Technological Retardation

The Decline of the Swiss Watch Industry*

Von Martin Maurer

In this paper it will be attempted to understand the decline of the Swiss watch industry as the result of the sector's cartelization and the absence of foreign competitors. Moreover, the role of the labour market situation and the stalemate of innovative activities will be examined. The final goal is to understand the sector's poor performance as rising from a tendency inherent in its non-competitive structure.

1. Introduction

For the Swiss watch industry the last ten years were more than just tough. Within a decade it lost its position as the world's largest and best watch producing sector. Many factors have been mentioned in explaining the bad performance of the watch industry before 1975, and especially after 1975. The impact of the exchange rate variations in the 'seventies, management attitude, industrial policy, etc. did doubtedlessly play an important role in determining the actual performance of the sector. However, to understand why they were relevant in this particular sector, but not in other ones, one has to analyze the structural properties of the watch industry and its specific flexibility to react to a changing environment.

Three main themes appear to be central: The high degree of cartelization and the reluctance to open the sector, the labour market situation, and the particular relationship between the technology in use and the 'best' one. The paper will focus entirely on these three strongly interrelated themes.

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2. The Performance of the Swiss Watch Industry

Geographically the watch industry is concentrated in the French speaking cantons of Switzerland, mainly in the mountainous area of the Jura. There, agriculture is unproductive compared with midland farming, and the development of the watch industry is historically based on the absorption of surplus labour from the agricultural sector. For a very long time production was organized in a putting-out system — even in 1973 there were still 10,000 domestic workers employed[1] — and well in the 20th century only started the factory to become the dominant form of organization of production.

The watch industry dominates the regional economic development in this area; however, its influence on the overall Swiss economic performance is small, since its share of the total GDP is calculated to be about 2 %. The pecularity of the sector is the high share of exports on total production; about 90 % is sold on foreign markets.[2] Since the beginning of the 19th century the industry dominated the world trade in watches; in 1950 still 50 % of the world consumption was met by the Swiss watch industry. Even at the eve of the biggest post-war crisis, in 1974, the share still consisted of 43 %. But the crisis had a tremendous impact on the watch industry. In 1974 more than 64,000 people were employed in this sector; one year later employment dropped to about 52,000, and in 1976 it was well below 48,000. Between 1974 and 1976 the exports (in volume) dropped from 59.0 million units to 42.1 million units, or (in value terms) from SFr 3702.4 million to SFr 371.7 million. This was a hard disruption after a long period of hardly any major changes; its impact was not just transitory but made fundamental changes necessary. This process of restruction neglected during the 'sixties still goes on today and certainly will do so for some more years.

2.1 The Importance of Watch Exports

Though the share of watch production in overall Swiss output is small, its share of overall exports is quite considerable, a reflexion of the sector's high export ratio. The share's decline shows that the watch industry had lost ground in its export dynamics, especially compared with the chemical industry and the metal/machine industries. The downfall is particularly remarkable after 1967: Within fourteen years its share decreased to half its initial size, from 14.3 % to 7.2 %, although

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[1] *Schwertfeger* (1975), 260.
[2] *Schwertfeger* (1975), 260, although lower shares have been estimated. See *Berwert* (1977), 159.

production rose both in value and in volume terms from 1960 to 1974 (though at a diminishing rate). The following annual average give quite a clear picture:

Table 1

Year	I	II	III	IV	V	VI
1960	15.5	— 0.29	30,195	1,522.4	1,259.2	106.1
1965	14.0	— 0.45	38,365	2,209.5	1,798.5	197.6
1974	10.5	* * *	59,020	* * *	3,702.4	* * *
1976	8.3	— 0.28	42,143	4,390.5	3,071.7	60.7
1980	7.2	- - -	28,514	- - -	3,549.9	- - -

I: Share of watch exports of total Swiss exports.
II: Trend of change of the watch export ratio between the respective and subsequent year. * * * = calculation omitted for the period 1974 to 1976. - - - = no calculation has been made.
III: Watch exports in volums (1,000 units).
IV: Trend of change of watch exports in volums.
V: Watch exports in value (in million SFr).
VI: Trend of change of watch exports in value.

Note: The trends have been calculated with the Maximum Likelihood Iterative technique.

Both in volume and in value terms the growth of output did not increase drastically anymore.[3] It is worth noting that in the period 1965/74 the growth of exports in produced units and in value increased, while the share of watch exports on overall exports was quite drastically declining. The value terms, moreover, are in current prices, and the lack of the appropriate export price deflator makes an exact assessment impossible.[4]

3. The Stability of the Production Structure

The most striking feature of the structure of the Swiss watch industry is probably the low degree of intersectoral linkages, and the high degree of intrasectoral connections which is reflected in a high degree of de-

[3] Between 1965 and 1974 it increased 5.8 % annually as opposed to an annual increase of 5.0 % between 1960 and 1965, when measured in terms of volume units. In terms of values it grew at 8.4 % and 11.0 %, respectively, in the two subsequent periods. After 1975 the sector faced a drastic decline. Between 1976 and 1980 exports in volumes declined at 10.4 % and in value terms the rate of growth was very low (2.0 %).

