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Designing Wartime Economic Controls: Productivity and Firm Dynamics in the Japanese Cotton Spinning Industry, 1937–1939

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Abstract

In 1937, the Japanese government accelerated the expansion of its military expenditure and began to impose controls on the economy to maintain the balance of international payments. The controls were developed through trial and error. The cotton spinning industry was one of the industries most deeply affected by these controls. Initially, the government simply reduced the allocation of foreign exchange for raw cotton imports. However, because this measure prevented the export of cotton products, especially to countries outside the yen bloc, a new scheme of control, the "export–import link system," was adopted from the second half of 1938. This scheme was intentionally designed to give firms incentives to export to non-yen bloc countries and to incorporate elements of market mechanism into economic control. Analyzing firm-level data, we find that under the link system, firms with higher labor productivity tended to grow faster, as occurs under a market economy. This relationship was not observed during the early stage of the control. This difference is reflected in the pattern of the change in aggregate labor productivity. Under the export–import link system, the positive reallocation effect was substantial, similar to a market economy, whereas it was almost zero under the early controls. These findings indicate that the design of controls matters for the performance of controlled economies.

Key words: Economic control, war economy, World War II, productivity, textile industry, Japan

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1. Introduction

There is a large literature on the performance of economies during World War II, which became a topic of interest as soon as the war ended (for a survey, see Harrison 1998, Eloranta et al. 2016, and Eloranta 2019). This literature has revealed how resources were mobilized in major warring countries, how armament production was performed, and how polities and bureaucracies worked for mobilization. In addition, since the 2000s, several articles have studied the microeconomic mechanisms of the war economy. Budrass et al. (2010) revealed that fixed-price contracts for procuring aircraft in Germany gave firms incentives for productivity growth and that the driving forces of productivity growth were learning-by-doing and outsourcing. Again in the German context, Streb (2009) investigated negotiations and renegotiations on contractual forms between procurement agencies and construction firms. In the context of Japan, Okazaki (2011) found that outsourcing was central to expanding aircraft production during the war. Okazaki (2006) explored the role of labor organization in preventing labor disputes and enhancing productivity during the war.

This paper is in the vein of these microeconomic studies on war economies. During wars, governments could impose strong economic controls for the sake of the war effort that would have been unacceptable during peacetime. Such controls had intended and unintended consequences owing to the responses of the private sector. The relationships between government controls and private sector responses are essential for the operation and consequence of wartime economic controls. As we detail below, because wartime economic controls in Japan developed through trial and error, various control schemes were implemented. Comparing these different control schemes and their consequences provides some insights into comparative economic systems.

The focus of this paper is the controls on the cotton spinning industry in Japan during the Second Sino–Japanese War that commenced in July 1937. Just before the war, the Japanese government began to implement direct controls on the economy to maintain the balance of international payments (Hara 1998, 2013; Nakamura 1999; Okazaki and Okuno-Fujiwara 1999). The cotton spinning industry was one of the major targets of the economic controls. Not only was it a major industry in prewar Japan, but cotton yarn was also used for producing cotton fabric, Japan's largest export item in the 1930s (Seki 1954; Abe 1989; Braguinsky et al. 2015, 2021). However, almost all the raw material for cotton spinning, i.e., raw cotton, was imported from non-yen bloc countries. Thus, the cotton spinning industry was strategic for managing the war economy, in terms of both reducing imports and promoting exports.

To preview the main findings of the paper, to cope with the large deficit in the international balance of payments, the government adopted a foreign exchange licensing system in early 1937, and the allocation of foreign exchange for importing raw cotton was restricted. The Japan Cotton Spinners' Association (*Dainihon Boseki Rengoka; Boren* hereafter) began to allocate raw cotton to each member firm according to a certain formula that was decided ex ante. In addition, the government obliged cotton spinning firms to undertake mixed yarn spinning, combining staple fiber with raw cotton to produce yarns for domestic consumption. However, these interventions reduced exports of cotton products, especially to non-yen bloc countries. Consequently, in the middle of 1938, the government adopted a new scheme for controlling the cotton industry, referred to as the "export–import link system." Under the new scheme, instead of an ex ante allocation, the government allocated raw cotton ex post, based on each firm's export record. Using firm-level panel data, we investigate the relationship between productivity and the growth of production for each spinning firm, and compare the relationships between different control regimes. We find that under the export–import link system, firms with higher labor productivity tended to grow faster, as would occur under a market economy, whereas this relationship was not observed under the earlier controls. Furthermore, this difference is reflected in the patterns of average productivity changes.

The remainder of the paper is organized as follows. Section 2 overviews the transition of the Japanese economy to a controlled economy in the late 1930s. Section 3 describes the structure of the cotton industry, and provides details on the control schemes. In Section 4, we analyze the productivity implications of the control schemes, and Section 5 concludes the paper.

2. Transition to a controlled economy

During the early 1930s, the Japanese economy was recovering from the Great Depression under the careful macroeconomic policy of the Finance Minister Korekiyo Takahashi (Cha 2003). However, in 1936, the landscape of the macroeconomy changed dramatically, when a group of young army officers assassinated Takahashi and several other political and military leaders. The assassinations, known as the February 26 Incident, were suppressed by the army, but they increased its political influence, and both military expenditure and the total government budget began to increase sharply. The government budget for financial year (FY) 1937, drawn at the end of 1936, was 1.51

times larger than that for FY 1936.[1] The announcement of the expansion of the government budget was immediately reflected in prices and the international balance of payments. More precisely, the hike in speculative demand stimulated by the budget expansion led to sharp rises in the wholesale price index and commodity imports from December 1936 and, simultaneously, the government ran a large international balance of payments deficit (Figure 1).

Figure 1

The deficit in the international balance of payments was the trigger for the imposition of economic controls. This process is well documented by Akira Hara (Hara 2013). Hara (2013) stressed the importance of distinguishing yen-bloc and non-yen bloc trades because the former did not require foreign exchange. By the middle of the 1930s, Japan had included Kwantung state and Manchuria in the yen bloc; after the outbreak of the Second Sino–Japanese War, the yen bloc expanded to the northern part of China occupied by the Japanese army. Figure 2 illustrates the trade balance by currency bloc, based on the data from Hara (2013). While the trade balance with the yen bloc continued to record surpluses, that with the non-yen bloc continuously recorded deficits, with the deficit increasing sharply in the first quarter of 1937.

