover, were even disconnected each another: there were no evaluations about intersectoral exchanges of domestic or international resources needed to increase output.<sup>5</sup> Finally, it can safely be concluded that the heavily bureaucratic and inconclusive nature of the autarkic plans owed much to the absence of instruments which would coerce firms, which formally remained free to produce what they wanted, to adopt specific decisions regarding investment and output (Petri 2002, p. 128).

The idea that autarky represented the instrument with which Mussolini wanted to achieve full and total insulation from the global economy became influential after 1945 (Federico and Giannetti 1999, p. 1139). That idea came to be divulged, among others, by Ernesto Rossi, a towering figure in post-Fascist Italy (Rossi 1966). Anyone wishing «to collect all the slogans, passwords, driving directions» (*direttive di marcia*) of Mussolini would «put together a *fritto misto* of anarchist, laissez-faire, capitalist... cooperativist, socialist, trade unionist, corporatist and communist's statements with a rich side dish of nonsense and sophism of all types, coming from all the deposits of nonsense in the universe» (Rossi 1966, p. 232). The implicit suggestion is that Mussolini's confutations to the idea of autarky as total insulation should not be taken too seriously. Yet things become slightly different when taking into consideration the opinion of academics and the high echelons in the bureaucracy who were close to industrialists (Troisi 1936, pp. 29-30; Guarneri 1988, p. 587). They seemed to share the view that autarky should not be intended as total insulation from external influences but as a form of economic nationalism and a second-best option which the fragmentation of global trade had made necessary (Troisi 1936, pp. 29-30).

<sup>5</sup> ACS, Fondo IRI, numerazione nera, b. 83, *Relazione riassuntiva dei piani autarchici*; AConf, Fondo Balella, b. 96, f. *Piani autarchici* and b. 97; ATdR, sez. 27 – varie.



«Autarky [...] does not mean self-sufficiency (*Stato chiuso*), detached from international trade» maintained Guarneri to the House of Corporations (*Camera delle Corporazioni*) in March 1938.

The overall volume of exchanges, also under autarky – continued Guarneri – more than shrinking, is meant to expand. It will expand in both directions, i.e. imports and exports, because it is unconceivable that a country can continue to purchase without selling, or can continue to purchase more than it can do without being put in a position to pay (Guarneri 1988, p. 589).

Similar statements were also common in the autarkic plans (Troisi 1936, pp. 29-30). In effect, as Petri emphasised, in very few cases only did autarkic authorities pursue total independence from abroad (Petri 2002, p. 129). Of the 65 products included in the plans (on this see Table 1), no one was meant to be totally replaced with domestic production. Plans were not moreover too optimistic, but were informed by a certain realism, which in its turn reflected the aim to reconcile the restoration of the balance of payments with the strengthening up of Italian industry (Toniolo 1980, pp. 303-304; Petri 2002, p. 131).

At this juncture and before concluding the section, also the other accusation, namely the antieconomic nature of autarky, merits some attention. There is enough evidence suggesting, as also the case studies presented here show, that many investments at the time when they were initiated undeniably proved anti-economic. However, they also were meant to become economic by the time international trade would be restored. Zamagni and Petri have thrown sufficient light on the numerous undertakings and innovations introduced in the 1930s that became competitive after the Second World War.<sup>6</sup> While confirming these findings, more recent studies showed that the elaboration of new technology and the possibility of developing large economies of scale, while going hand in hand, constituted a major preoccupation for big firms that invested behind the shelter of autarky (Cerretano 2020a). Similarly, a list of initiatives to be conducted in the various fields of chemical production came to be illustrated by the leading chemist Nicola Parravano in December 1936. Significantly, Par-

<sup>6</sup> See the several examples examined in Zamagni (1997).

TABLE 1. *Autarkic plans and their achievements, 1936-1941*

	X	Y	Z
Solid fuel	33	344	63
Liquid fuel	25	200	50-60
Methane gas	100	n.a.	211
Electric energy	100	45	102
Steel	93	25	82
Chromium	0	0	-
Aluminium	100	150	120
Magnesium	100	900	60
Lead	100	8	93
Zinc	100	38	100
Cadmium	100	567	120
Copper	50	700	73
Tin	65	-	38
Iron and pyrite mineral	50	29	105
Bauxite	100	27	164
Manganese mineral	30	250	129
Nickel mineral	50	19.900	55
Magnesite	90	56	82
Kaolinite	20	233	115
Phosphates	0	0	-

*Note:* Projected self-sufficiency rate (in %) to be achieved by 1941 (X), increase (in %) from 1936 to be achieved by 1941 (Y), and actual output reached in 1941, expressed as a % of projections (Z).

*Source:* Petri (2002, p. 130).

ravano suggested to make good use of autarky in order to fill the technological gap with foreign competitors (Parra-vano 1936, p. 3). Autarky, in other terms, could help the country to experience an increase in the fertilisation of land and consequently in agricultural yield; in the production of man-made fibres which the country already exported massively; in the production of certain raw materials and their surrogates such as light metals, chlorine, caustic soda, varnishes, synthetic rubber, artificial resins and so on (Parra-vano 1936, pp. 5-9).

## 2. *The autarkic plan of nitrogen*

In Italy the 'nitrogen problem', as it came to be called, had been the object of much and growing attention already during the Great War, when the country resorted to massive imports to meet the national requirements of nitrogen fertilisers. Imports of nitrogen from Chile had grown on average to 60 thousand tons just before the war to about

100 thousand after its outbreak – this was a trend common to the allied countries, such France and Britain. That growing trend in imports also followed from the fact that the domestic industry of calcium cyanamide and nitric acid (both used as fertilisers) could only meet a small fraction of domestic consumption. The strong dependency on imports of sodium nitrate soon seemed to signal the need for a domestic production of nitric sodium. Despite its initial relative technological backwardness, the Italian chemical industry managed to make important incursions into that new sector and in the space of a few years, from 1918 to 1921, chemical Italian firms developed two competitive methods for the ammonia synthesis process, namely the Casale and the Fauser processes.<sup>7</sup> They both built on the Haber-Bosch process which was originally developed by the great chemical concern BASF during the Great War, and were likely facilitated by the suspension of the patent legislation and patent protection from the inception of the war well into the early 1920s. The production of nitrogen was obtained through the distillation of liquid air and the hydrogen through the liquefaction of water gas, in its turn obtained through the gasification of solid fuel, i.e. coal, or the electrolysis of water. The production of synthetic ammonia allowed the mass production of nitrogen that was then used in agriculture at costs that soon proved competitive *vis-à-vis* natural sources. It probably represented the only innovation in the international diffusion of which the Italian chemical industry played a key role in the inter-war period.

The organisation of the nitrogen industry in Italy is illustrated in Table 2. This lists all the plants in operation in the country along with the firms owning them. Besides Montecatini, the largest chemical Italian firm, of some importance were the Sarda Ammonia e Prodotti Chimici (which maintained the Fauser plant in Coghinas which Montecatini sold to Società Elettrica Sarda in 1926); then the Azogeno, with plants at Bussi and Vado Ligure, which was set up in 1923 by French and Swiss interests and in which the Italgas had a stake of 20 percent and which operated on the basis of the

<sup>7</sup> On Luigi Casale see Pastonesi (1957). Of some importance is also the material kept by the Archivio storico della Società Italiana Ricerche Industriali by the Archivio di Stato di Terni. As for Fauser (whose father was a Swiss national), see Fauser (1984).

TABLE 2. *Ammonia plants in Italy until 1933*

Business group	Location	Production start	Process	Hydrogen technology	Output capacity in nitrogen, in 1,000 tons per year	
					Starting	1933
Montecatini (Ammonia e derivati and Meridionale Ammonia)	Merano (Bozen)	1925	Fausser	Electrolysis	14,000	19,000
	Crotone	1927	Fausser	Electrolysis	6,000	15,000
	Novara	1924	Fausser	Electrolysis	4,000	4,000
	Mas (Belluno)	1924	Fausser	Electrolysis	1,000	1,000
Società Terni	Terni	1923	Casale	Electrolysis	1,000	1,000
	Nera Montoro (Terni)	1924	Casale	Electrolysis/coke gas	6,000	6,000
Società Azogeno	Vado Ligure (Savona)	1927	Claude	Gas di coke	3,000	3,500
	Bussi (Pescara)	1926	Claude	Electrolysis	1,500	1,800
Società Sarda Ammonia	Coghinas (Sassari)	1927	Fausser	Electrolysis	3,000	3,000
Società Costruzioni Brambilla	Verres (Aosta)	1933	N.E.C.	Electrolysis/water gas	7,500	—

*Source:* Authors' elaboration from ASBCI, SOF, cart. 203, fasc. 3.