[4] If the consumer price index is taken as deflator, then the rates are calculated as 5.2 %, 5.6 %, and 0.1 % for the three respective periods.

centralisation. It has been estimated that about 50 % of all firms are specialized in the production of some components of the watch work or in other particular segments of the production process. Almost as many firms specialize in assembling and in mounting the finnished products. Even before 1975 only about twenty companies produced every part of the watch. Out of more than 600 companies only twenty had an annual turnover of more than SFr 10 millions, whereas more than 50 % of them had a turnover lower than SFr 0.5 millions.[5]

The degree of competition among different producers was kept very low by means of cartelization which led to severe criticism and political pressure, mainly from the USA. In the early 'sixties economic pressure through the rise of foreign competitors resulted in first only a slight liberalization of the watch making industry in 1961. Later on, in 1965, some of the most restrictive agreements were abolished, although others lasted as long as 1974. The tightest among those restrictions went so far as to forbid the cartel members to sell or buy movements and watch parts to or from non-members, or to declare some transactions between supplier and buyer within the cartel as exclusive dealing agreements. The restrictions did not only apply to the watch industry itself, but also to the highly specialized tool industry: The exports of tools, blueprints, and jigs had been forbidden. Moreover, the quality label 'Swiss Made' required the production process to be exclusively established in Switzerland itself, and until 1965 entry into the sector was conditioned by governmental approval, as was the introduction of new (or the change of existing) specializations.

None of these rules favoured changes within the production structure, and the remarkable stability of the structure does hardly surprise. If we take the trend between 1955 and 1965 as representative for the whole period from the 'fifties to 1974, then the comparison of the 1975-data with those of 1965 gives us an idea about the impact of the crisis in the mid-seventies on the structure of this sector (but, of course, not on the number of producers).

Had the intra-sectoral linkages via the input side been less pronounced, and had the firms stood in competition with one another rather than in contractual cooperation, the crisis would have had affected the structure of the sector differently: Smaller firms would have been driven out by competitive forces. The figures, however, clearly reflect a marked impact on the scale of firms, but not on their structure.

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[5] The Economist, 28. 11. 1964, 1060, and *Blattner* (1978), 336.

Table 2

Number of Persons in Production Units with ... Employees

	1955 number	%	1965 number	%	1975 number	%
1 - 9	2,941	7.6	5,219	6.8	5,570	9.1
10 - 99	20,379	52.4	42,778	56.0	38,496	63.0
200 - 499	13,261	34.1	11,951	15.6	8,242	13.5
500 and more ..	2,274	5.9	16,495	21.6	8,750	14.3
Total	38,861		76,443		61,058	

Number of Production Units with ... Employees

1 - 9	2,004	72.2	1,648	60.1	1,851	64.6
10 - 99	697	25.1	1,031	37.6	975	34.0
200 - 499	71	2.6	42	1.5	29	1.0
500 and more ..	3	0.1	19	0.7	12	0.4
Total	2,775		2,740		2,867	

Note: For 1955 the categories are 1 - 10, 11 - 100, 101 - 500, and 500 and more. For 1975 the numbers refer to watch and jewellery.

Source: Statistische Jahrbuecher der Schweiz, var. iss., Bern.

4. The Managerial Failure to Innovate and Restructure

Mismanagement is very often used to explain the lack of innovative activities and the decay of a sector, and with respect to the watch industry an incident is usually quoted which is supposed to show the particular relevance of this argument. The electronic watch had been developed by a Swiss, but Swiss companies did not take up the idea. It was a US firm which pioneered in that field acquiring a lead in this segment of the watch market. The question remains why there was no major watch producer which broke out of the cartel and took up the implementation of the electronic watch.

I shall assume that in the Swiss watch industry the larger producers had the potential to gain from scale effects, whereas the smaller handicraft-type of producers produced under diminishing returns due to

economies of specialization and scale diseconomies.[6] Moreover, those watch producers which were vertically integrated with small producers would have to bear costs necessary to restructure not only their own production process but also that one of their contractual partners, since none of those would otherwise make the step to accomodate its technology to the new requirements.

The small entrepreneurs did not have much to gain from a change either, taking into account the risk involved in restructuring and the minor impact they could have had within the whole structure of the cartel. Exclusive dealing contracts amount to a de facto price and quantity fixation in which the least flexible entrepreneurs get just a sufficient rate of return. We have, therefore, to analyze why the large watch producers decided to abstain from major technological changes.

4.1 Innovation Incentives in a Cartelized Structure

To leave a cartel the members of which are economically about equally strong is in itself quite risky, since the remaining members will try to isolate the outsider in order to save the cartel. We shall abstract from these thoughts and try to show that apart from this risk it might be more profitable to remain in the cartel.

In each point of time, every firm is confronted with the decision to stick with the existing technology X or to invest in a generally available new one, Y. The potential innovator (who in our case is identical with the potential outbreaker) estimates the demand for his watches, the price elasticities, and the cost of production associated with the different demand levels.

Following Sylos-Labini we define the demand elasticity of prices as $\varepsilon = p_2 Q_1 / p_1 Q_2$ in which p_1 and Q_1 denote the existing (and known) price

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[6] Since the latter were quantitatively more important than the former we should find that the sector lost potential scale economies due to its structure. Indeed, if we accept Kaldor's explanation of Verdoorn's empirical finding, then we expect the correlation between the rates of growth of productivity and production to be weak and non-significant. An OLS estimation turned out to give a significant relation only for the period from 1965 to 1974 (significant at a 99 %-level):

$$\dot{\lambda}/\lambda = -0.039 + 1.059\,\dot{Y}/Y \qquad R^2 = 0.59$$
$$(0.020)\quad (0.282)$$

Kaldor proposed an elasticity of 0.5 to be valid for his explanation. An elasticity larger than unity would, then, indicate that other factors than scale economies played a decisive role; those can be improvements in the existing capital stock and efficiency rising measures. It is, however, not possible to say anything about scale economies for this period. The fact that the OLS produced a non-significant and weak relation for the period from 1961 and 1964, however, might indicate the point made above.