Figure 2

The deficit in the balance of payments with the non-yen bloc led to pressure for depreciation of the yen, although the exchange rate with the pound sterling had been maintained at around 2 shillings and 2 pence from the middle of 1933. One policy option for the Japanese government was to allow a yen depreciation to adjust the balance of payments. However, the government did not choose this option because it feared the acceleration of domestic inflation and an increase in the prices of imported munition goods (Asahi Shinbun-sha 1938). Thus, in January 1937, the government began to

[1] Between FYs 1936 and 1937, the general account budget increased from 2,318 million yen to 3,489 million yen, and the budget for the Ministries of Army and Navy increased from 1,062 million yen to 1,819 million yen. It is notable that the budget had been stable from FY 1933 to FY 1936 under Takahashi's policy. See Ministry of Finance, "*Meiji Shonendo-iko Ippan Kaikei Sainyu Saishutsu Yosan Kessan*" (Revenue and Expenditure of the General Account from the First FY of the Meiji Era) (https://www.mof.go.jp/policy/budget/reference/statistics/data.htm).

control imports through the licensing system for foreign exchange.[2] Under this system, a firm or an individual should have foreign exchange allocation ex ante from the Ministry of Finance to undertake a foreign exchange transaction of 30,000 yen or more in a month. When the government launched this system, the Ministry of Finance stated that it would be a temporary measure for six months to halt speculative imports. However, the expiry date was extended in May 1937 because the deficit in the international balance of payments was expected to continue for years (Asahi Shinbun-sha 1939).

It is notable that the events detailed above occurred before the outbreak of the Second Sino–Japanese War on July 7, 1937. Thus, direct economic controls commenced before the war because of the deficit in the international balance of payments, which was caused by the increase in the government budget (Hara 1998, 2013). When the war broke out, the government expanded economic controls. There was a significant reduction in the threshold at which foreign exchange licenses were required; the previous threshold of 30,000 yen per month was lowered to 2,000 yen per month in July 1937, and then to 100 yen in December 1937 (Asahi Shinbun-sha 1939). In addition, two laws were enacted in September 1937, the Temporary Measures Act on Exports and Imports (*Yushutsu-nyu-hin-to Rinji Sochi Ho*) and the Temporary Act for Fund Adjustment (*Rinji Shikin Chosei Ho*). Despite their titles, both laws remained in place until the end of the Pacific War. The first act gave the government broad authority to control production, distribution, and consumption of commodities related to exports and imports, while the second act enabled the government to control loans from long-term funds, fund-raising from the capital market, and the foundation and merger of firms. As we will detail, the Temporary Measures Act on Exports and Imports was used extensively to control the cotton industry.

In January 1938, the government—specifically the Planning Board *(Kikaku-in)*, which was founded in October 1937—drew up the Material Mobilization Plan for 1938. This plan aimed to adjust demand and supply of each of the commodities essential to the war economy. It was continuously drawn up and implemented until the end of the Pacific War. In determining the basic structure of the Material Mobilization Plan, the Planning Board anticipated the supply of each commodity and then allocated supplies between the army, the navy, the civil ministries, and the private sector. The allocation to the private sector was divided by use, i.e., production capacity expansion, exports, and

[2] When the licensing system commenced, the Ministry of Finance informed the relevant officials from the foreign exchange banks that "As maintaining the foreign exchange rate is an important national policy, we expect your cooperation" (Asahi Shinbun-sha 1939, p. 161).

other uses. The structure of the plan implied that it was inevitable that controls on production, distribution, and consumption of commodities would be introduced in implementing the plan (Nakamura and Hara 1970; Okazaki and Okuno-Fujiwara 1999; Hara 2013).

The key variable for the Material Mobilization Plan was "import capacity," i.e., the amount of foreign exchange available for importing commodities in the period covered by the plan,[3] which, in turn, was based on the anticipation of exports in that period. The plan decided in January 1938 for the rest of that year was based on the import capacity of 3,057 million yen, but this assumption was revealed to be too optimistic as the situation evolved. In June 1938, the Planning Board revised the import capacity down to 2,665 million yen (Table 1). This revision reduced the scale of the Material Mobilization Plan, which in turn made it necessary for the government to strengthen controls on production, distribution, and consumption (Hara 2013).

Table 1

3. Controls on the cotton industry

3.1 Controls in the early stage

The cotton industry had special importance within the system of economic controls that commenced in early 1937, because raw cotton was the largest item imported from the non-yen bloc in terms of value. In 1936, raw cotton accounted for as much as 30.7% of the imports from the non-yen bloc (Figure 3). Hence, the government focused on raw cotton as a target for import restrictions when it launched the foreign exchange licensing system.

Figure 3

Raw cotton was a basic input for the cotton spinning industry, and the product of the cotton spinning industry, i.e., cotton yarn, was a basic input for the cotton weaving industry. Both cotton spinning and cotton weaving were major industries in prewar Japan,[4] each with their own distinctive structures. The cotton spinning industry was

[3] During the Pacific War period, when normal international trade ceased, the marine shipping capacity became the key variable instead of the import capacity (Nakamura 1999; Yamazaki 2016).

[4] In 1936, the cotton spinning and cotton weaving industries accounted for 8.1% and 4.9%, respectively, of the production value of the manufacturing industry (Ministry of International Trade and Industry 1961).

composed of a limited number of large firms. In the latter half of 1936, there were 71 cotton spinning firms, and the average number of workers per firm was 2,102.[5] It is notable that these firms were organized into a strong industrial association, *Boren*, which was founded in the late nineteenth century, and repeatedly initiated coordinated output cuts to cope with declines in demand (Shoji 1930; Takamura 1971; Braguinsky et al. 2021).

The cotton weaving industry had a dual structure, as shown in Table 2. First, many cotton spinning firms operated weaving plants; on average, these plants employed 355 workers in the latter half of 1936. Second, there were numerous small and medium-sized firms that specialized in weaving. There are no data on the number of these nonintegrated firms, but they had as many as 46,804 plants in 1936, with an average of just four workers employed at each plant (Table 2).[6] These nonintegrated firms were organized into regional industry cooperatives; the regional industry cooperatives were organized into a nationwide association in 1928, the Japan Export Cotton Industry Cooperative Association (*Nihon Yushutsu Men'orimono Kogyo Rengokai; Menkoren* hereafter) (Japan Cotton and Staple Fiber Weaving Industry Association, 1958). In endeavoring to control the cotton industry, the government was required to work in the context of these structures and organizations.

Table 2

At the end of 1936, when it was preparing for the foreign exchange licensing system, the government made inquiries with *Boren* and the Raw Cotton Traders Association (*Menka Dogyo-kai*) concerning the estimated demand for raw cotton in 1937. The associations advised that they would need at least 14 million piculs of raw cotton, which was around 92.4% of the raw cotton imported in 1936 (Asahi Shinbun-sha 1939, pp. 283–284). Based on this information, in January 1937, the government announced that raw cotton imports of 14 million piculs would be approved for 1937. However, in just the first half of 1937, 12 million piculs were imported and, when the Sino–Japanese War broke out, new licensing of foreign exchange allocations to war cotton stopped (ibid, p. 285).