Claude patents; and last but not least the Terni with plants in Terni and Nera Montoro which used the Casale patents.<sup>8</sup>

The plant of Terni in Nera Montoro, for some time the largest plant of synthetic ammonia in Italy along with the Montecatini's plants in Merano and Crotona, was the only one to make use of hydrogen coming from both electrolysis of water and the gas coke, which came from the electricity generation plants and the coke-making plants of the mother firm. Montecatini however controlled two-thirds of the country's production capacity until the early 1930s. That dominant position was reinforced with the cartel agreements whereby Montecatini would make the sale of sulphate ammonium output of all Italian firms operating in that line of business. Montecatini struck the most important of such agreements with Terni in 1932. By those agreements Terni handed out the production of synthetic nitrogen to Montecatini while putting caps on the expansion of production.<sup>9</sup> Moreover, that agreement, along with a similar one arrived at with the Società Carbuio which Terni had acquired in 1922, allowed Montecatini to curb competition from Terni, which was the second largest producer by output and output capacity of nitrogen products.

The recovery of demand for nitrogen fertilisers starting in 1932-1933 and continuing until 1934 was impressive by all standards. In 1933, consumption went back to the 1929 levels (i.e. 61.5 thousand tons) and in 1934 it increased to almost 74 thousand tons, i.e. 20 percent higher than in the pre-1929 levels (see Nützenadel 2001, pp. 289-312). Under those circumstances, unsurprisingly, Montecatini decided to increase production capacity. That decision, however, implied technological choices which were markedly different from those taken the decade before.

Since 1932, it had become apparent, as the chairman of Montecatini Guido Donegani pointed out, that the elec-

<sup>8</sup> As for the Claude process, this was perfected by the French chemist Georges Claude and was based on the use of high pressure. It ensured greater productivity than the Haber-Bosch process but required greater capital outlays. On the Claude process see Archivio storico della Banca d'Italia (hereinafter ASBI), Carte Jung, pratiche n. 37, doc. 1, *Accertamenti sugli impianti nazionali dell'azoto*, pp. 23-29 and 53-60. On Azogeno of some use is Benegiamo (2013). On Casale see Bonelli (1975, p. 133), but also Pastonesi (1957) and the Archivio storico della Società Italiana Ricerche Industriali by the Archivio di Stato di Terni.

<sup>9</sup> ASBCI, SOF, Archivio Storico Banca Intesa, Patrimonio Banca Commerciale Italiana (ASBCI), Fondo Sofindit (SOF), cart. 269, fasc. 2, sf. 1, *Situazione e prospettive economiche degli impianti idroelettrici ed elettrochimici della Terni*.

trolytic method had lost momentum in terms of cost structure over other processes, and especially the coke process (Montecatini 1938, p. 329). The fall in prices and the improvements in the terms of trade after 1929 had a big role in that process. But also the electric or electrolytic process seemed less susceptible of scale economies than the coke process in the early 1930s. It would be more rational to add electricity production capacity to increase the output of zinc and aluminium, while using hydrogen from coke, to increase the production of synthetic ammonia (Montecatini 1938, p. 329). That explained why Montecatini made a request for approval (to the government) to start the construction of a coking and a fertiliser-making plant at San Giuseppe Cairo, near Genoa, in May 1934. In spring 1935, Donegani presented that plant as offering a good chance of incorporating in an Italian plant all improvements made abroad in the Fauser plants making hydrogen out of coke.<sup>10</sup>

The military campaign in Ethiopia and the ensuing increase in demand in nitric acid, a component in explosives, encouraged Montecatini in 1936 to accelerate the construction of the plant in San Giuseppe and to double its productive capacity, i.e. from 14 to 28 thousand metric tons of nitrogen. One reason for this should also be found in the increase in demand for electricity and in the company's need to make available about 100 million kWh per year for the new aluminium plant in Bozen by slashing production of electrolytic nitrogen at Sinigo. Despite the increase in consumption, Montecatini considered the new plant large enough to meet new and additional demand from the agricultural sector.<sup>11</sup> Events were later to prove how wrong that decision was.

From 1936, the demand for nitrogen fertilisers experienced an impressive surge. This surge coincided with a series of unexpected and unfortunate events in Montecatini's plants that reduced output capacity. On November the 19th 1936 an explosion at Sinigo, which probably resulted from the excessive speed with which the operations were carried out (in its turn a consequence of the boom in demand) in the plant's ammonia nitrate section, while killing 16 work-

<sup>10</sup> Montecatini, *Verbali dell'Assemblea Generale Ordinaria*, 29.3.1935.

<sup>11</sup> Montecatini, *Verbali dell'Assemblea Generale Ordinaria e Straordinaria* (hereinafter AGOS), 31.3.1936.

ers, interrupted production for about three months. A similar incident took place at the other plant, San Giuseppe Cairo, where an explosion delayed the start of operations to as late as 1937.<sup>12</sup> In addition to all that, a bottleneck in hydroelectric generation, reflecting a major drought, took place in 1936. The consequence was a reduction of Montecatini's output. Significantly, the other big Italian producer of fertilisers, namely Terni, similarly failed to grasp the opportunity offered by both the recovery of demand and the difficulties of Montecatini as the planned expansion of the company's plant at Nera Montoro from 16,5 to 23 thousand tons failed to materialise (Tarchi 1941a, p. 10).

The difficulties encountered by the producers of fertilisers and the increase in demand brought about an increase in imports, especially of sodium nitrate from Chile, with negative effects on the balance of payments (see Table 3). Against that backdrop of industrial failure and growing imports, the 'Corporazione della Chimica' and the newly-born 'Comitato Tecnico Corporativo dell'Azoto' began to work on the four year autarkic plan about nitrogen, which was completed in summer 1937.<sup>13</sup>

The main points of the plan were as follows. First and foremost, while envisaging the end of imports, it contemplated an increase in output which would meet the exceptional consumption in 1937. Secondly, it allowed for an increase in both domestic consumption and production capacity in the years to follow of about 15 percent per year. Last but not least, it contemplated a given amount of production capacity (i.e. 20 percent) to be left idle and to be used only in the event of war.<sup>14</sup> Table 4 shows the main points of the plan. According to the plan, the production capacity of synthetic ammonia and calcium cyanamide would grow of 110 and 100 percent respectively between 1937 and 1941. As for the hydrogen needed for the production of synthetic ammonia, significantly, the autarkic plan stated that «the new plants for the production of hydrogen should only use the electrolytic process and for that reason the establishment of new electricity production plants should be contemplated, along with a more rational system of distribution of electric-

<sup>12</sup> Montecatini, AGOS, 31.3.1937.

<sup>13</sup> See the RDL 14.1.1937, n. 848 and Tarchi (1941b, pp. 95-96).

<sup>14</sup> ATdR, sez. 27-175.12, *Piano autarchico Azoto*.

TABLE 3. *Value of imports and exports in nitrogen fertilizers 1931-1939 (in 1,000 lire)*

	Imports	Exports	Imp./exp. balance
1931	52,635	17,746	-34,889
1932	23,817	16,582	-7,235
1933	29,805	6,328	-23,477
1934	27,433	2,017	-25,416
1935	28,740	279	-28,461
1936	32,150	838	-31,312
1937	157,405	1,026	-156,379
1938	71,025	551	-70,474
1939	64,246	1,473	-62,773

Source: Tarchi (1941a).

TABLE 4. *Nitrogen autarkic plan 1937 (in metric tons)*

Synthetic ammonia	1937	1938	1939	1940	1941
For agricultural uses	85,000	95,000	107,000	123,000	141,000
For industrial uses	15,000	165,000	17,000	20,000	25,500
Exports	-	3,500	14,700	17,000	18,500
Stockpiling	-	-	8,300	-	-
Requirements	100,000	115,000	147,000	160,000	185,000
Potential reserves	2,000	6,000	32,000	32,000	37,000
Total output requirement	102,000	121,000	179,000	192,000	222,000
Calcium-cyanamide	1937	1938	1939	1940	1941
For agricultural uses	30,000	35,000	40,000	46,800	53,000
Potential reserves	2,000	11,000	6,000	8,000	11,000
Total output requirement	32,000	46,000	46,000	54,000	64,000
Total					
Nitrogen total output	130,000	150,000	187,000	206,000	238,000
Total potential reserves	4,000	17,000	38,000	40,000	48,000
Total nitrogen output requirements	134,000	167,000	225,000	246,000	286,000

Source: Fondazione Einaudi, Archivio Thaon di Ravel (hereinafter ATdR), sez. 27-175.12, *Piano autarchico Azoto*.

ity which should always allow [...] the use of hydroelectric energy outside the peak hours».<sup>15</sup>

Despite, however, the emphasis on the principle that the approval to the establishment of new plants would only be given to those using the process of water electrolysis or the gasification of national brown coal, the growing scarcity (and growing prices) of electric power, along with relative abundance of coals' by-products in foreign mar-

<sup>15</sup> ATdR, sez. 27-175.12, *Piano autarchico Azoto*.



kets, made that principle untenable. Thus, little surprise that the Figline Valdarno plant, which was owned by the Società Toscana Azoto and which probably was the only plant closely to follow the indications of the plan, i.e. the production of hydrogen from national brown coal, proved a failure. Out of a planned yearly production of 17 thousand tons per year by 1939, that plant only achieved a mere 2.5 thousand tons per year until the mid-1940s.<sup>16</sup> By the end of 1937, Terni's decision to scrap plans for the expansion of electrolytic hydrogen and the inability of Toscana Azoto to expand output meant that the production capacity foreseen for 1939 fell short of about 27 thousand tons (Tarchi 1941a, p. 10). Against the initial plans and, as a consequence of that, as well as of the incidents taking place at Sinigo and San Giuseppe Cairo, the Corporazione in the end decided to approve the setting up of additional output capacity amounting to as much as 70 thousand tons (Tarchi 1941a, p. 10).