and quantity, whereas the suffix 2 denotes the new (and probably only estimated) price and quantity levels. Thus, $p_2 = \varepsilon \cdot (Q_2/Q_1) \cdot p_1$, in which p_2 is the unknown, but ε an estimation. From this information, the entrepreneur calculates his maximum annual profits he can earn if using technology Y until the competitors have implemented it as well:

$$\hat{\pi}_i = \hat{p} \cdot Q(\hat{p}) - \hat{c}(Q(\hat{p})) = \varepsilon \cdot [Q(\hat{p})/Q(p)] \cdot p \cdot Q(\hat{p}) - \hat{c}(Q(\hat{p})) ,$$

and as long as he uses technology X, but his competitors have already implemented Y:

$$\tilde{\pi}_i = \tilde{p} \cdot Q(\tilde{p}) - c(Q((\tilde{p})) = \varepsilon \cdot [Q(\tilde{p})/Q(p)] \cdot p \cdot Q(\tilde{p}) - c(Q(\tilde{p}))$$

π_i denotes profit in year i, p the profit maximizing price (identical with p_2 above), $Q(p)$ the expected demand associated with p, and $c(.)$ the costs associated with $Q(.)$. $\hat{\pi}_i$, $\hat{p}$, $Q(\hat{p})$, and $\hat{c}(.)$ are the respective denotations for the profit calculation when using technology Y, while his competitors use X still. $\tilde{p}$ denotes the price for watches if a competitor innovated first, and our entrepreneur is still using X, and $\tilde{\pi}$ the corresponding profit.

The potential innovator takes into account the response of his competitors. If he innovates, the others (who for simplicity we treat as an absolutely homogeneous entity) will eventually follow. If he does not innovate, the others might do so (with probability q) or stick to the existing technology (with probability $1 - q$).

His present value profit π_{IN} stemming from an innovation consists, therefore, of two parts. First, the extra-profits earned by adopting a superior technology, and second, after t years have passed needed by his competitors to implement the new technology, as well, the profits corresponding to the long-run rate of profit earned on the new technology. The price p_N corresponding to the (given) long-run rate of profit is derived from a simple accounting identity. The long-run profits are, then,

$$\pi_i^N = \varepsilon \cdot [Q(p_N)/Q(p)] \cdot p \cdot Q(p_N) - \hat{c}(Q(p_N)) .$$

Thus, if an innovation is undertaken, the expected discounted profit will be:

$$\pi_{IN} = \sum_{i=1}^{t} \frac{1}{(1+r)^i} \cdot \hat{\pi}_i + \sum_{j=t}^{\infty} \frac{1}{(1+r)^j} \cdot \pi_j^N$$

The first component of the right hand side will for simplicity be defined as A, and the second one as B.

If the entrepreneur decides not to invest, his profits π_{NI} consists of three parts: First, the profits he would earn if sticking to the old technology while his competitors produce with the new one, and, second, the profits corresponding to the normal rate of profit once he has implemented the new technology, as well. Both components are weighed with probability q. The third part reflects the profits in case nobody invests (weighed by the counter-probability $1 - q$). These long-run profits π_i^M correspond with the price p_M which is also derived from a simple accounting equation. The expected discounted profit π_{NI} if the innovation is not undertaken is, then:

$$\pi_{NI} = q \cdot \left[\sum_{i=1}^{t} \frac{1}{(1+r)^i} \tilde{\pi}_i + \sum_{j=t}^{\infty} \frac{1}{(1+r)^j} \pi_j^N \right] + (1-q) \sum_{k=1}^{\infty} \frac{1}{(1+r)^k} \pi_k^M .$$

Here, too, the three components will be defined simply as C, B, and D, respectively.

Technology Y will then be introduced by our entrepreneur, if $\pi_{IN} - \pi_{NI} > 0$. He abstains from it, if $\pi_{IN} - \pi_{NI} \leq 0$.

Thus

$$\pi_{IN} - \pi_{NI} = A + B - qC - qB - (1-q)\, D \gtreqless 0$$

or

$$A - qC \gtreqless (1-q)\, D - B \ .$$

The most important single determinant is the time factor t. The longer the period in which extra-profits can be earned (i.e. the higher A), the higher the opportunity loss in foregoing the innovation (i.e. the smaller C). Moreover, B will become negligible. One can argue that q itself will rise with t, since an innovation with high barriers of entry is more likely to be adopted. However, on the right hand side the effect of a changing probability on D and B will partly offset each other, and on the left hand side its influence with a small value of C will be negligible.

If a new technology is easy to implement, i.e. t is small, then $A - qC < (1-q)(D-B)$ is more likely. This seems to be relevant for the Swiss watch industry: Research projects were undertaken in jointly financed institutions (at least from the 'sixties onwards) and, therefore, generally available. Moreover, none of the larger watch companies produced its own capital goods or had exclusive backward linkages. This implies that no barriers of entry by means of process innovations were possible. Indeed, the machine industry would only have developed new capital goods if it could have sold it to the whole sector.

We recognize now the crucial points. The small barriers of entry have been mentioned, and the effect of the missing backward linkages (which

were the consequence of the autarky of the watch industry) must be considered to have had a similarly strong influence. Strongly lowered capital costs or an innovation which would have allowed to produce a new watch at much lower costs would have decreased the long-run price p_M sharply (due to much lower input costs). If Engel's Law is relevant, then a drastic lowering of the production costs would have allowed to enter a much more price elastic segment of the watch market — this has been demonstrated by the Japanese watch makers. In our terminology: the radical lowering of the production costs rises the component B. Despite smaller barriers of entry would $(1 - q) \cdot (D - B)$ exceed $(A - qC)$.