The shortage of raw cotton was addressed by a coordinated output cut initiated by *Boren*. Since 1930, *Boren* had coordinated output cuts by suspending spindles evenly

[5] Japan Spinners' Association, *Menshi Boseki Jijo Sankosho* (Handbook of Cotton Spinning), the latter half of the 1936 issue, pp. 25–26.
[6] We note that some of the nonintegrated firms were large. For example, Obitani Shoten had 3,708 looms, and Nakashichi Momen had 1,624 looms in 1936 (Abe 1989, pp. 182–183).

across member firms to cope with excess capacity due to demand shortages. The suspension rate was set at 27.4% from November 1936 (Matsubara, 1937, part 2, pp. 69–80). In September 1937, *Boren* decided to raise the suspension rate to 32.4% from October. This was the first output cut in response to supply-side rather than demand-side constraints in the history of *Boren* (*Geppo*, 540, October 1937, p. 70; Asahi Shinbun-sha 1938, pp. 290–291).

However, owing to an increase in output per spindle, this measure did not yield a substantial reduction of output and raw cotton consumption. Hence, the government took a more direct measure to reduce raw cotton consumption in November 1937, instructing *Boren* to reduce monthly cotton yarn production to 275,000 bales (49,940 tons),[7] when average monthly production had been 361,000 bales in 1936. From January 1938, the monthly production limit was reduced to 270,000 bales (Asahi Shinbun-sha 1939, pp. 290–291; Minobe 1939a, pp. 57–58; Seki 1954, p. 446).

Following the introduction of this policy, *Boren* started a new scheme to reduce production and raw cotton consumption. Rather than setting suspension rate of spindles, *Boren* allocated raw cotton to each member firm, given the total cotton yarn production and raw cotton consumption decided by the government. The allocation scheme was as follows (Imamura 1938, p. 10).[8]

a. Calculate each firm's base cotton yarn output per day and number of spindles based on output from October 1936 to September 1937, and the number of spindles for the month's production allocation authorized by *Boren*, respectively.
b. Calculate each firm's base cotton yarn output by multiplying (a) by its authorized number of spindles.
c. Calculate each firm's base output share in the total of all firms' base cotton outputs.
d. Allocate raw cotton to each firm according to (c).

Boren authorized the number of spindles that could be operated by each member firm in each month. The authorized number of spindles of a firm was calculated by [the number of installed spindles × the operation rate × (the number of days in each month − 4)], where the operation rate was determined by the type of firm and the period in which each spindle was installed. For smaller firms, and firms that consumed all the yarn that

[7] A bale (*kori* in Japanese) is a quantity unit of cotton yarn, equal to 400 lbs (181.60 kg).
[8] *Boren*, "*Menshi seisan chosetsu kitei shiko saisoku*" (Detailed enforcement rule of cotton yarn production adjustment regulation), November 24, 1937 (*Dainihon Boseki Rengokai Geppo*, 543, pp. 97–98).

they produced in weaving themselves, higher operation rates were applied. For spindles installed in recent years, lower operation rates were applied.[9]

According to this system, the cotton yarn production of each firm was determined basically by the number of spindles it had installed. Hence, *Boren* simultaneously regulated the installation of spindles. The formula by which *Boren* calculated the operation rate was a disincentive to increase spindles, especially for larger firms, but *Boren* also directly regulated the installation of new spindles. It determined an upper bound for each firm's increase in spindles from the level at the end of 1936. These upper bounds were as follows: firms with less than 100,000 spindles could increase spindles by up to 30% or 20,000 spindles (the lower limit applies); for firms with less than 200,000 spindles, the corresponding limits were 20% or 30,000 spindles (the lower limit applies); for those with less than 500,000 spindles, the limits were 15% or 40,000 (the lower limit applies), and for firms with 500,000 spindles or more, 8% or 50,000 spindles (the lower limit applies).[10]

Corresponding to these measures by *Boren*, the government prepared the organizational and legal framework for controlling the cotton industry. In October 1937, it announced the Outline of the Plan for Adjustment of the Cotton Industry (*Mengyo Chosei Keikaku Taiko*) (Asahi Shinbun-sha 1939, p. 282; Matsubara 1937, part 2, p. 191). Then, in January 1938, the Council for Cotton Industry Adjustment (*Mengyo Chosei Kaigi*) and the Council for Cotton Yarn Consumption Control (*Menshi Shohi Tosei Kyogikai*) were established, with members comprising high-ranking government officials and representatives of related cotton industry associations (Minobe 1939b, pp. 224–226). The control system, described below, was based on the Outline and the discussions at these councils.

First, to save raw cotton, from February 1938, spinning firms were obliged to produce yarn involving a mix of at least 30% staple fiber and other raw materials with raw cotton, except in the case of yarns for export and yarns for export products (fabrics). The corresponding requirement for weaving firms (integrated and nonintegrated) was using at least 33% of staple fiber yarn to produce fabrics, except for fabrics for export. Thus, from February 1938, the Japanese people could no longer purchase all-cotton products (Asahi Shinbun-sha, 1938, p. 304; Minobe 1939b, p. 177, p. 211).

Second, controls on the distribution of cotton yarn were enforced in March 1938. To enforce the first measure, a voucher system was implemented, so that all-cotton yarn

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[9]See *Boren*, *"Menshi seisan chosetsu kitei shiko saisoku*," op cit.

[10] *Boren*, "*Meishi seisan choseki kaisei kitei*" (Revised regulation of cotton yarn production adjustment regulation), November 24, 1937 (*Dainihon Bseki Rengokai Geppo*, 543, pp. 96–97).

could be distributed only to the firm to which it was allocated for export products (Japan Cotton and Staple Fiber Weaving Industry Association 1958, p. 23). The distribution control scheme involved the following elements.

a. The Council for Cotton Industry Adjustment determined the quantity of cotton yarn production for export and for domestic consumption (mixed with staple fiber) in each month, three months in advance.[11] Exports in this context referred to exports to the non-yen bloc (exports to the yen bloc were treated as domestic consumption), and included the export of cotton yarn and the consumption of cotton yarn for export products.
b. The distribution of cotton yarn for domestic consumption was determined for each weaving firm based on the quantity each firm purchased in the latter half of 1936 and the first half of 1937.
c. The distribution of cotton yarn for export products in each month was announced three months in advance, and categorized according to self-consumption by integrated firms and consumption by nonintegrated weaving firms.

To enforce this distribution scheme, the government legislated the Cotton Yarn Distribution Control Rule (*Menshi Haikyu Tosei Kisoku*), based on the Temporary Measures Act on Exports and Imports, and *Menkoren* took charge of the practical issues of the distribution controls. In particular, *Menkoren* investigated the past records concerning the cotton yarn consumption of each member firm, and issued vouchers for cotton yarn distribution.

Third, the licensing system for installation of textile equipment was implemented in February 1938 (Minobe 1939b, p. 211), and fourth, official prices were set on cotton yarn in May 1938 (ibid, p. 227, pp. 301–302).