Evidence seems to suggest that Montecatini was unable to resist new demands for additional output capacity, as a government's pressing need was to develop a national manufacture of nitrates to be eventually employed in the making of explosives. Montecatini reacted to the new backdrop by asking in April 1938 the approval for additional production capacity for about 65 thousand tons of the nitrogen plants at San Giuseppe Cairo. In reality, as Table 4 also corroborates, the increase in production capacity in this sector in Italy resulted from the expansion of plants already in existence in 1936 or during the elaboration of plans. It is safe to conclude that all new plants and new projects ended in failure after 1936. After Montecatini, the largest producer of synthetic ammonia, more than Terni, was Vetrocoke, the only firm which in Italy, along with Montecatini, managed to integrate the production of coke with that of nitrogen products, a model first adopted in Italy by the former company. Unlike Terni, Vetrocoke competed in terms of quality with Montecatini, which managed to keep a market share of about 60 percent in the latter half of the 1930s (see also Table 7). Terni had initially branched out from electricity generation into that sector, and had never managed to become a full-fledged chemical undertaking.

<sup>16</sup> On Toscana Azoto, see *Sindacato nazionale fascista chimici* (1940, p. 156).

By contrast, Vetrocoker, while exploiting in full the benefits of autarky, succeeded in developing a strategy of diversification into this sector based on the use of gases made in the coke ovens and only partly used as a source of energy. Starting from that source of energy, Vetrocoker (belonging to Agnelli, the owner of the car-maker FIAT) set up a system of manufacture spanning from heavy organic chemicals such as benzene, toluene and xylene, made out of exhausted oils, to the production of synthetic ammonia but also synthetic resins such as Plexiglass.<sup>17</sup> In the field of nitrogen fertilisers, moreover, the technological capabilities of Vetrocoker proved competitive *vis-à-vis* Montecatini, a development which is confirmed by the fact that the former firm managed to break the latter's monopoly in the production and sale of ammonium phosphate, a fertiliser first developed by Fauser in the early 1930s.<sup>18</sup>

Table 5 sketches the evolution of the synthetic ammonium industry between 1937 and 1940. It shows in particular the plants producing it, their location, ownership and above all their production capacity over those four years. One important conclusion is that the overall production capacity, in 1940, was much bigger and in line with the target set by the autarkic plan (compare the figures in Table 5 with those in Table 4). Despite, moreover, all the requests for approval made to expand plans, the lion's share of that increase was mostly due to the growth of two plants: the San Giuseppe Cairo's plant belonging to Montecatini and the Vetrocoker's works at Porto Marghera, near Venice. It should be emphasised that the figures in Table 5 refer to full capacity in the event the plant were put in the position to produce at full capacity the whole year. In 1937, and again in the ensuing years, the Corporazione had set out the margin between production capacity of plants and normal production at 20 percent, but that margin grew during the autarkic period, passing from 21.3 to 32.2 percent between 1937 and 1940, and this against a trend of growing imports.

The reason behind that pattern should be found in the scarcity of hydrogen. In a motion dated January 1940, the

<sup>17</sup> On Vetrocoker see ACS, Segreteria Particolare del Duce, *Carteggio Ordinario*, f. 526.416.

<sup>18</sup> ATdR, b. 97, f. *Comitato interministeriale per l'autarchia, Seduta del 9 gennaio 1942*.

TABLE 5. *Developments of Italian ammonia plants, from 1937 to 1940*

Business group	Location	Production start	Process	Hydrogen technology	Output capacity in nitrogen, in 1,000 tons per year			
					1937	1938	1939	1940
Montecatini	Merano (Bozen)	1925	Fausser	Elect./water gas (a)	14,000	22,000	22,000	22,000
	Grotone	1927	Fausser	Electrolysis	16,000	20,000	20,000	23,000
	Novara	1924	Fausser	Electrolysis	5,600	6,600	6,600	6,600
	Mas (Belluno)	1924	Fausser	Electrolysis	1,000	1,000	1,000	1,000
	Bussi (Pescara)	1934	Fausser	Elect. Sodium chloride	1,500	1,500	1,500	1,500
Azogeno	San Giuseppe Cairo (Savona)	1936	Fausser	Coke gas	21,000	42,000	65,000	65,000
	Vado Ligure (Savona)	1927	Claude	Coke gas	5,500	4,500	5,500	7,100
	Bussi (Pescara)	1926	Claude	Electrolysis	6,500	6,500	6,500	6,500
	Coghinas (Sassari)	1927	Fausser	Electrolysis	3,000	3,000	3,000	3,000
Toscana Azoto	Figline Valdarno	1937	N.E.C.	Lignite Gas	1,500	1,500	1,500	1,500
	Terni (b)	1923	Casale	Electrolysis	—	—	—	—
	Nera Montoro (Terni)	1924	Casale	Coke gas /Elect. (a)	12,000	12,000	20,900	20,900
Vetrocoke	Porto Marghera (Venice)	1939	Casale	Coke gas	—	—	32,000	32,000
	Soc. Costruzioni Brambilla	1933	N.E.C.	Elect./water gas (a)	10,000	10,000	10,000	10,000
Total	97,600	130,600	195,500	200,100				

Notes: (a) the electrolysis is the main process, while the second was used when the first was insufficient. On average, electrolysis units adopted water gas for 25-30% of their annual output. (b) Dismantled in 1935.

Source: Authors' elaboration from ATQR, sez. 27-175.12, *Piano autarchico Azoto*; Tarchi (1941a); Molinari (1949, Vol. 2, p. 874).

'Comitato Tecnico Corporativo dell'Azoto' (i.e. nitrogen) conceded that «the qualitative deviations from the plan during its implementation (especially in relation to the excessive development of less 'autarkic' processes) have been a consequence of the urgent need to achieve the quantitative targets of the plan with the means which already were available to us» (Tarchi 1941b, p. 114). The 'qualitative deviations' were prompted by the high price of electric power as well as the increased and cheaper supply of gas from coke ovens. Under those circumstances it comes as little surprise that the nitrogen that was made out of gas from coke ovens and water came to account for about 80 percent of the overall increase in production capacity (i.e. 80 thousand tons out of 100 thousand) between 1937 and 1941, thus making the whole nitrogen industry more dependent on sources of hydrogen which were not autarkic (see also Table 6).

Then paradoxically autarky put an end to the autarkic myth whereby nitrogen could be made out of water, air and electricity. Moreover, autarky also failed to make the country less dependent or totally independent from imports of nitrogen fertilisers, which according to an important source represented a negative trade balance entry of about 86 million lire (Molinari 1949, Vol. 2, p. 876). Despite the doubling of production capacity, output continued to be below the planned requirements as the total substitution of coke imports, which was achieved in 1938, and the inability of obtaining additional gas from coke ovens had set new downward constraints to the previous ambitious output targets. In addition, the issue of the scarcity of that gas could not be alleviated after the outbreak of the war, because, in spite of a larger production of coke following the growth of iron and steel, there remained bottlenecks in the supply of electricity which was needed in the production of synthetic ammonium from electrolytic hydrogen.

Against that background, the update of the nitrogen plan in 1940, unlike the one set out in 1937, sounded unrealistic. It allocated 60 percent of output capacity to the armament industry while ensuring (on paper) an increasing supply of nitrogen fertilisers to agriculture with the aim, among other things, to replace phosphate fertilisers. Surprisingly enough, after the first year of war (i.e. 1941 which represented the last year of peacetime production before

TABLE 6. *Sources of hydrogen used in the ammonia production in Italy, 1937-1940 (% on the total)*

Fonte	1937	1938	1939	1940
Water gas	6.0	5.2	10.0	10.8
Coke gas	36.0	41.0	50.2	51.5
Water Electrolysis	51.6	48.0	34.0	35.5
Other (ammoniacal water, lignite, etc.)	6.4	5.8	5.8	2.2

Source: ATdR, sez. 27-175.12, *Piano autarchico Azoto*; Molinari (1949, Vol. 2, p. 873).