5. The Development of the Labour Market

The growth of the sector, in the absence of any major technical changes, implies growth of the labour supply. Only an 'unlimited labour supply' in Kaldor's sense allows the production of an increasing output at a constant technology and a constant wage rate. A sufficient labour supply enforces — ceteris paribus — the existing structure; managers/entrepreneurs were not forced to restructure their process of production by adopting labour saving means of production, as a mean to prevent a 'profit squeeze'.

The social environment had influenced the labour market heavily. Migration is not very common (partly due to the language barrier) and the predominance of the watch industry has created a skill which ties the workers to a certain extent to their craft. Rapid technical change depreciates that skill; the fear of labour market segmentation has certainly strengthened their resistance against a thorough structural change. Very likely other factors (agricultural properties, family ties, etc.) reduced the importance of the relatively declining wage and the rising wage gap. During the 'fifties employment patterns shifted from agriculture to industry all over Switzerland.

From the mid-fifties onwards the labour market was prevented from tightening by immigration of foreign workers; and even after 1963/64, when the number of immigrants was restricted by the government, the watch industry had comparably few problems in hiring the required workers. This was largely due to the 'double rationing', the rationing not only of the overall number of immigrants, but also of the number of immigrants per region in order to prevent high concentration of foreign labourers in high wage areas, since immigrants reacted much more than the local labour force to wage differentials.

Table 3

	1955	1965	1975
Total Workforce	68,253	76,437	61,058
of it female	32,272	37,501	27,683
female in %	47.3	49.1	45.3
owners	2,781	2,097	1,594
employees	65,472	74,340	59,464
foreigners	2,092	15,185	16,641
foreigners as % of empl.	3.1	19.9	27.2

Note: The 1975-data refer to watches and jewellery.
Source: Statistische Jahrbuecher, var. issues, Bern.

Table 3 shows the composition of the labour force. The high percentage of women (even before foreign workers were employed at large scale) is remarkable and rather untypical for Switzerland.

Between 1965 and 1975 more than 10,000 women lost their job, most of them during the crisis in 1974/75, and their share on the total labour force dropped considerably. Table 4 allows us to consider the issue of employment of foreign workers more closely and it turns out that they were strongly affected by the disruption in the mid-seventies.

Table 4

Year	I	II	III	IV
1960	58,250	906.2*	1,157	2,005.6
1965	63,574		14,619	
1965	76,443	— 1,338.9	14,619	660.9
1974	64,594		21,376	
1976	47,629	— 1,990.6**	12,423	— 342.9
1980	41,343		11,653	

I: Employment
II: Trend of annual change in employment
III: Foreign workers
IV: Trend of annual change of foreign workers

Note: The figures above the line refer to blue-collar workers only which were employed in factories. In 1965 the base was changed and data since then refer to the total employment; for 1965 both data were available. The two trends were estimated with a Maximum Likelihood Iterative Method. All estimates significant at a 99 % level, except * and ** (significant at a 90 % and a 95 %-level, respectively).

Source: Statistische Jahrbuecher, var. issues, Bern.

To get an idea of the overall labour market situation one can refer to the number of open jobs and the number of people looking for a job which were reported to the Labour Office — not a very good proxy, but since absolute levels are not on issue here, it can be accepted.

Table 5

Year	Open Jobs	Job Seekers	Excess Demand
1962/65	864	1,596	732
1966/70	692	896	204
1971/74	308	364	56

Note: All figures are annual averages for the respective periods.
Source: Statistische Jahrbuecher, var. issues, Bern.

An excess demand certainly prevailed, but the market did not experience the same tightedness as elsewhere; after all, quite a considerable number of job seekers were reported. The decline of the excess demand after the mid-sixties might be at least partly a result of efforts to substitute labour and to raise its efficiency. This, however, is a heroistic interpretation.

6. The Dynamics of Wages: Incentive or Threat?

The well-known argument that lower wages sustain a virtuous circle needs certainly further qualifications when we deal with a relatively small sector. The prices of watches is very unlikely to determine the cost of living of the sector's workers (since watches weigh only slightly in their consumption bundel). Whether a sectoral virtuous circle is sustained, depends on the purchasing power determined in the economy as a whole, the willingness of the workers to accept a smaller (real) wage increase, and the extend to which the rise in productivity enables to pay higher wages and to lower the output price without squeezing profits. The workers are not — as in a macroeconomic model — confronted with a price increase following their wage rise. A wage push will rather induce a switch of technique which can imply a fundamental change of the production structure and the working conditions. They weigh, therefore, the advantage of a higher material standard of living against the disadvantage of structural change which may bring about geographical migration, labour segmentation, and/or unemployment. In short, they weigh the trade-off between material advantages of a high productivity system against the immaterial advantages peculiar to a specially decentralized, small scale production system. But it is never-

theless reasonable to assume that workers would not accept a secular decline of their real wage.

The limit of this strategy — preserving a structure by abstaining from wage increases — can be shown in a simple diagram (Figure 1). Let the rate of growth of the nominal wage be a function of the expected rate of inflation and the portion of the productivity increase which the workers are able to get. We assume, moreover, that both productivity and the expected inflation rate increase with time (although the later exceeds zero only after the actual rate of inflation has reached a threshold level). In addition, we assume that the change of the expected inflation rate increases — at least over the relevant periode of time — whereas the rise of productivity decreases.