Table 3 indicates the impact of the series of controls on the supply and demand of cotton yarn at the aggregate level. After a speculative increase in the first half of 1937, raw cotton imports declined sharply with the commencement of the foreign exchange licensing system. The decline in the raw cotton imports and the imposition of the related government controls are reflected in the cotton yarn production from the first half of 1938. In the prewar period, most cotton yarn was used domestically to produce cotton fabric, and spinning firms with integrated weaving divisions accounted for around 27% of this domestic consumption. In the first half of 1938 when the controls on cotton yarn distribution were implemented, consumption of cotton yarn by both

[11] Production of cotton yarn is classified into four categories by yarn counts.

integrated and nonintegrated weaving firms declined. In addition, reflecting the regulation requiring mixing cotton and staple fiber to produce yarn for domestic use, which was imposed from February 1938, raw material for spinning changed (Figure 4). Thus, part of the decline in consumption of raw cotton was the result of spinning firms beginning to use staple fiber for producing yarn.

Cotton fabric production declined in the first half of 1938 (Table 5). Remarkably, during these six months, exports to the non-yen bloc declined sharply and exports to the yen bloc increased contrary to the government's intentions. This was because exports to the yen bloc were more profitable because of higher inflation in that area (Minobe 1939b, p. 419).

Table 3, Table 4, Figure 4, Table 5

3.2 The export–import link system

The decline in cotton fabric exports in the first half of 1938 impelled the government to reform its control scheme for the cotton industry. The revision of the Material Mobilization Plan in June 1938, noted above, further motivated the reform (Minobe 1939, p. 311, p. 320; Komatsu 1938, pp. 28–33)[12]. Thus, in July 1938, to promote the export of cotton products but suppress their domestic consumption, a new control system, the export–import link system, was implemented (Minobe 1939b, p. 443, pp. 500–503). It involved the following features.

a. Instead of receiving a foreign exchange allocation for raw cotton through *Boren* ex ante, each spinning firm received foreign exchange directly from the government according to its export record ex post.
b. The amount of foreign exchange allocation was calculated according to the standard quantity of raw cotton inputs to produce cotton yarn, the standard quantity of cotton yarn inputs to produce cotton fabric, and the standard prices for raw cotton.
c. Each spinning firm was responsible for exporting the cotton yarn it produced.
d. To fulfill responsibility (c), each spinning firm was required to export cotton yarn directly in the form of yarn, produce cotton fabric itself to export, or have certain subcontracting weaving firms produce cotton fabric to export. The

[12] Planning Board (*Kikakuin*) "*Hoten Taisaku Kyoka no Teido to Kore ga Eikyo Narabini Jikkojo Koryo wo Yosuru Jiko*" (Extent of Strengthening the Compensation Measure, Its Effects, and the Issues to Be Considered in Its Implementation), June 25, 1938 (see Nakamura and Hara 1970).

subcontracting weaving firms were required to be registered with the government. In addition, it was specified that weaving firms should not be subcontractors to plural spinning firms to avoid mixing yarn with other spinning firms.

e. At the commencement of the scheme, the government allocated spinning firms a certain quantity of raw cotton in advance as a pump-priming device.[13]

This new scheme was distinctive in the following three respects. First, it removed the ex ante allocation of raw cotton import. Under the new scheme, the allocation of raw cotton was determined solely by each spinning firm's export record. Moreover, each firm's exports were not regulated by the government or *Boren* (point (a) above). Second, nonintegrated weaving firms could continue to produce cotton fabric only by being registered subcontractors of spinning firms (point (c) above). This was essential because the function of the link system hinged on whether the government could trace the whole process from raw cotton imports to cotton product exports. According to the scheme, spinning firms organized weaving firms as their subcontractors. By December 1939, 56 of the 75 spinning firms had organized 2,407 weaving firms as subcontractors (Japan Cotton Spinner's Association, 1940, pp. 32, 96).

The system's designer, Yoji Minobe, then head of the textile industry section of the Ministry of Commerce and Industry, described the implications of the link system as follows (Minobe 1939b, p. 60, author's translation):

> The individual link system[14] aims at making firms demonstrate their ability freely. Under this system, constraints such as production allotments by cartels or industrial associations are abolished as much as possible, and by the free competition and the survival of the fittest, the abilities of excellent firms are fully utilized. Thus, those firms with excellent equipment and technology or with high effort level, will have the chance to fully operate their equipment, and thereby a decline in the export price of the products and [an] increase in international competitiveness will be achieved. This is the advantage of this system.

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[13] The quantity of raw cotton allocated in advance was 77,180 tons, which was around 9.3% of the raw cotton imports in 1937 (Japan Cotton and Staple Fiber Weaving Industry Cooperative Association and Japan Cotton and Staple Fiber Weaving Industry Association, 1958), p. 25.

[14] The "individual link system" linked foreign exchange allocations to each firm with their export records, as was the case for the cotton industry. Conversely, a "group link system", which was applied to rayon products, linked foreign exchange allocations to the export records of a group of firms (Minobe 1939b, p. 62).

As Minobe clearly stated, the essential characteristic of the link system was the incorporation of competition and motivation into the control system. It was intentionally designed to enhance the efficiency of the industry and promote exports to the non-yen bloc countries.

The implementation of this system had a substantial impact on the cotton industry at the aggregate level from the second half of 1938. In the cotton spinning sector (see Table 4), first, imports of raw cotton increased, although only slightly. Second, exports of cotton yarn to the non-yen bloc increased sharply. Third, domestic consumption of cotton yarn declined significantly. This was largely achieved through a reduction in the consumption of nonintegrated weaving firms. The weaving sector was also affected (see Table 5). Corresponding to the change in the allocation of cotton yarn, the production of cotton fabric by nonintegrated firms declined sharply. The most remarkable change in the weaving sector occurred in the allocation of cotton fabric. In summary, the government's aims in establishing the link system were achieved, as domestic consumption and exports to the yen bloc declined substantially, while exports to the non-yen bloc increased.

4. Productivity implication of the controls

In this section, we investigate the implications of the government controls for the productivity of the cotton industry. We focus on the cotton spinning sector because comprehensive firm-level data are available for this sector.

From the late nineteenth century, *Boren* collected comprehensive monthly data on the inputs and outputs of the cotton spinning industry at the firm level, and published the data in the *Monthly Bulletin of Boren* (*Dainihon Boseki Rengokai Geppo; Geppo* hereafter) in a table titled "*Zenkoku boseki-gaisha eigyo jikkyo ichiranhyo*" (Monthly returns of the millowners of the Japan Cotton Spinners' Association) (Braguinsky et al. 2015, 2021). The data are valuable because, in addition to physical inputs and outputs, they include information on daily wages by gender, working days per month, working hours per day, and the quality of cotton yarn, specifically the yarn count (fineness), which enables us to measure the physical productivity of each firm precisely. Unfortunately, this additional information was not provided in *Geppo* from 1926. However, we found that *Boren* continued to collect these data and recorded them in tables for internal use (*Beppyo* hereafter).[15] Using *Beppyo*, we construct firm-level

[15] *Beppyo* for 1926–1934 are held at the library of Osaka University. For *Beppyo* for 1935–1939, please contact the author.

semiannual panel data for the period 1932–1939. The first year, 1932, was just after the Great Depression, while the last year, 1939, was just before the World War II substantially affected the international trade. In converting monthly data to semiannual data, we sum the data on outputs, inputs, and working days, and take averages for the data on working hours, daily wages, and yarn counts.[16] The basic statistics of the samples are reported in Table 5.