TABLE 7. *Nitrogen fertilizers output in Italy, 1941 (in tons and %)*

Firms	Ammonic Sulphate		Ammonic Nitrate		Calcium Nitrate		Nitrogen total	
Montecatini	181,964	62.52%	12,586	35.50%	123,715	61.72%	60,748	59.10%
Vetrocoke	52,063	17.89%	9,550	26.94%	21,829	10.89%	17,303	16.83%
Terni	25,196	8.66%	7,699	21.72%	29,860	14.90%	12,411	12.07%
Brambilla	17,867	6.14%	-	-	11,186	5.58%	5,397	5.25%
Azogeno	9,376	3.22%	5,619	15.85%	-	-	3,837	3.73%
Toscana Azoto	-	-	-	-	13,861	6.91%	2,149	2.09%
Sarda Ammonia	4,607	1.58%	-	-	-	-	944	0.92%
Total	291,027	100.00%	35,454	100.00%	200,450	100.00%	102,784	100.00%

Source: AConf, b. 25, f. *Fertilizzanti*, sf. *Ufficio Esportazione Fertilizzanti Azotati Italiani*.

the total dislocation of the Italian economy), the share of output capacity given to the armament industry remained small, as it can be drawn from Table 7. That probably indicated that the government gave priority to the agricultural sector, a choice that sounded paradoxical after the country's entry into the war. At that point in time, however, it was increasingly recognised that all plans aimed at enlarging the existing plants were unrealistic. As an important observer pointed out under those circumstances the problem was that «it is not clear how it is possible to achieve, within the time frame indicated by the Corporazione, the production target envisaged by the latter given the difficulty in having sources of hydrogen at low cost and at the planned volume» (Molinari 1949, p. 877). That problem came to be solved only at the end of the 1940s with the technological revolution revolving around the production of hydrogen through catalytic oxidation of methane (Fauri 2000, p. 283).

### 3. *The autarkic plan of aluminium*

As will be seen below, aluminium had a prominent place in autarkic plans and policies. The reasons for that were two-fold. The first motive should be found in the growing military importance of that metal. As early as the First World War, aluminium had become highly strategic for military purposes as it came increasingly to be deployed in the making of airplanes, initially in the manufacture of engines and parts of the frame and, later, in the manufacture of all components. At the end of the war, airplanes wholly made of metals and aluminium alloys made their first appearance. The technology of airplanes wholly made with metal experienced impressive growth in the 1930s, an evolution which was epitomised by the German Junkers and the British Spitfires (Homze 1976; Crouch 2004; Overy 2005). In Italy too there were significant examples of those new developments. One of those was the Breda 32, which represented the Italian version of the new global trend towards a greater use of aluminium and other metals in the making of airplanes (Parano 1932, p. 36). A second reason giving aluminium a special role in autarky was that it could contribute to the substitution of certain non-ferrous metals, such as tin and copper. Purchases of copper and tin could only be made in the sterling or dollar areas. The replacement of copper and tin with aluminium in the making of electric devices and in food cans and containers, and as well as more generally in metallurgy, would allow major savings of much needed foreign currency.

Once more, it comes as little surprise that Fascist Italy put together an autarkic plan concerning aluminium (Bertilorenzi 2014, pp. 236-269). To be sure, Nazi Germany but even Britain adopted similar plans for the production of armaments as part of their run towards rearmament in the 1930s (Bertilorenzi 2014, pp. 236-269). However, in the Italian case evidence seems to suggest that in the aluminium plan the broader issue of scarce foreign currency, more than that about the mass production of airplanes, featured prominently. Indicative of that attitude is also the fact that the plan sought to offer a number of indirect incentives to stimulate a domestic demand for aluminium. In doing so, the plan had to face a number of serious difficulties during its stages of elaboration and conclusion. To start with, the production of aluminium required the import of raw materials, which were cheaper abroad. This became a problem

once the plan bet on the production of aluminium from alternative and still experimental technology which had the advantage of reducing raw materials imports. The reason for this was obvious: that technology was still unsound from, above all, an economic viewpoint. In addition to that, until the Second World War the international aluminium industry was tightly controlled by a small number of firms worldwide, which shared out markets, while setting output quotas, and which considered Italy part of that broader oligopolistic context. Except for Montecatini, which however entered into the aluminium business with the support of a German producer, the Italian industry of aluminium was controlled by non-Italian firms (Perugini 2015, pp. 129-130). Those groups were in Italy in full control of raw materials (mainly bauxite, but also alternative ones, like leucite as we shall see), plants and know-how. Those firms, moreover, managed to achieve a very tight control over the Italian market and industry until at least 1934, i.e. the year when exchange controls were imposed (Bertilorenzi 2008, pp. 42-71).

The standard production method in use in the industry since the end of the nineteenth century was based on the melting of alumina (aluminium oxide) in electrolytic Hall-Héroult blast furnaces. Alumina, moreover, was obtained from bauxite, i.e. a mineral rich in aluminium, through the Bayer process. While the electrolysis of alumina required huge volumes of electricity, the Bayer process, along with bauxite of high standards, needed huge volumes of coal and caustic soda. One metric ton of aluminium required about eight tons of raw materials, notably bauxite (four tons), coal (two tons), and sundry materials (Peterson and Miller 1986). Although the Hall-Héroult system was widely accepted, the global actors into the industry were quick to realise its high running costs (high consumption of coal for example) and had therefore never sought to look for alternatives since the end of the nineteenth century (Soudain 1970). In the 1920s, Italy became a target of new investments in the aluminium industry, using old established and new technologies alike. In the choice of technology, there was little interference from the government in those developments. By contrast, the leading firms investing in Italy found it more convenient to exploit alternative technologies and to create an integrated system of production avoiding the import of alumina, orientating themselves towards the use of hydroelectric power, in which the country

enjoyed comparative advantages. As we shall see, the autarkic plan, despite the failure of the above-mentioned alternative know-how, in 1937 continued to rest on the possibility of using a set of technologies which was alternative to the Bayer method.<sup>19</sup>

As mentioned, Italy was initially excluded from the small club of countries pioneering this industry. The aluminium industry made its first appearance in 1887, when in Switzerland and in the USA the 'Aluminium Industrie Actiengesellschaft' (hereinafter AIAG) and the 'Company of America' (hereinafter ALCOA) were launched. Soon after those company (1889), in France the 'Société Électrométallurgique Française' was incorporated by one of the fathers of the industry, i.e. Paul Héroult. In 1921 that undertaking merged with the 'Produits Chimiques d'Alais et de la Camargue' and came to be known as Pechiney. During the First World War, finally, Germany began an important producer of aluminium after the launch of the Vereinigte Aluminium Werke (hereinafter VAW).<sup>20</sup> In 1907 a firm called the Società Italiana per la Fabbricazione dell'Alluminio (hereinafter SIFA) was set up jointly by German and Italian interests in opposition to the group of old-established firms dominating the industry world-wide. SIFA had an integrated system of production with works and bauxite mines at Bussi, in the Abruzzo region, where a hydroelectric plant had been set up specifically for the production of aluminium. During the Great War, French interests invested in Italy to meet military requests of aluminium setting up the 'Alluminio Italiano' (hereinafter AI) in 1916, with works at Nera Montoro, near Perugia, and after the war at Borgofranco d'Ivrea, near Ivrea. After that Italy joined the war in 1915, French interests obtained control over the SIFA company which originally was controlled by German stakeholders. As Table 9 shows, the size of those plans and the scale of production remained fairly limited (Rispoli 1987).

The firms which were established after the war were, unsurprisingly, much larger in size. In the 1920s the following firms were launched: the Società Anonima Veneta Alluminio (1926), with works at Porto Marghera, near Venice, which was controlled by the Swiss AIAG; the Società Italiana

<sup>19</sup> ATdR, sez. 27-175.14, *Piano autarchico Potassa ed Alluminio*, s.d., but 1937.

<sup>20</sup> On AIAG see AIAG (1942); Rauh (2009); Knoepfli (2010). On ALCOA see Carr (1952); Smith (1988). On the French firms of some use are Gignoux (1955); Cailluet (1995). On VAW, see Rauch (1962).



TABLE 8. *Production, consumption and imports of aluminium in Italy, 1922-1929*

	Production	Consumption	Imports	Production as % of consumption	Imports as % of consumption
1922	800	1,000	200	80.00	20.00
1923	1,473	3,323	1,977	44.32	55.68
1924	2,058	4,961	2,947	41.48	58.52
1925	1,880	8,506	6,693	22.10	77.90
1926	1,929	5,445	3,566	35.42	64.58
1927	2,544	5,846	3,617	43.51	56.49
1928	3,618	5,141	1,760	70.37	29.63
1929	7,036	10,113	3,284	69.57	30.49

*Source:* Authors' elaboration from Archivio storico della Banca d'Italia (hereinafter ASBI), Carte de Stefani, f. 22.7, sf. 42, Lapenna (Montecatini) a De Stefani, 13.5.1931 and Metallgesellschaft's yearbooks.