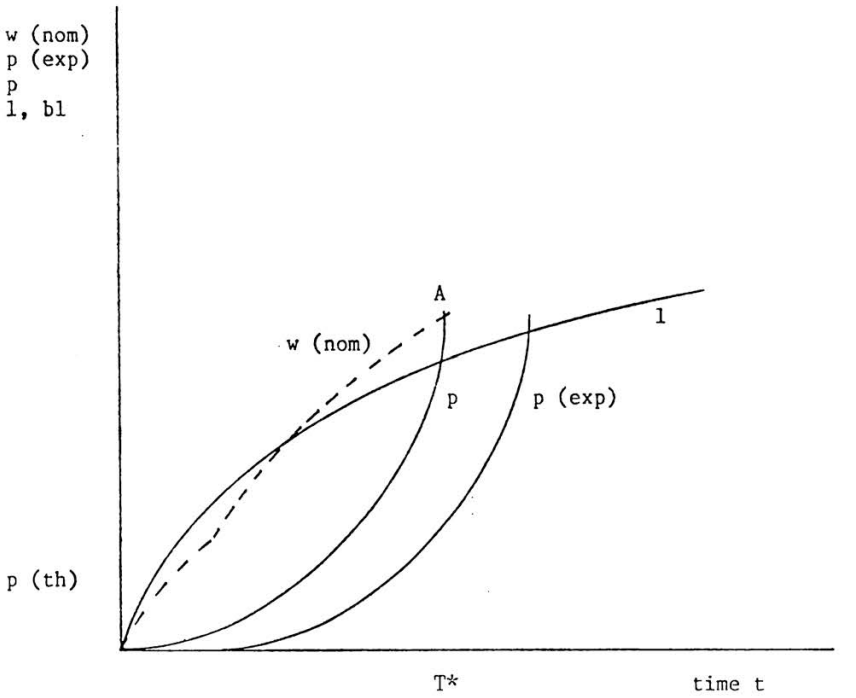

Figure 1

w (nom) = rate of growth of nominal wage
p (exp) = rate of expected inflation
p = actual rate of inflation
l, bl = rate of growth of productivity and its share b claimed by the workers, respectively

The two following equations hold:

$$w_t \text{ (nom)} = p_t \text{ (exp)} + bl$$

$$p_t \text{ (exp)} = \begin{cases} 0 & \text{if } p_t \leq p \text{ (th)} \\ p_{t-1} - p \text{ (th)} & \text{if } p_t > p \text{ (th)} \end{cases}$$

At point A the growth of the real wage is zero. Beyond that moment T^* the trade unions will have to face a loss of their standard of living if neither inflation falls nor productivity increases. Therefore, whether the unit wage costs change in the medium term depends as much on the ability and capability of the entrepreneurs/managers to adopt productivity increasing technologies as on wage restrainments. A vicious circle arises when the cost of living is rising and productivity cannot be improved.

Although sectoral figures for wages and productivity are not available and any attempt to give an approximate idea is subject to considerable doubts, the calculated figures at least do not contradict the above stated hypothesis.

Table 6

Period	$\dot{w}$ (nom)	$\dot{p}$	$\dot{w}$ (real)	$g\lambda$	$g\lambda^*$	$g\lambda^* - \dot{p}$
1956/62	4.7	1.8	2.9	—	2.7	0.9
1962/68	7.0	3.9	3.5	5.9	7.6	4.1
1968/74	6.9	6.3	0.3	4.3	8.7	2.4

Note: $\dot{w}$ (nom): Growth rate of the hourly wages in the watch industry according to wages for injured workers; weighted average of skilled male and female workers (weight: participation ratio, 0.55 for male workers, 0.45 for female workers).

$\dot{p}$: Rate of inflation for consumer goods.

$g\lambda$: Rate of productivity growth according to the indices of employment and production, as published in the Statistische Jahrbuch.

$g\lambda^*$: Estimated rate of productivity growth. For employment the official figure in 1965 have been set equal to the index for employment, and the other annual figures have been derived according to the index. Output figures have been calculated from export figures: Exports $(1 + 0.05)$ = Output.

$g\lambda^* - \dot{p}$: Real growth of productivity. The inflation rate underestimates the real productivity gain, because export prices are typically lower than the domestic rates of price change. This will partly explain the difference between $g\lambda^* - p$ and $g\lambda$.

Despite the weakness of these figures one might well have a look at the change of the wage-productivity ratio:

$$(\dot{\omega}\,(\text{nom})/\dot{\lambda}^*)_{62/68} = 0.9 \qquad (\dot{\omega}\,(\text{nom})/\dot{\lambda}^*)_{68/74} = 0.8$$

$$(\dot{\omega}\,(\text{real})/\dot{\lambda}^*)_{62/68} = 0.6 \qquad (\dot{\omega}\,(\text{real})/\dot{\lambda}^*)_{68/74} = 0.1\ .$$

These figures, if anything, support the assertion that wage claims were modest, i.e. not threatening the rate of profit, but subject to a squeeze themselves. The following picture can be drawn from these figures: Up to the early 'sixties the real wage increased relatively slowly due to the ongoing stream of immigrants and due to a relatively low productivity increase. We may hypothesize that due to the large

labour supply, the cartelization, and the virtually complete control of the market segment of high and medium priced watches major process innovations to decrease per unit costs and to replace labour were not induced; the rising demand was met with the widening of the capital stock and improvements in the production process. However, productivity did rise, though at a decreasing rate. This can be the cause of two possible actions: Either restructuring took place (i.e. the existing technology X was replaced by a 'better' technology Y), or improvements and 'defensive investments' (Lamfalussy) were forced (i.e. X was kept and improved[7], or substitution processes within X were undertaken, so that X' was changed into X'').

We reject the first possibility to be relevant on the ground outlined so far. The sectoral stability and its decentralized production structure, but also the product mix, an innovation stalemate due to the specific market structure, and the existence of dynamic X-inefficiencies are signs which do not suggest an ongoing structural change. Moreover, major product and process innovations would have very likely allowed for a sustained productivity growth lasting longer than three years. But between 1967 and 1974, productivity growth decreased again. This seems much more in line with the second explanation, for which we shall try to find a theoretical base.