Table 5

We assume the following Cobb-Douglas production function:

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + \beta_3 \mathrm{COUNT}it + \beta_4 \mathrm{NONCOTTON}it + \gamma_t + \varepsilon_{it}, \quad (1)$$

where y_{it} is the logged value of cotton yarn output, and k_{it} and l_{it} are the logged values of capital and labor inputs, respectively. Capital inputs are measured by the number of operating spindles × working days × working hours per day, and labor inputs are measured by the number of workers × working days × working hours × 1/2. The number of workers is calculated by the number of female workers + the number of male workers × (male wage/female wage). We divided labor inputs by 2 because most firms applied a two-shift working system.[17] γ_t is the half year fixed effect and ε_{it} is the error term. Thus, we measure the inputs of production factors by their flows (Braguinsky et al. 2015). It is well known that the physical productivity of cotton yarn depends on the yarn count (Fujino et al. 1979; Braguinsky et al. 2015), and the larger the count, the finer is the yarn. Therefore, we add the average count of the cotton yarn of firm i in half year t, COUNT_{it}, to equation (1). In addition, because we infer that the difference in the raw material affects the physical productivity, we add the ratio of raw material other than raw cotton, $\mathrm{NONCOTTON}_{it}$.

We estimate equation (1) using ordinary least squares. The estimation results are reported in Table 6. Column (1) presents the results when we do not control for the composition of raw material, whereas column (2) presents the results when we control for it. In both cases, the coefficients of COUNT are significantly negative and the magnitudes are almost the same. The estimated coefficient –0.039 (column (1))

[16] *Beppyo* are missing for June 1935, July 1937, and August 1937. Hence, for the first half of 1935 and the second half of the 1937, we multiplied the sum of the data for the first five (four) months of 1935 (1937) by 1.2 (1.5) to convert to semiannual data.

[17] In cases where working hours per day were less than 11 hours, we considered that the firm applied a one-shift working system.

indicates that to produce the same quantity of yarn but one count higher (finer), the spinning firms should increase capital and labor inputs by 3.98% (1 – exp(–0.039)).

In column (1), the half year dummies for 1938 and 1939, when the distribution controls and the link system were implemented, are consistently negative and statistically significant. In addition, their magnitude is substantial. For instance, the coefficient for the second half of 1939, –0.224, means that, on average, other things being equal, the total factor productivity (TFP) is 20.1% (1 – exp(–0.224)) lower than the reference period, i.e., the first half of 1932. In column (2), the half year dummies for 1938 and 1939 are not significantly different from zero. The coefficient on NONCOTTON is negative and statistically significant; its mean is zero until 1937, and then 0.143. This implies that mixing staple fiber and other raw materials with raw cotton lowered the TFP by 18.1% (1 – exp(–1.359*0.143)) on average. Almost all the negative half year effects after the implementation of the distribution controls and the link system are explained by the change mandated in the raw materials to save foreign exchange.

Table 6

The estimation of the production function above does not capture the change in the weighted average productivity due to the change in the composition of production by firms. However, the government regulated the allocation of raw cotton, and thereby the allocation of production, from January 1937, and it attempted to incorporate an element of market competition through the export–import link system from July 1938. The regulation and the reform of the regulation scheme may affect the firm dynamics and there may be a composition effect on productivity change. To explore this possibility, we first estimate the relationship between each firm's production growth and its productivity in a previous period.

One productivity measure is the TFP of a firm, adjusted for count and raw material effects, as follows:

$$TFP_{it} = y_{it} - \widehat{\beta_0} - \widehat{\beta_1}\, k_{it} - \hat{\beta}_2 l_{it} - \hat{\beta}_3 COUNT_{it} - \hat{\beta}_4 NONCOTTON_{it}. \qquad (2)$$

Another measure is labor productivity (LP). To adjust LP for count and raw material effects, we first remove these two effects from production:

$$ady_{it} = y_{it} - \hat{\beta}_3\ (COUNT_{it} - 20) - \hat{\beta}_4\ NONCOTTON_{it}, \qquad (3)$$

$$LP_{it} = \exp(ady_{it})/\exp(l_{it}). \quad (4)$$

In equation (3), we adjust production of various counts to production of 20 count yarn, which was the standard count in prewar Japan (Fujino et al. 1979; Braguinsky et al. 2015). Then, we estimate

$$(ady_{it} - ady_{it-1}) = \delta_0 + \delta_1 X_{it} + \delta_2 ady_{it-1} - \delta_3 MERGER_{it} + \delta_4 EXIT_{it} + \zeta_t + \varepsilon_{it}, \quad (5)$$

where X_{it} is a productivity measure (TFP_{it} or LP_{it}). MERGER and EXIT are the dummy variables that equal one if firm i experienced a merger or exit, respectively, in half year t, and zero otherwise. We expect that the production growth of a firm that experienced a merger (exit) in a certain half year would be higher (lower) than otherwise.

The estimation results are reported in Table 7. From January 1932 to December 1936 (Period 1), the cotton spinning industry essentially operated under a market mechanism. For both TFP and LP, the coefficients on ady_{it-1} are negative and statistically significant, reflecting the reversal to the mean. The coefficients on MERGER and EXIT have the expected signs, but some are not statistically significant. Although the coefficient on TFP is not significantly different from zero, the coefficient on LP is positive and statistically significant. The positive impact of LP on production growth suggests that a firm with lower labor costs could increase its market share through competition.[18] The reason for the insignificant coefficient on TFP may be that capital cost was not relevant to firms' short-term decisions on production.

From January 1937 to June 1938 (Period 2), the allocation of raw cotton to each firm was determined by the government and *Boren* according to the established ex ante formula. In this period, the coefficient on LP became negative and statistically significant, which implies that under the system of direct control by the government, the production share of a firm no longer depended on its labor cost, as it did in the market economy. This is not surprising because cotton yarn production was almost completely associated with the input of raw materials,[19] and the allocation of raw cotton was determined by the government and *Boren* mechanically according to the ex ante formula, independent of market competition.

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[18] *Boren* continued to cut output from February 1930, but Boren regulated just the number of business days per month and the ratio of operating spindles to installed spindles (Matsubara 1936, Part 2, pp. 71–75). Hence, spinning firms could increase production by installing new spindles and enhancing the productivity of spindles and labor.

[19] Regressing the log of yarn production on the log of inputs of raw materials using the data for 1932–1939, we find that the coefficient on inputs is 1.011 and the R-squared is 0.997.