dell'Alluminio (hereinafter SIDA), which was jointly set up by Montecatini and the German firm VAW and with works at Porto Marghera (Venice), and Mori, near Trento. In particular, the Montecatini-VAW joint venture opted for the development in Porto Marghera of the Haglund process, which would reduce the use of coal and recover the waste. As with the Bayer one, that process used bauxite but unlike it did not produce huge volumes of waste (in the Bayer process the ratio was one ton of waste per one ton of finished product), while allowing the simultaneous production of pig iron (bauxite contained iron as well). That process, however, while proving too expensive, produced aluminium of poor quality. The poor quality followed from the different type of alumina developed containing a high level of impurities (in particular titanium) which barred certain end-uses of that type of aluminium (notably for the alloys deployed in the manufacture of airplanes) and which was more difficult to melt through the electrolytic process and was as a consequence of that more energy consuming. Hence the high costs of production. Similarly, the iron pig produced was of little use given its low qualitative standards (Koelliker and Magnani 1930, pp. 78-82). The poor working of the Hanglund process was also behind the deterioration of the relations between Montecatini and VAW which ended up with the rupture of relations as well as the divestment of the German firm from the Italian joint venture in 1934 and chronic shortage in Italy of alumina at the end of the 1920s (Bertilorenzi 2008). After 1934, Montecatini adopted the Bayer system of production and overcame the shortages of alumina by acquiring it by SAVA

TABLE 9. *The Italian aluminium industry. Firms outputs, national consumption and international trade, 1926-1934, in tons*

Year	SIFA	AI	SIDA	SAVA	Tot. Prod.	Tot. Cons.	Import	Export.
1926	817	1,112	–	–	1,929	5,000	3,780	137
1927	956	1,588	–	–	2,544	5,200	4,226	252
1928	993	1,355	70	1,200	3,618	4,000	2,166	311
1929	815	1,168	4,000	1,390	7,373	9,300	3,520	270
1930	–	1,309	4,870	1,789	7,968	8,200	1,543	710
1931	–	1,060	5,900	4,146	11,106	7,000	1,698	3,018
1932	–	1,288	6,062	6,063	13,413	5,500	410	2,485
1933	–	1,521	4,444	6,106	12,071	7,000	274	3,947
1934	–	1,647	4,899	6,310	12,856	9,400	225	5,933
1935	–	1,685	5,089	7,002	13,776	15,000	203	6,087
1936	–	1,682	7,098	7,094	15,874	17,000	313	210

Source: Authors' elaboration from Innocenti (1984); Metallgesellschaft year-book, various years, ASBI, *Consorzio sovvenzioni industriali, Sede principale*, p. n. 73, f. 2.

(Perugini 2015). SIDA's aluminium with a high content of titanium did not easily find a market in Italy and was as a result sold in stock into the Japanese market, with the help and intermediation of the Swiss firm AIAG.<sup>21</sup>

During the 1920s, also the US firm ALCOA became an important actor into the nascent Italian aluminium industry. In 1924, the French interest which had invested into the country during the war sold a stake in Alluminio Italiano to ALCOA as part of a broader strategy of reconciliation between European and US producers, which ended up with informal cartel understandings and the creation of joint ventures in emerging markets. In 1928 this process of concentration and cooperation came to an end and was replaced by a new period of conflict and competition. The entry of AIAG into Italy and the joint firm Montecatini-VAW alarmed the French who fearing an imminent crisis left the country. The French abandoned the country altogether, ALCOA came to control the Alluminio Italiano, while AIAG came to own SIFA, which under the control of the Swiss continued the production of alumina discontinuing that of aluminium because it was considered anti-economic. ALCOA, moreover, expanded its interests in Italy by acquiring the Prodotti Chimici Nazionali, which should have supplied the works at

<sup>21</sup> Archivio Edison (hereinafter AE), *Servizio pratiche societarie, soc. Montecatini*, Sc. 3 fasc. 5; SIDA, *Verbale del consiglio d'amministrazione*, 11.7.1933 and 14.3.1934.

Borgofranco with alumina obtained from an alternative raw material, leucite through the Blanc process, which had the advantage to produce both alumina and potash (then used as a fertiliser). Unlike the process in use in VAW plants, the Blanc process used leucite instead of bauxite, which was more abundant, less expensive, and more readily available in the Latium and Campania regions around Rome and Naples. However, in 1928 the Blanc process was still in its early stages and had not yet been scaled up and brought to the level of industrial production. The decision to develop that process penalised ALCOA's incursion into the country. It is safe to conclude that ALCOA failed to adopt the Bayer process despite owning large bauxite resources in Istria, and in the end came to be overtaken by AIAG and Montecatini. The Alluminio Italiano plant at Borgofranco owned by US interests failed to grow to a decent scale also because ALCOA had failed to put together an integrated system of manufacture after the decision to pursue the Blanc process.

At the end of the 1920s, then, the Italian aluminium industry was largely under the control of foreign interests. No doubt, those interests were attracted by the rapid growth in demand in the country. Domestic consumption doubled between 1926 and 1929 favouring both the strategies of investments delineated above and the growth of imports (see Table 9 on this). Montecatini was attracted to this line of business in an attempt to find an outlet for its growing production of hydroelectricity. Some of the largest mechanical and automobile firms, such as FIAT and Alfa Romeo, soon became important buyers of aluminium, which benefited in technological terms from the Great War (which, as with autarky, facilitated large investments of an innovative product). After 1929, however, consumption shrunk significantly going back to the levels of the early 1920s. This contraction took place just as additional capacity was being thrown in the market with the beginning of operations of SIDA ad SAVA. The outcome was a major crisis which the electrolysis process, given its impressive capital outlays, made certainly worse because a reduction of output brought about major increases in running costs. Interestingly, from 1931 and 1934, the position of the country changed dramatically and from an importer it became an exporter of aluminium. This was largely the consequence not so much of the quality (which remained lower) or the low production costs of the Italian aluminium as the cartel agreements and the connections between Italian

firms and their mother companies. These guaranteed outlets abroad. Moreover, crucial to the growing exports were the agreements signed for the creation of a stock buffering in 1931. These agreements contemplated the purchase and resale in international markets of excess or unsold output from the Italian subsidiaries until 1934. Some of these stocks were then resold to Soviet Russia, also thanks to the intermediation of the Fascist government.

Until 1935, the agreements on stocks characterised the evolution of the sector in Italy. That agreement however did not stimulate investment because without a large domestic market the producers found it more convenient to increase the utilisation of existing capacity more than making additional investment. When those agreements came to an end, moreover, the existing production capacity proved insufficient as the domestic market began to grow after the military aggression of Ethiopia and the economic sanctions against Italy, which stimulated military demand for aluminium while reducing imports significantly. In the mid-1930s, the production capacity was the same as the one in the late 1920s, and was falling behind that of other European countries that had undertaken rearmament based on the large use of aluminium or implemented import-substitution measures. In 1935-36, Montecatini made huge investment to scrap the Haglund process and adopt the Bayer one. In addition, it set up a plant at Bozen, called the Società Nazionale Alluminio (hereinafter SNAL) while SAVA expanded output capacity at Porto Marghera where it also build a second Bayer alumina plant. Increasingly frustrated by the Blanc process, ALCOA failed by contrast to expand plants. In 1936, the output capacity of this industry in Italy passed from 15 to 20 thousand metric tons per year: that outcome owed much to Montecatini's expansion into the sector and to a limited extend from that pursued by AIAG which in those years was reducing output in Switzerland and increase that in Germany and that some extent in Italy.

Those investments were nevertheless considered insufficient by the Italian government that looked with anxiety at the absence of a full-fledged Italian industry of aluminium. To solve that problem various strategies were put together which then went in the autarkic plan. At the end of 1934, with the setting up of *Corporazioni*, various problems relating the production of aluminium came under focus in the ambit of autarky. These included the issue of how to

TABLE 10. *Aluminium autarkic plan of 1937*

Firm	Business group	Unit	Annual production, in tons				
			1937	*1938	*1939	*1940	*1941
<i>Alumina production</i>							
Sia	Montecatini	P. Marghera	7,000	7,000	—	—	—
INA		P. Marghera	18,000	26,000	26,000	30,000	30,000
SIME/SIFA	AIAG	Bussi	13,000	13,000	14,000	14,000	14,000
SAVA	AIAG	P. Marghera	27,000	40,000	60,000	60,000	60,000
P.C.N.	ALCOA	Aurelia	—	6,000	8,000	8,000	8,000
New plants (from leucite)			—	—	22,500	22,500	46,000
<i>Total</i>			65,000	92,000	130,500	134,500	158,000
<i>Aluminium production</i>							
INA	Montecatini	Mori	7,800	8,400	8,500	10,000	10,000
		Bolzano	4,700	7,300	9,000	10,000	10,000
SAVA	AIAG	P. Marghera	8,150	17,350	17,500	17,500	20,000
SIME		Bussi	—	—	—	5,000	5,000
Sai	ALCOA	Borgofranco	1,600	2,950	3,000	3,000	5,000
New plans (from leucite)			—	—	10,000	10,000	20,000
<i>Total</i>			22,250	36,000	48,000	55,500	70,000

Source: ATdR, sez. 27-175.14, *Piano autarchico Potassa ed Alluminio*, s.d., but 1937.

meet new demands for aluminium from the air force, the increase in exports of mechanical components made of aluminium and the compulsory substitution of copper with aluminium in certain products (i.e. electric appliances). The representative of aluminium industry in the 'Corporazione metallurgica' was Luigi Manfredini, managing director of SIDA.<sup>22</sup> Those ideas and the main point of that discussion failed immediately to materialise in terms of legislative measures. In 1935, aluminium became one of those products the imports of which was prohibited. Any import of aluminium was subject to the approval of the ministry of finance.<sup>23</sup> With hindsight, that measure was however useless if not counter-productive (after all, Italy was an aluminium exporting country), because in 1935 there was a surge in demand for aluminium which was unmatched by additional investment. New investment to meet the new demands were made after that Mussolini presented a motion to the *Corporazione della Metallurgia e della Meccanica* in 1936

<sup>22</sup> See "I Consigli delle corporazioni e i problemi da discutere in sede corporativa" (1934, p. 349).