7. Productivity Increase without Major Technical Change

To tackle this question we have to make the crucial but reasonable assumption that the growth of labour productivity in the machine producing industry was larger than that one in the watch industry itself. Further, we assume that these gains were not fully appropriated by the machine sector but spilled over to the purchasing sectors.

We have already seen that workers weigh the immaterial advantages of a decentralized structure quite heavily and abstain from excessive wage pushes. Entrepreneurs, though unwilling to restructure, will certainly reorganize the production process in order to gain from external economies. Both moments are relevant to understand the slow secular rise of productivity. However, we abstract first from a cheapening of the means of production.

A technology X can be organized in different manners (which have been called X', X'', ...). As figure 2 shows, for different wage-profit

[7] X and Y denote two entirely different basic technologies, whereas X' and X'' shall refer to two different techniques belonging to the basic technology X.

relations, a different technique may be optimal. Assume the workers pressed the wage from w^0 to a level above w^*, then the entrepreneurs would switch from X' to X'' as soon as the wage rate exceeds w^* (i.e. the rate of profit falls short of r^*). As figure 3 — Robinson's 'marginal productivity of investment' — shows, a reorganizing of the production process induced by a decreasing rate of profit implies a rise in the labour productivity and in the capital/labour ratio. (One has, however, to make the further assumption that the rate of profit in the basic-good remains constant; watches are in this context obviously non-basic goods.)

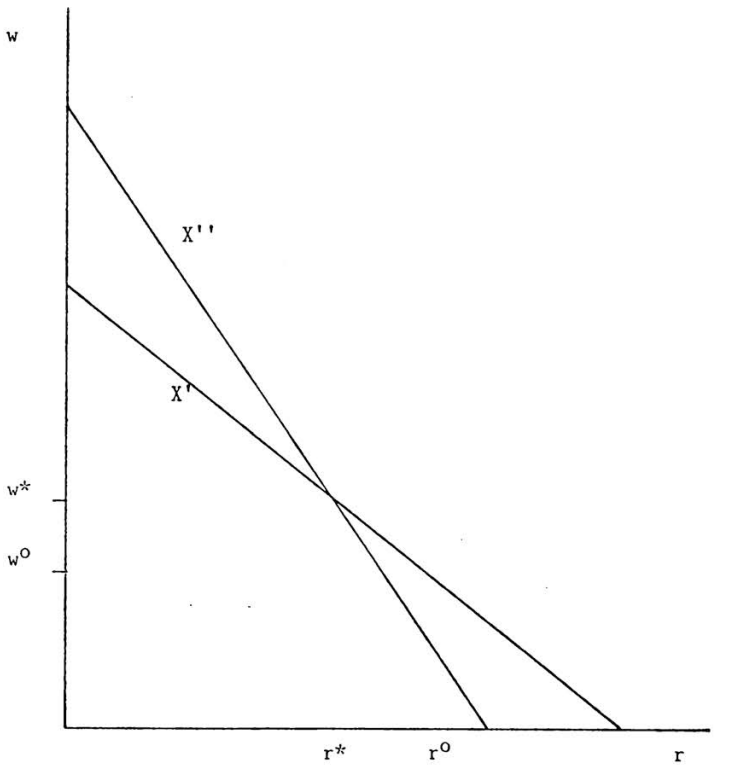

Figure 2

This process explains part of the moderate productivity gain, but it implies a decreasing rate of profit, and a relatively aggressive wage policy which does not really fit with the characterization presented above. At this point, the second aspect of sectoral interlinkages becomes crucial. Higher productivity growth in the machine industry lowers the

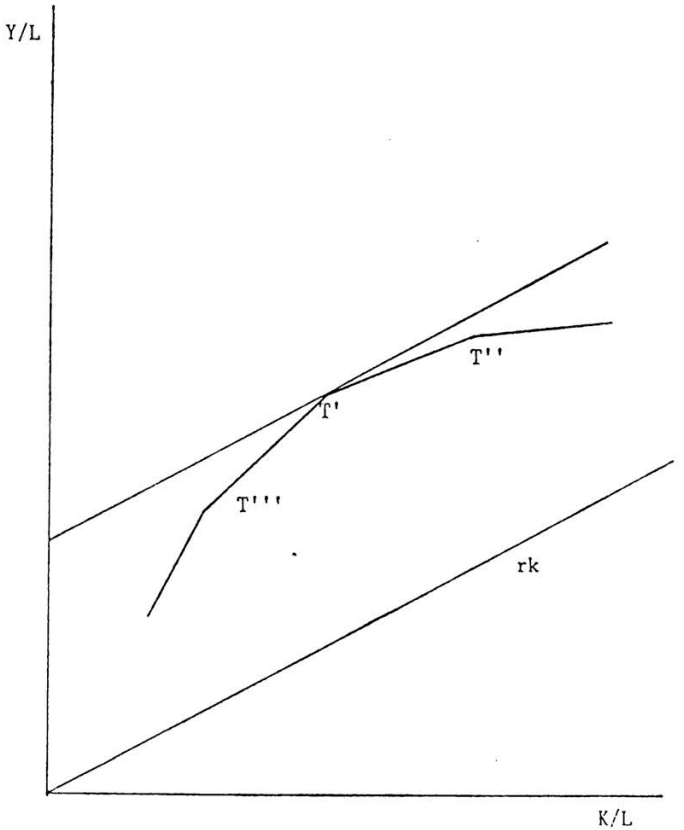

Figure 3

Y/L = labour productivity
$K/L = k$ = capital labour ratio
r = rate of profit

value of capital inputs even when the same machines are purchased.[8] The physical capital/labour ratio remains constant, while the value capital/labour ratio decreases, since the means of production are less expensive. As Pasinetti[9] has shown, one can unambigously derive the movement of the capital/output ratio, but not that one of the capital/labour ratio: The former does decrease over time for the sector purchasing the capital goods.