Finally from July 1938 to December 1939 (Period 3) when the export–import link system was implemented, the coefficient on LP became positive and significant again, and its magnitude is as large as it was before the period of government controls. As stated in the previous section, the government intended to incorporate an element of market competition in designing the link system. The regression results in Table 7 indicate that the link system succeeded in emulating the market mechanism at least in the sense that the firms with lower labor costs increased their share of production. Indeed, Kishiwada Boseki, a major spinning firm, stated in its business report for the first half year (author's translation)[20]:

> The individual link system of cotton fabric export, announced at the end of this term, has caused a huge sensation in the cotton industry, because it fundamentally transforms the existing system of the cotton industry. As far as export of cotton fabric is concerned, the link system brings back free competition in the past, and the future of the industry has changed again to be uncertain.

Table 7

Next, given the findings on the pattern of production growth, we evaluate its implications for aggregate productivity using the decomposition formulas of Baily et al. (1992) and Foster et al. (2001), as follows:[21]

within effect	$\Sigma_{i\in S}\,\theta_{it-1}\,LP_{i,t}-LP_{i,t-1}$,
between effect	$\Sigma_{i\in S}\,(\theta_{it}-\theta_{it-1})-(LP_{it-1}-LP_{t-1})$,
covariance effect	$\Sigma_{i\in S}\,(\theta_{it}-\theta_{it-1})\times(LP_{it-1}-LP_{t-1})$,
exit effect	$\Sigma_{i\in X}\,\theta_{it-1}\,(LP_{t-1}-LP_{it-1})$,
entry effect	$\Sigma_{i\in N}\,\theta_{it}\,(LP_{it}-LP_{t-1})$,

where S, X, and N are the sets of firms that survived, exited, and entered in each period, respectively, and θ_{it} is the production share of firm i in half year t. The within effect is the portion of the aggregate labor productivity change due to the labor productivity change of each firm, weighted by its initial share. The between effect is the portion of the aggregate labor productivity change due to the change in the production share of

[20] Kishiwada Boseki Co., *Eigyo Hokoku-sho (Business Report)*, first half year of 1938.
[21] Okazaki (2014) applied this formula to the labor productivity of the coal mining industry in wartime Japan.

each firm, weighted by the initial deviation of each firm's labor productivity from the industry average. The covariance effect is the interaction of the above two effects. The exit (entry) effect is the portion of the aggregate labor productivity change due to the labor productivity difference between exiting (entering) firms and the industry average in half year t–1. Between, covariance, exit, and entry effects are related to the change in the composition of production by firm. In this sense, the sum of the four effects can be regarded as a composition effect or reallocation effect.

Table 8 reports the decomposition result, where the figures are converted to the per year change to make them comparable between periods. From Period 1 to Period 2, the total labor productivity growth declined from 0.019 to 0.012. It is remarkable that almost all of this decline is attributable to reallocation or the composition effect. That is, whereas the effect of each firm's productivity growth (the within effect) was almost the same between Periods 1 and 2, the effect related to the change in the shares of firms is substantially smaller in Period 2 than in Period 1. The decline in the reallocation effect in Period 2 is consistent with the finding on the relationship between labor productivity and production growth. In Period 3, labor productivity growth recovered to the level in Period 1, and this increase was driven by the reallocation effect. This is consistent with the result on the relationship between labor productivity and production growth. Combining the results in this section, we can conclude that the link system contributed to productivity growth recovering from the control period by incorporating the elements and functions of a market mechanism.

Table 8

5. Conclusion

In Japan, government controls on the economy commenced in 1937, when the government accelerated its expansion of military expenditure. The controls developed through trial and error. The cotton spinning industry was one of the industries most deeply affected by these controls. At first, the government simply reduced the allocation of foreign exchange for raw cotton imports. However, because this measure prevented the export of cotton products, especially to non-yen bloc countries, a new scheme of control, the export–import link system, was adopted. This scheme was intentionally designed to give firms incentives to export to non-yen bloc countries. Analyzing firm-level panel data, we find that under the link system, firms with higher labor productivity tended to grow faster, as they would under a market economy, whereas this relationship was not observed under the early stages of the control scheme. This

difference is reflected in the pattern of the change in the aggregate labor productivity. Under the link system, the positive reallocation effect was substantial, in line with a market economy, whereas it was almost zero under the early controls. These findings suggest that the design of controls matters for the performance of controlled economies.