<sup>23</sup> See "Le nuove norme di controllo delle importazioni" (1934, p. 79).

which was entitled «substitution of imported metals with aluminium and aluminium alloys».<sup>24</sup> The issue of insufficient incentives to investment remained however unsolved. To start with, the substitution of certain imported metals with aluminium posed tremendous technical problems. In addition, the plan individuated the market as the main incentive to investment. According to Mussolini, for example, the industry of aluminium would grow on the back of the air force.<sup>25</sup> However, it is tempting to conclude that without a more compelling plan those indications were deemed to have no effect. In Germany and even in Britain, for example, the production of aluminium came to be linked to a detailed plan of mass production of airplanes (Bertilorenzi 2014).

Early in 1937, it became clear that the speech and the indications of the 'Duce' were not enough to stimulate growth in aluminium output. In the face of a requirement of 40 thousand tons for 1937, the production capacity was 20 thousand metric tons (Manfredini 1937). Against that background, the autarkic plan was first put together. It envisaged the growth of domestic demand, via the substitution of imports and through the growth of those outlets which made large use of aluminium. In addition, it detailed the yearly production of alumina, aluminium and even the volume of electric power needed.<sup>26</sup> Detailed as it was, the plan however showed major weaknesses. The first of these was that it revolved around the possibility of adopting leucite as raw material, despite the failure of the technology deployed to produce aluminium with leucite. In 1938, after almost ten years of tests and experimentations, ALCOA abandoned the leucite method once and for all. The American giant was however replaced by the Italian state in the quest for the new method setting up a Società Italiana della Potassa which however never started production.<sup>27</sup>

The plan focused primarily on the development of the above-mentioned alternative set of technology, underestimating the long-standing problems of the industry such as the adequate supply of electricity with which to sustain the

<sup>24</sup> See "La presentazione al Duce delle mozioni della corporazione della metallurgia e della meccanica" (1936, p. 21).

<sup>25</sup> See "La presentazione al Duce delle mozioni della corporazione della metallurgia e della meccanica" (1936, p. 21).

<sup>26</sup> ATdR, sez. 27-175.14, *Piano autarchico Potassa ed Alluminio*.

<sup>27</sup> ACS, Fondo IRI, numerazione rossa, *Società italiana potassa*, b. 497.

TABELLA 11. *Production of aluminium Italian companies and comparison with the overall forecast of the autarkic plan, 1938-1943, in tons*

	AI (ALCOA)	Mori Montecatini	Bolzano Montecatini	SAVA AIAG	Total production	Total delivered product	Plan's projection
1938	1,576	7,385	6,443	10,363	25,767	26,000	36,000
1939	2,172	8,603	8,141	15,047	33,963	32,900	38,000
1940	2,463	8,569	11,826	15,932	38,790	42,800	40,500
1941	2,936	7,488	19,234	18,537	48,195	59,100	45,000
1942	2,423	7,143	17,751	16,224	43,541	52,600	50,000
1943	2,140	7,788	20,375	15,889	46,192	56,000	60,000

*Source:* Authors' elaboration from Innocenti (1984); *Piano autarchico* and Metallgesellschaft's yearbooks.

growth of aluminium production. Indicative of that attitude was the fact that the plan confined itself to an expression of faith about the ability of the electric generation firm SADE to supply enough electricity. The explanation for the over-emphasis on that dubious technology was a simple one: the use of leucite and the production of potassa would allow 'the improvement' – stated the plan – 'of the trade balance for about 30 million lire'.<sup>28</sup> The fact that ALCOA had failed to overcome the experimental stage of that technology was not seen as indicative of the latter's inherent fault. In relation to this, it was probably no coincidence that the plan was elaborated by the *Corporazione della Chimica* which over-emphasised the issue of potash and the possibility of developing the Blanc method. In addition, in the other plants producing according to the standard process output never met the targets set by the plan. The plan, in effect, only gave some indication which, should they have been followed closely, would have brought about a major oversupply in the industry. Also, the incentives were not enough to encourage all firms producing in Italy to invest. While SAVA and Montecatini were investing massively, ALCOA was thinking about an exit strategy in a market that the American firm had failed to control and in which it had made serious technological miscalculations. Still in 1938, when examining the state of the art and the implementation of the plan, the planners once more candidly admitted that «the radical solution to the issue of aluminium can be facilitated [...] by

<sup>28</sup> ATdR, sez. 27-175.14, *Piano autarchico Potassa ed Alluminio*, p. 6.

the creation of a large national industry of potash made out of leucite». <sup>29</sup> That confirmed the extent to which the technological foundations of the plan were shaky.

In contrast to that, the firms using the standard technology, i.e. Bayer/Hall-Heroult, obtained good results which were not too far from those indicated in the plan, at least until 1941. After the total dislocation of the Italian economy after 1941, made it near to impossible the implementation of the plan. The firm epitomising the 'autarkic battle', Montecatini, grasped the chances offered by the plan to start a national production of aluminium which accounted for the largest share of Italian output until the 1960s. The Swiss-owned firm SAVA by contrast exploited the autarkic plan to reconsider its international strategy, shifting its centre of gravity from neutral Switzerland to Italy where it could increasingly count on an expanding domestic market. It is no coincidence that the expansion of AIAG's subsidiary in Italy, SAVA, was only slightly less impressive than the expansion that it experienced in Nazi Germany, where, as in Italy, it cynically seized the chances offered by import substitution policies and Nazi rearmament (Rauh 2009).

#### 4. *The autarky plan of the man-made fibres industry*

The man-made fibres industry offers rich insights into autarky for a number of reasons. First and foremost, it was, in terms of capital invested and people employed, one of the largest high-tech industries in the country. It was moreover one of the sectors that most benefited from autarkic policies. After a period of decline beginning in 1927, autarky gave new impetus to expansion, ensuring the survival of the leading enterprises in the sector. That survival could not at all be taken for granted in the difficult context of the 1930s. Relying on cheap labour and large-scale economies, the Italian firms produced cheap rayon, namely a cellulose fibre and the only chemical fibre to be mass-produced until the 1940s. After the closing up of the British and US markets in 1925 and 1930 respectively a good deal of their output flooded the Asian markets, China and India in particular,

<sup>29</sup> ATdR, sez. 27-149, *Relazione riassuntiva dei piani autarchici nell'anno XVI. Volume secondo*, p. 47.



where however rayon Japanese firms were gaining ground very rapidly.<sup>30</sup> While favouring the creation of a domestic market, autarky offset the losses in foreign markets. An idea of the magnitude and rapidity of the expansion of the domestic market can be gauged by looking at domestic consumption, namely output plus imports less exports.<sup>31</sup> The share of consumption over production grew from 34 to 77 percent between 1931-1940 (Tables in Cerretano 2020b). As it often happens in a latecomer country, the domestic market had had a very marginal role in the early development of the industry in Italy. In relation to this, it can be concluded that, while facilitating the consolidation of the domestic market, autarky brought about one of the most important changes in the industry until the 1980s.

Another reason of interest should be found in the interplay between autarky and currency policy. «In the list of the big autarkic issues» stated historian Maiocchi, «soon after the complex issue of energy supply there was the issue of textiles» (Maiocchi 2003, p. 76). Natural fibres, which were largely imported, generated an outflow of gold which equalled that generated by coal imports (Maiocchi 2003, p. 76). Table 12 briefly sketches the relative importance of those items for the Italian balance of payments.

In relation to the issue of cotton imports, monetary authorities realised soon the potential impact of man-made fibres on the balance of payments. These ensured an inflow of gold through exports and a reduction of gold outflow following the import of natural fibres which constituted, as mentioned, a very important entry of the trade balance.<sup>32</sup> Before continuing it would be germane to mention that before the advent of nylon and the wholly synthetic fibres in the 1950s, rayon was the only chemical fibre to be mass-produced. Moreover, this was a cellulosic fibre because it was made mostly of cellulose which was melted and then solidified in the form of filaments. Rayon soon became one of the most exported industrial products of the country (exports in both relative and absolute terms grew even in the latter half of the 1930s) as Table 12 shows. In 1934 the whole Italian rayon industry showed a positive balance worth 400 million

<sup>30</sup> See Cerretano (2020a, pp. 1-21).

<sup>31</sup> See Figures in Cerretano (2020b, Table 1, p. 21, Table 4, p. 29).