[8] An analytically very crucial and empirically reasonable assumption requires the productivity growth outweighing the effect of a change in distribution on the value of capital.

[9] *Pasinetti* (1980), 208 ff.

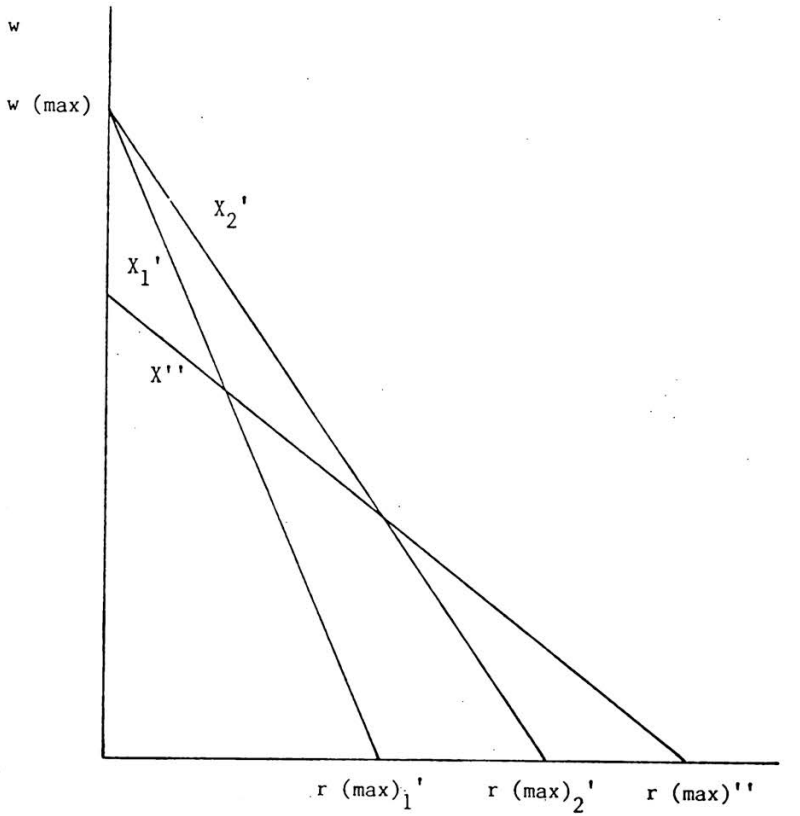

Figure 4

This is quite an important conclusion with respect to the different techniques X' and X''. The impact of the machine sector's productivity growth is very unlikely to be even on the machines embodying X' and those embodying X''. Assume for simplicity only X' is favourable affected by external economies. In that case, the wage-profit curve will turn around the intercept of the wage rate, since the maximal rate of profit will have increased. This case is depicted in figure 4.

Obviously, external economies can change the optimality of the different techniques, irrespective of wage demands. It has to be emphasized at this point that a change in the wage rate is neither a necessary nor sufficient condition for a change of technique or a decreasing rate of profit. What matters are the relation between the productivity increase spilled over from the machine sector and the wage rate in the watch

industry, and the ratio between the watch industry's wage rate and the sector's own productivity increase. The rate of profit reflects to a certain extend the relation between those magnitudes.

7.1 Localized Learning Process

A more dynamic and more flexible explanation is needed, however, for a satisfactory analysis of the productivity growth in the watch industry. Particularly the substantial rise between 1964 and 1966 — the respective growth rates were 5.0 %, 8.5 % and 12.9 %, as opposed to about 3 % in the previous and following years — call for additional arguments. Assume the sector produces with any linear combination of X' and X''. Over time learning effects raise the efficiency and productivity so that labour per unit of output decreases, although the same input mix is used. Similarly one can think again of the cheapening of machines, a better utilisation of the existing capacity, etc. Managerial and organizational improvements lower all input per unit of output coefficients. The effect of these 'localized learning processes'[10] is the movement of a specific technique of the productivity curve outwards along the initial capital/labour ratio, thus changing the shape of the productivity curve.

These considerations allow the following interpretation of the sector's productivity growth. Up to the mid-sixties productivity growth was mainly carried out by the optimal use of different techniques belonging to technology X. A secular movement from X' to X'' is very likely, bearing in mind both the increase of wages, and the effect of the productivity increases in the machine sector. The interlinkages with the latter certainly had another favourable side effect: Machines of the same type, but produced in different years, change their technological characteristics. These kinds of improvements might be small, but they do increase the productivity of the user. After the labour market got tighter, and the wage pushes were more pronounced, a more efficient use of the existing technique was urged both to accomodate wage increases and to ease the pressure from the decreasing availability of labour. Ongoing — and enforced — localized learning processes counteracted the threatening profit squeeze by increasing labour productivity considerably. I shall argue that the steep gain in productivity in the mid-sixties was largely due to a special effort to improve the technique

[10] David developped his theory in a different context both analytically and historically. I feel, however, that the basic idea behind his learning process is applicable here. For its derivation as a Markov Chain, see *David* (1981), 62 ff.

in use. The effect of localized learning probably did shape the pattern of growth of productivity more than the external economies did (the influence of which is uncertain).