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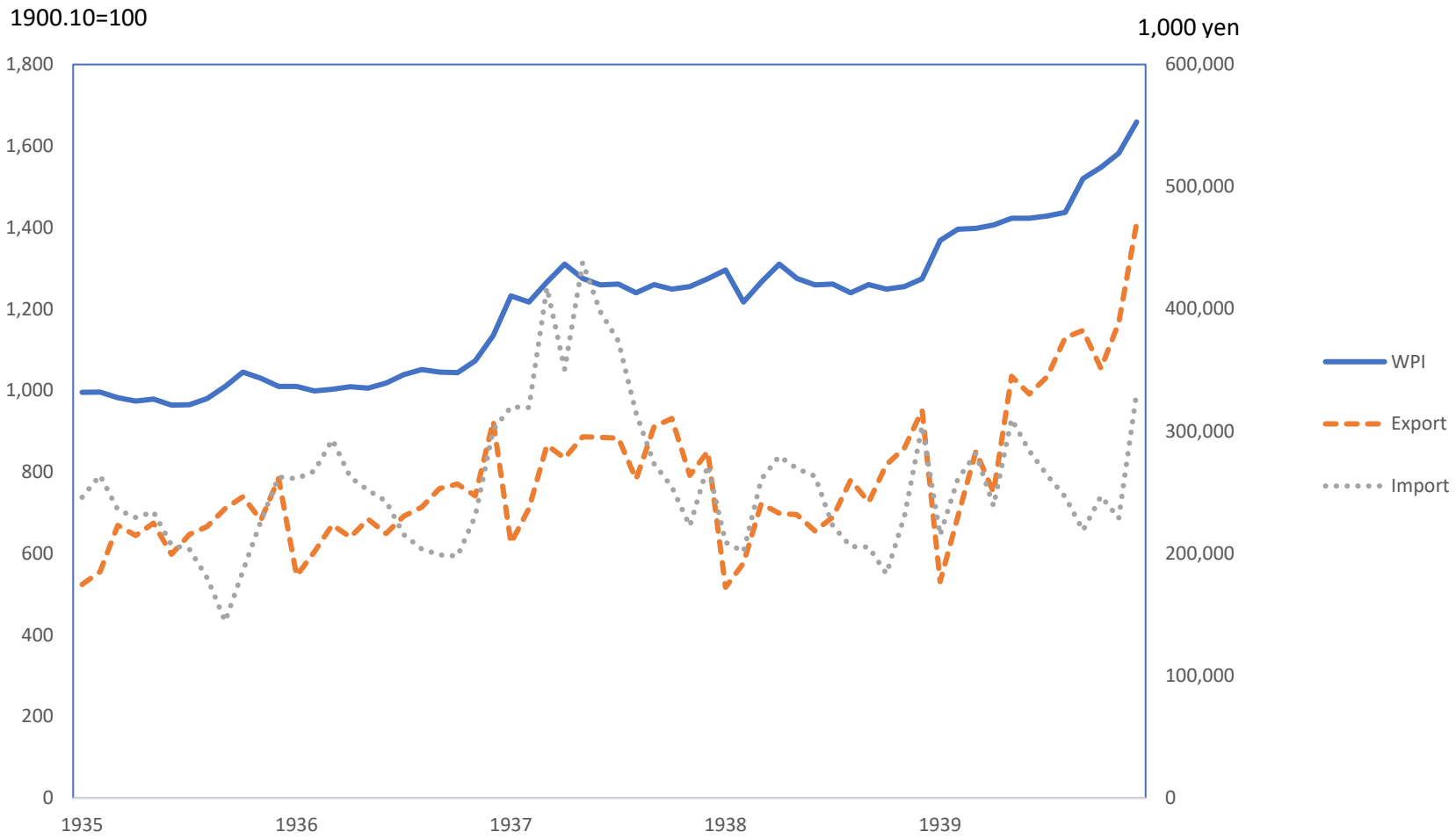
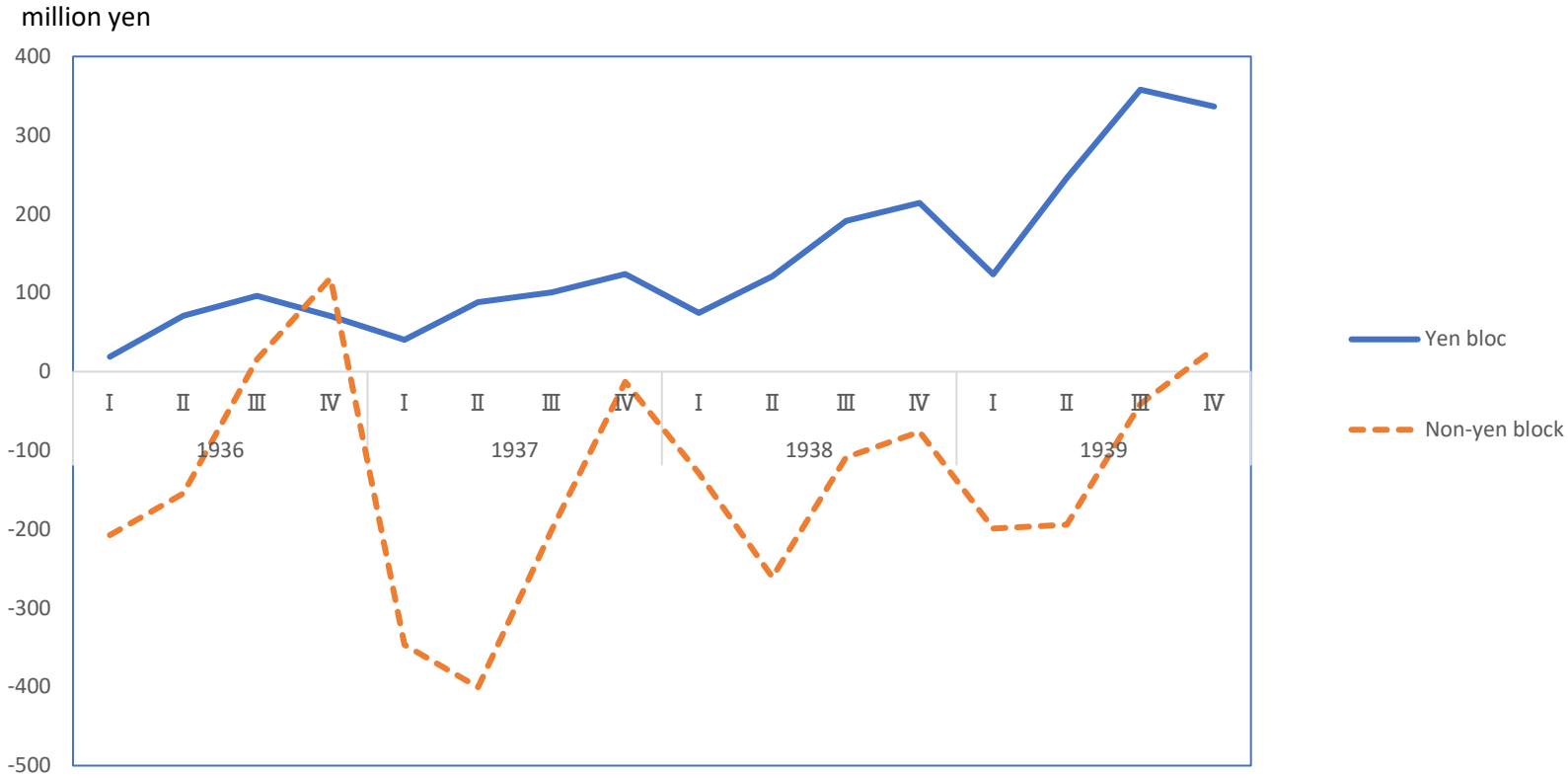
Figure 1 Inflation and international balance of payments in Japan



Source: Bank of Japan (1964); Ministry of Finance, *Kin'yu Jiko Sanko-sho (Handbook on Fonancial Issues)* , various issues.