<sup>32</sup> About cotton imports, see Federico *et al.* (2011, pp. 26-27).

TABLE 12. *Italy's international trade. The most exported goods, 1891-1939 (% and ranking)*

	Raw silk		Olive oil		Cotton fabrics		Rayon		Cars	
	%	X	%	X	%	X	%	X	%	X
1891-5	27.3	I	5.7	II	n.d.					
1900-4	27.6	I	3.0	V	3.5	III				
1909-13	18.2	I	2.3	VI	2.1	III				
1925-9	10.9	I	2.5	VIII	8.6	II	3.2	III	3.2	III
1935-9	2.4	VII	n.d.		4.6	I	4.3	II	n.d.	n.d.

Source: Authors' elaboration from Federico *et al.* (2011, pp. 25-26).

lire and starting from 1935 it became the second most exported Italian product.<sup>33</sup>

On the other hand, the leading figures in the industry and particularly SNIA Viscosa were quick to realise the potential help that autarky could offer for the launch of new investment. While pursuing the aim to develop a domestic market for rayon after 1931, the head of SNIA Viscosa, Franco Marinotti, proved as quick as skilful in grasping the opportunities offered by the new course in political economy. He of course used the unique ability of the sector to export as a bargaining counter. The final report of the ministry of corporations indicated that the solution to the massive deficit in the trade balance relative to textiles could only come from the massive increase in production of rayon in the form of yarn and above all of staple fibres.<sup>34</sup> The *corporazioni* dealing with textiles estimated a requirement of cotton for 1940 of about 210 thousand metric tons (of which 70 thousand were re-exported), foreseeing that the domestic output would only be able to cover 40 percent (i.e. 85 thousand metric tons) of that requirement through rayon yarn (amounting to 13 thousand tons), rayon staple fibres (the production of which was estimated at 50,6 thousand tons) and to a much more limited extent through home-grown cotton (for 12 thousand metric tons) and hemp (10

<sup>33</sup> See Federico *et al.* (2011, pp. 26-27); and ASBI, Segreteria particolare, prat. n. 394, fasc. 4, pp. 6-8, *Progetto per il coordinamento delle importazioni ed esportazioni dell'industria del rayon*, 2.3.1939.

<sup>34</sup> Ministero delle corporazioni, Segreteria generale del Consiglio Nazionale delle Corporazioni, *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937, in ACS, Fondo IRI, AU.1.6.18.2, MAAS CCR.it/asihap3/HapConsole.aspx.

thousand metric tons).<sup>35</sup> A similar line of policy was taken for wool, the requirement of which was estimated at 50 thousand tons that rayon would cover for about 35 percent (i.e. 17 thousand tons).<sup>36</sup>

The point was however that the creation of a domestic market and autarky became instrumental to the launch of staple fibres. Staple fibres were yarn cut at regular length that could be spun in combination with natural fibres. They constituted the most important technological breakthrough since the start of the industry in the late 1890s which allowed the consolidation of this sector in the 1930s. The autarkic countries, Italy, Germany and Japan, were the largest producers of those fibres, while SNIA Viscosa along IG Farben was a first mover in that branch of production. With the stimulus of autarky, SNIA Viscosa gave new impetus to their production, which had initially begun under the leadership of Riccardo Gualino in the early 1920s, which was discontinued in the years following the monetary reform in Italy and which continued unabated from the early 1930s until the 1970s. With the creation of a domestic market, autarky permitted the continuation of a strategy of large-scale economies and cheap labour which had initially been envisaged by Gualino in the 1920s.

In addition to rayon, autarky stimulated a domestic production of cellulose, which along sulphuric acid and caustic soda was the most important raw material in rayon making. Cellulose had to be of very high standards and was generally imported from Scandinavian countries. After 1921 consumption and imports of cellulose boomed.<sup>37</sup> That expansion was largely a consequence of the growth of the rayon industry after the Great War. In a report on raw materials sent to the minister of finance Thaon de Revel in October 1936 the deficit of cellulose was estimated to be 320 thousand metric tons (the deficit of cellulose for rayon was estimated at 70 thousand tons) per year or the equivalent of an outflow of gold for 200 million lire.<sup>38</sup> In addition to that, the report

<sup>35</sup> See *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937.

<sup>36</sup> See *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937.

<sup>37</sup> See Cerretano (2020a, Table 1, p. 5).

<sup>38</sup> ATdR, busta n. 27.6.127, *Proposte realizzazione autarchia. Situazione materie prime in Italia: cellulosa, cellulosa nitrabile, rayon, cloro*, Roma, October 1936, dattiloscritto, c. 86, p. 83.

highlighted the instability of cellulose prices which were sticky downwards, a fact indicating a scarcity of that good in international markets. The report then suggested that a national production should be initiated as soon as possible and that private firms, and not the government, should begin that.<sup>39</sup> The corporazione for textiles and the technical committee of that body envisaged a domestic production of cellulose from annual plants, such as reeds.<sup>40</sup> The reeds would have produced 10 tons of cellulose per hectare, then meeting the national requirement with 15 thousand hectares of land.<sup>41</sup> The technical committee moreover envisaged a first crop and production of cellulose for 1941 and indicated 1944 as the year when a national production of cellulose would reach 75 thousand tons, a production requiring production facilities worth 115-150 million lire, 55 thousand tons of coal and 35,5 million Kwh of energy.<sup>42</sup> It finally entrusted private firms (i.e. SNIA Viscosa) with the monitoring and implementation of the plan.<sup>43</sup>

Cellulose for the making of staple fibres could be of lower quality than the cellulose employed in yarn. That technical feature made the in-house development of a cellulose production starting from fast growing plants, first reeds and then poplar, more easily attainable. More important in the decision to branch out in that sector was however the scarcity of cellulose starting from 1932, as also the report to Thaon di Revel had pointed out. Scarcity and growing prices continued until the 1940s and once again after the Korean war in the early 1950s. That price inflation, as the FAO pointed out, justified the search of alternative sources of cellulose.

For the implementation of large-scale production of cellulose, SNIA Viscosa launched the Società Agricola Industria Cellulosa Italiana in 1937. That company maintained a vast agricultural estate in Basso Friuli, a region in the North East area of the country. It carried out land reclamation on a large scale, but it also embarked upon electricity and

<sup>39</sup> ATdR, busta n. 27.6.127.

<sup>40</sup> *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937.

<sup>41</sup> *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937.

<sup>42</sup> *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937.

<sup>43</sup> *Relazione riassuntiva piani autarchici al Comitato Corporativo Centrale*, November 1937.

chemical production. The production of cellulose and other chemicals remained non-existent until the end of the war but they were resumed growing significantly in the post-war period. As Mediobanca, a leading long-term industrial bank, pointed out in 1971, the Società Agricola Industriale with its supplies of cheap cellulose to the mother company, made SNIA Viscosa still profitable in the late 1960s.<sup>44</sup> In addition, SNIA Viscosa developed technologies which it sold to firms world-wide. With hindsight those investment would have been hardly possible without the reduction of imports and without state support.

But how did the government help that sector? Support came in the form of import prohibition of cellulose but also cotton and wool. Equally important were the compulsory purchases and mixes of rayon imposed on traditional textile firms, notably cotton weavers. Cotton firms represented the largest outlet for autarkic rayon.

According to a report commissioned by the Istituto Cotoniero Italiano, in absolute terms, the amount of staple fibres consumed by the cotton industry increased from 140 to 600 thousand metric tons between 1935 and 1939 (Mauro 1944, pp. 41-42). In cotton weaving the use of cotton increased from 85 to 317 thousand tons between 1934 and 1938, according to the ministry of corporations.<sup>45</sup> The reduction of cotton imports began in February 1935. The new measures, moreover, were implemented by the Istituto Cotoniero Italiano. The Istituto was initially created in 1913 and then renewed in the immediate post-war period. It became a compulsory sales cartel for all cotton weavers in 1934. Also, the leading figure of the Istituto became Gino Olivetti, one of the founders of *Confindustria*, the Italian association of industrialists. Finally, the operations of the Istituto were monitored by the ministry of corporations and controlled by the under ministry and then ministry of exchanges and currency (ministero degli scambi e delle valute), led by another figure linked to big Italian business, namely Felice Guarneri.<sup>46</sup>

<sup>44</sup> Ricerche e Studi SPA (1971, pp. 30-31).

<sup>45</sup> *Lettera del Ministero delle Corporazioni al Direttore della Banca d'Italia*, 10 March 1938, in ASBI, Direttorio Azzolini, cart 86, fasc 1, pp. 2-6.

<sup>46</sup> Mauro (1944, pp. 41-42) and *Lettera del Ministero delle Corporazioni al Direttore della Banca d'Italia*, 10.3.1938, in ASBI, Direttorio Azzolini, cart. 86, fasc. 1, pp. 2-6.