The learning process at a constant basic technology allowed for a while to accomodate both wage and profit demands. The more efficient use of X was certainly a rational response to the new situation. But the sector remained confined in a technique which started to become obsolete. The undertaken efforts to increase productivity were entirely defensive, since the localized learning process could not fundamentally alter the trend of a secular decline of productivity and competitiveness, although it was offset for a while. It is no coincidence that the mid-sixties experienced the first 'concerted action' of the bigger companies to overstep the narrow limits set by the prevailing production structure.

8. Wage Restrainment: Sin or Virtue?

Was it really a virtue of the trade unions to restrain from pressure, or could they have forced the entrepreneurs/managers to innovate? In other words, what would have happened if the immaterial advantages of a decentralized structure had not weighed so heavily in the 'utility function' of the workers, and if they had simply been wage maximizers?

Assume a superior technology Y is known and generally available. For any wage rate, then, the rate of profit earned by producing with technology Y is higher than that one earned by producing with technology X.

Assume r^0 to be the initial general rate of profit, then competition and wage claims would eventually drive back the rate of profit from r^* to r^0. This is exactly the problem tackled above: If these 'transitional profits' were not sufficiently large to make the implementation of Y a more profitable undertaking than the keeping of X, then the change does not occur. However, if workers had been pure 'wage income maximizers', they would have pressed wages up to w'; the entrepreneur/managers would have been forced to implement Y. But this presupposes that the technology was generally known and that the increased wage would have 'paid' for the loss of the immaterial advantages of a small-scale production process. This later point shall not be pursued further; a bargaining model would be necessary to fully analyze the implications of the argument. But even qualitative considerations about the relevance for our case are not possible. We shall just make the point

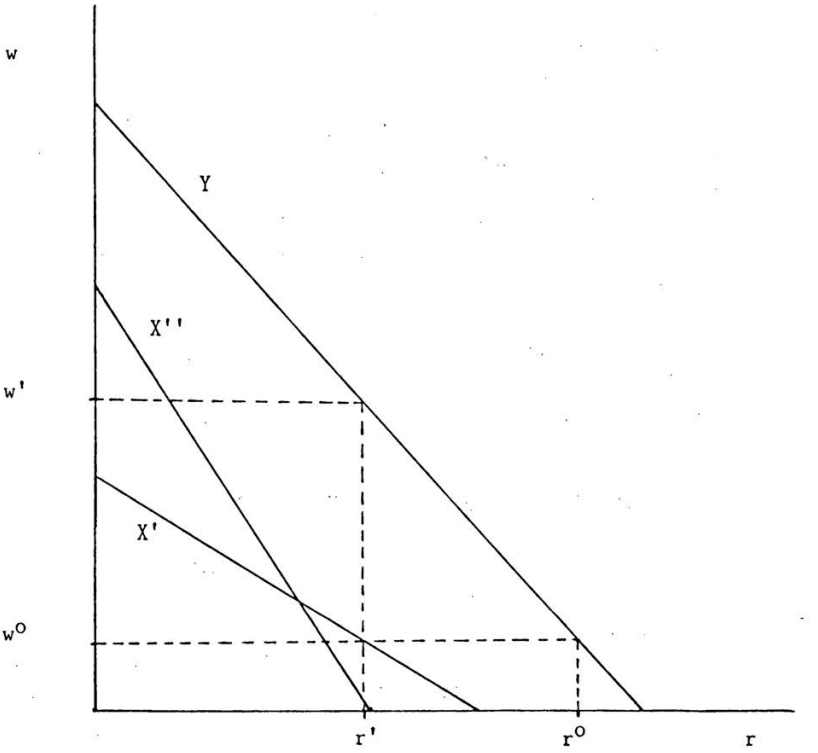

Figure 5

here that if the workers had knowledge of technology Y, and if they had been 'wage maximizers', then they could have induced the adoption of Y by pushing up the wage rate.

The open question is then whether in the case of the Swiss watch industry the knowledge of Y, i.e. the knowledge of the production of LED, LDC, quartz cristals, integrated circuits, etc. was available. Judging from the efforts which were made in the late 'sixties to develop those products we may well conclude that they were not readily available. However, this in itself might be an expression of the self-imposed autarky, as well. The absence of backward linkages did not give the appropriate demand signs which would have directed $R + D$ efforts of the electronic and machine industry towards the development and production of those parts. It is quite astonishing that within a few years those linkages were established either by contracts or by taking over a producer of these parts. But at that time the Swiss watch industry already faced a technological lag.

Summary

The production structure of the watch industry was not exposed to competition. Up to the 'seventies' foreign competitors were not able to challenge the quasi-monopoly position of the Swiss industry. Intra-sectoral competition was minimalized by means of a rigid cartelization. It has been argued that neither the individual entrepreneur nor the workers had sufficient incentives to restore intra-sectoral competition by acting more aggressively. Thus, major transformations which would have been necessary to defend the technological lead against recently arisen foreign competitors were not undertaken. Instead, inflexibilities made a quick response to the technological challenge of the mid-seventies impossible.

Zusammenfassung

Die Produktionsstruktur der Schweizerischen Uhrenindustrie war bis in die frühen siebziger Jahre abgeschottet. Auf den Märkten genoß der Sektor eine Quasi-Monopolstellung, und intrasektorale Konkurrenz wurde durch eine rigide Kartellisierung auf ein Minimum reduziert. Weder der einzelne Unternehmer, noch die Arbeitnehmer hatten ein Interesse diese intrasektorale Konkurrenz durch aggresiveres Handeln herzustellen. Daher blieben tiefgreifende Wandlungen aus. Nur diese aber hätten es dem Sektor ermöglicht, seinen technologischen Vorsprung gegen die junge ausländische Konkurrenz zu halten. Das Versäumnis führte zu Starrheiten, welche eine schnelle Anpassung an die technologische Herausforderung des letzten Jahrzehntes unmöglich machte.

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