Initially, the government and rayon makers did not make recourse to coercion on cotton firms to impose the use of rayon in their products, although the latter offered some resistance to the mixing of rayon with cotton until 1936.<sup>47</sup> On its part, SNIA Viscosa sought to stimulate rayon consumption by acquiring cotton spinners and cotton weavers (of these we should mention the SA Manifattura Maglierie Milano, SA Filatura di Voghera, SA Industrie Tessili Inverigo and the SA Torciture di Vittorio Veneto) and by striking certain agreements with cotton firms.<sup>48</sup> Significantly, in the face of cotton weavers complaints who could not find cotton yarn for the domestic market, Gino Olivetti pointed out that the domestic market was important «to allow the use of the national fibres [rayon] in mixture with cotton».<sup>49</sup> During 1934 and 1935, SNIA Viscosa agreed prices and sales conditions with the Istituto in an attempt to push the sale of rayon.<sup>50</sup> In January 1935, Olivetti pointed out to the member firms of the Istituto that the use of staple fibres would have reduced costs and improved the balance of payments and for that reason he recommended the price proposals of SNIA Viscosa.<sup>51</sup>

A first decree obliging cotton spinners to mix cotton with rayon came in March 1936 (RDL 8 March 1936). In July 1937, the Istituto deliberated that all member firms were obliged to use in mixed yarn at least 15 percent of staple fibres.<sup>52</sup> Other laws setting out the amount of staple fibres (20 percent) in cotton goods were passed in 1939 (RDL 6 February 1939, n. 315 and DM 20 April 1939, n. 1057).

State support also came on the front of foreign trade. As also Guarneri pointed out, one reason for that support should be found in the fact that rayon would contribute to

<sup>47</sup> *Verbale del Consiglio di Amministrazione della SNIA Viscosa*, 2.3.1936.

<sup>48</sup> *Lettera del Ministero delle Corporazioni al Direttore della Banca d'Italia*, 10 March 1938, in ASBI, Directorio Azzolini, cart. 86, fasc. 1, pp. 2-6.

<sup>49</sup> Circolare n. 21, *Approvvigionamento del cotone sodo per il consumo interno*, 4.5.1937, in Archivio del Lavoro, Milano, Fondo Raitano, Faldone 1, fasc. 1: *Relazioni e documentazioni relative all'attività e alla natura dell'ICI e alla situazione dell'industria cotoniera*, 1932-4-1948, sf. *Deliberazioni obbligatorie*.

<sup>50</sup> Franco Marinotti a Gino Olivetti, 6.11.1934 and 10.1.1935, in Archivio del Lavoro, Milano, Fondo Raitano, Faldone 1, fasc. 1: *Relazioni e documentazioni relative all'attività e alla natura dell'ICI e alla situazione dell'industria cotoniera*, 1932-4-1948, sf. *Deliberazioni obbligatorie*.

<sup>51</sup> Circolare n. 7, *Fornitura di Sniafiocco all'industria cotoniera italiana*, 21.1.1935, in Archivio del Lavoro, Milano, Fondo Raitano, Faldone 1, fasc. 1: *Relazioni e documentazioni relative all'attività e alla natura dell'ICI e alla situazione dell'industria cotoniera*, 1932-4-1948, sf. *Deliberazioni obbligatorie*.

<sup>52</sup> Circolare n. 7, *Fornitura di Sniafiocco all'industria cotoniera italiana*.

change permanently (and strengthen the composition and structure of the country's balance of payments. Hence the help provided to the industry when it came to commercial agreements with other countries. A case in point is that of Nazi Germany. Between 1934 and 1936 during the clearing and commercial agreements with the Nazis, the Italian regime managed to stave off attempts by the German rayon industry and the German government to cut Italian exports into that country, which after China and India represented the most important outlet for Italian rayon. Rayon, moreover, accounted for about 14 percent in terms of value of Italian exports into Germany.<sup>53</sup>

Of some importance was also the support given in the field of scientific research. The investment of SNIA Viscosa in the field of cellulose benefitted from the debate, initiated soon after the Great War, about the development of a domestic cellulose industry which was also considered to be instrumental to rearmament (Acerbo 1934; Maiocchi 2003, pp. 38, 48-49, 86). That debate was reignited by the deterioration of the balance of payments in 1934 and found a first practical result in the experimentation conducted by the CNR and the newly born 'Ente Nazionale per la Carta e per la Cellulosa nazionale', a body entrusted with the study of alternative sources of cellulose (Maiocchi 2003, pp. 38, 48-49, 86). One major conclusion of those studies, which saw also the significant contribution of Francesco Giordani, a leading figure of IRI, Carlo Levi and Francesco Carlo Palazzo, was that the country should pursue the cultivation of poplar as an alternative source of cellulose. That however was a long-term solution. For their immediate needs, the paper, rayon and chemical (explosives) industries could carry out the cultivation of annual plants, most notably the reed (or *arundo donax*), which would have provided cellulose of decent quality within a very short period and on which Giordani and Levi had conducted significant experimentation (Maiocchi 2003, pp. 38, 48-49, 86). The management of SNIA Viscosa carried out, simultaneously, the cultivation of poplar, of eucalyptus and above all of reed. The cultivation of poplar began to give good results only by the 1950s, whereas in the 1930s the firm would purchase wood from Slovenia, which Fascist Italy then occupied after 1941, and

<sup>53</sup> *Verbale del comitato interministeriale tenutosi presso il Ministero delle Finanze*, 12.12.1935, in ASBI, Direttorio Azzolini, cart. 86, fasc. 1, pp. 518-520.

attempt to cultivate reed. In the latter case, the help from the Ente Nazionale per la Carta e per la Cellulosa was crucial. The Ente had perfected a method for the production of pure cellulose from reed and carried out the selection of reeds which could be best employed in the making of cellulose. SNIA Viscosa managed to acquire that type of reed and to carry out its large scale cultivation after 1937 through the Società Agricola Industriale (Ostuni 2016, pp. 133-135).

### 5. *Conclusions*

From what has been said, it seems safe to conclude (or rather, confirm) that, despite the ideological *furore* and the propaganda of the regime, autarky had a strong pragmatic nature and was influenced by concrete reasons, such as the need for foreign currency reserves. Of some importance and also a consequence of that also was the attempt to create a domestic market which would offset the loss of foreign markets, while allowing profits and the reduction of risks associated with new investment. Judging from the evolution of some high-tech, capital-intensive sectors that were to become strategic for the Italian economy, moreover, in some cases big firms saw a good investment opportunity in the new developments in economic policy and in the creation of a domestic market. This is an important inference in relation to current debates. It offers a microeconomic and business history perspective to the debate about the growth of industrial production during the inter-war period. In relation to that, Fenoaltea and Bardini (2000), for example, pointed out that if «in 1911, metal-making, engineering and chemicals (the most advanced sectors) amounted to 32% of value added in manufacturing, by 1951 their share had risen to 44%». In a similar vein, Felice and Carreras highlighted that in the interwar years, «Italian industry undertook a modernization towards more advanced manufactures that the other economies had already lived through. [...] in the 1920s» – concluded they – «the growth rate of Italy's industry was higher than that of the United States and Korea, and close to that of Japan» (Felice and Carreras 2012).

Our contribution however also seems to suggest that autarky, and what could be called 'industrial policy' with



post-war jargon, was strongly influenced by monetary policy which in Italy (as in other countries that experienced inflation and the deflationary pains following the monetary reform after 1925) remained strongly conservative and deflationist until 1936-37. Hirschman was struck by the delay with which Italy adopted exchange controls resisting any attempt to devalue despite the rapid and impressive deterioration of the balance of payments after 1931. It is tempting to infer that to some extent autarky represented the other facet of a very orthodox monetary policy which could not however accommodate the huge balance of payments problems. Another implicit suggestion here is that that orthodoxy, with its negative effects on aggregate demand, may help to solve the conundrum of an apparent paradox between the robust growth of industry and the disappointing performance of productivity, which is generally attributed to cartelization, autarkic planning and the *regime's* controls over the labour market.

Here we sought to suggest a new perspective whereby the study of big Italian business is put within the general context in which the balance of payments constituted an important external constraint. It is evident that the regime's intervention into industry, while lacking control over industrial firms, did not constitute a form of external constraint for private undertakings which would then subvert inner corporate dynamics and force firms to pursue suboptimal industrial and technological choices. Paradoxically, that conclusion might be valid also for public-owned enterprises. In the case of the heavy and metal industries, for example, autarkic planning encouraged one of the most complex industrial reconstructions in the Italy of the 1930s, which, while headed by IRI, was characterized by the integral cycle, an increase in coal and iron imports and the reduction of scrap iron imports. With regard to Nazi Germany, Scherner concluded that investments typically were not the result of direct or indirect State pressure. More than from state pressure, investment originated from voluntary decisions (Scherner 2008).

From a technological standpoint, with probably the exception of cellulose, autarkic planning resulted in failure, also because the corporate actors ended up adopting the technology and know-how developed and used internationally. For most firms the adoption of autarky did not occasion the subversion of a market economy. At the same time,

the incentives offered by autarky gave the chance of reorganizing industry following the lines indicated thirty years earlier by Francesco Saverio Nitti.<sup>54</sup>

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