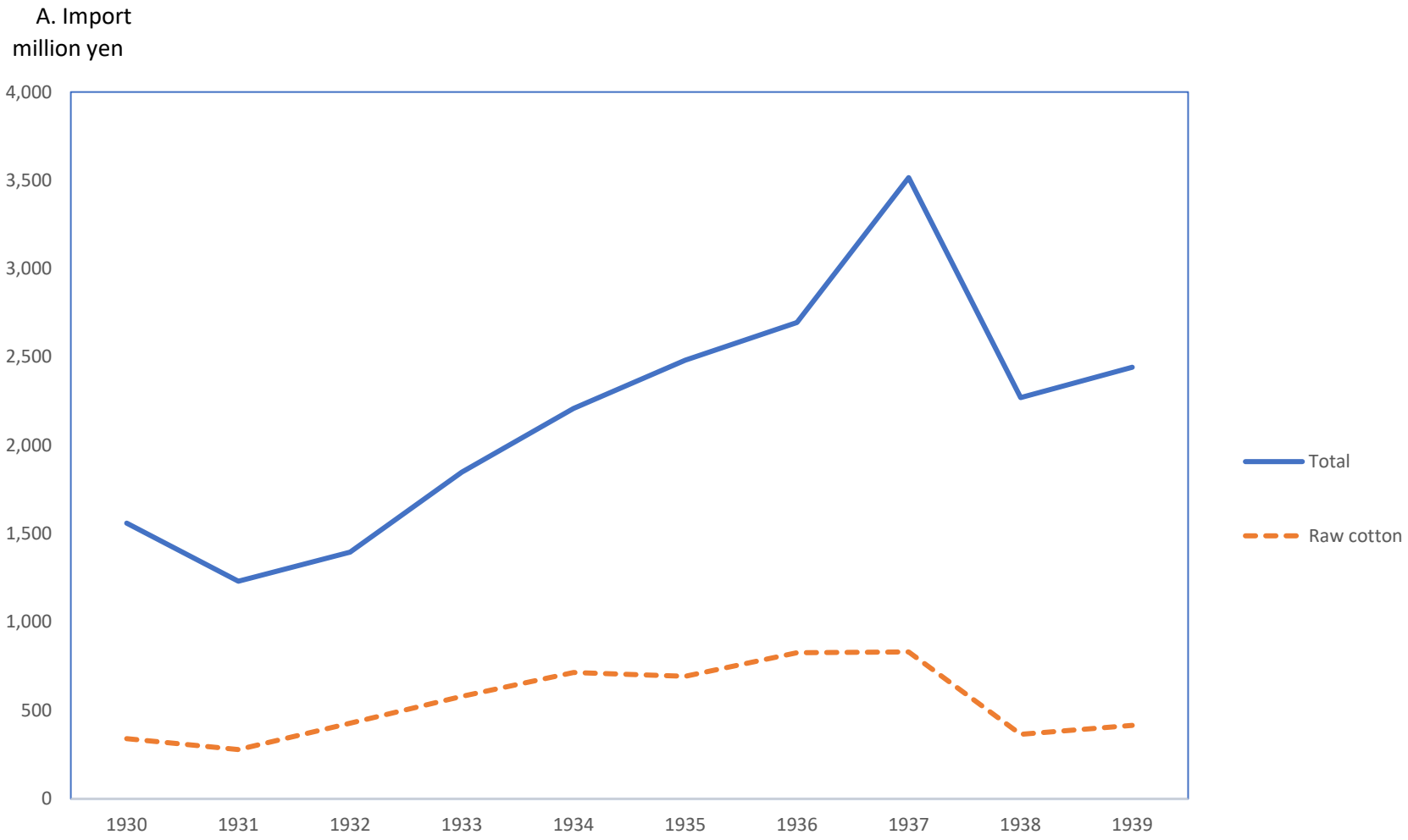
Figure 2 Balance of payments by currency bloc



Source: Hara (2013), p.210. Original sources are the Ministry of Finance, Nihon Gaikoku Boeki Shihanki Hyo (Quarterky Table of International Trades of Japan) and Ministry of Finance, Nihon Gaikoku Boeki Geppyo (Monthly Table of International Trades of Japan).

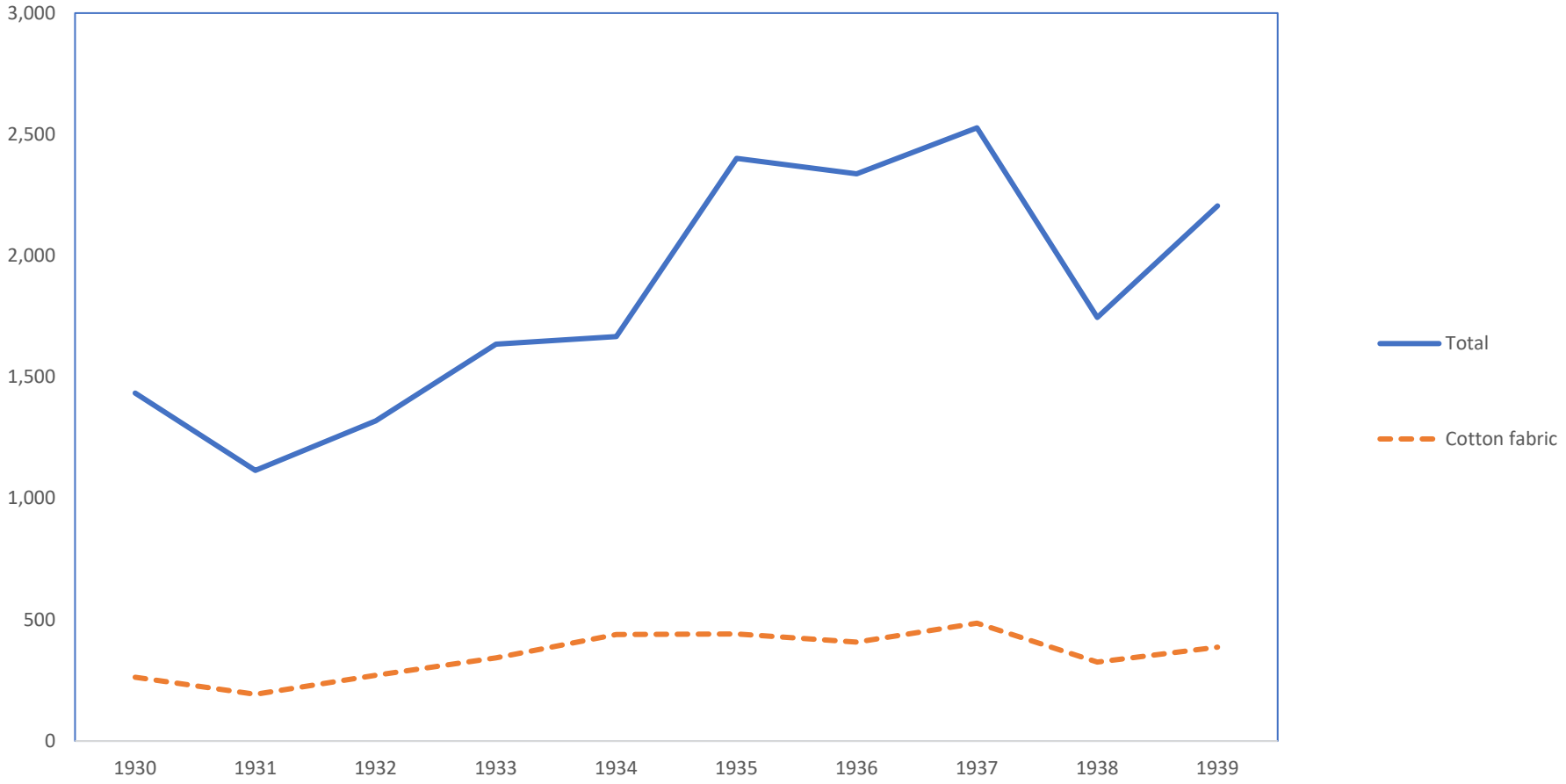
Note: Yen bloc included Kwantung state and Manchuria until 1937, and Kwantung state, Manchuria and China from 1938.

Figure 3 Trade with non-Yen bloc



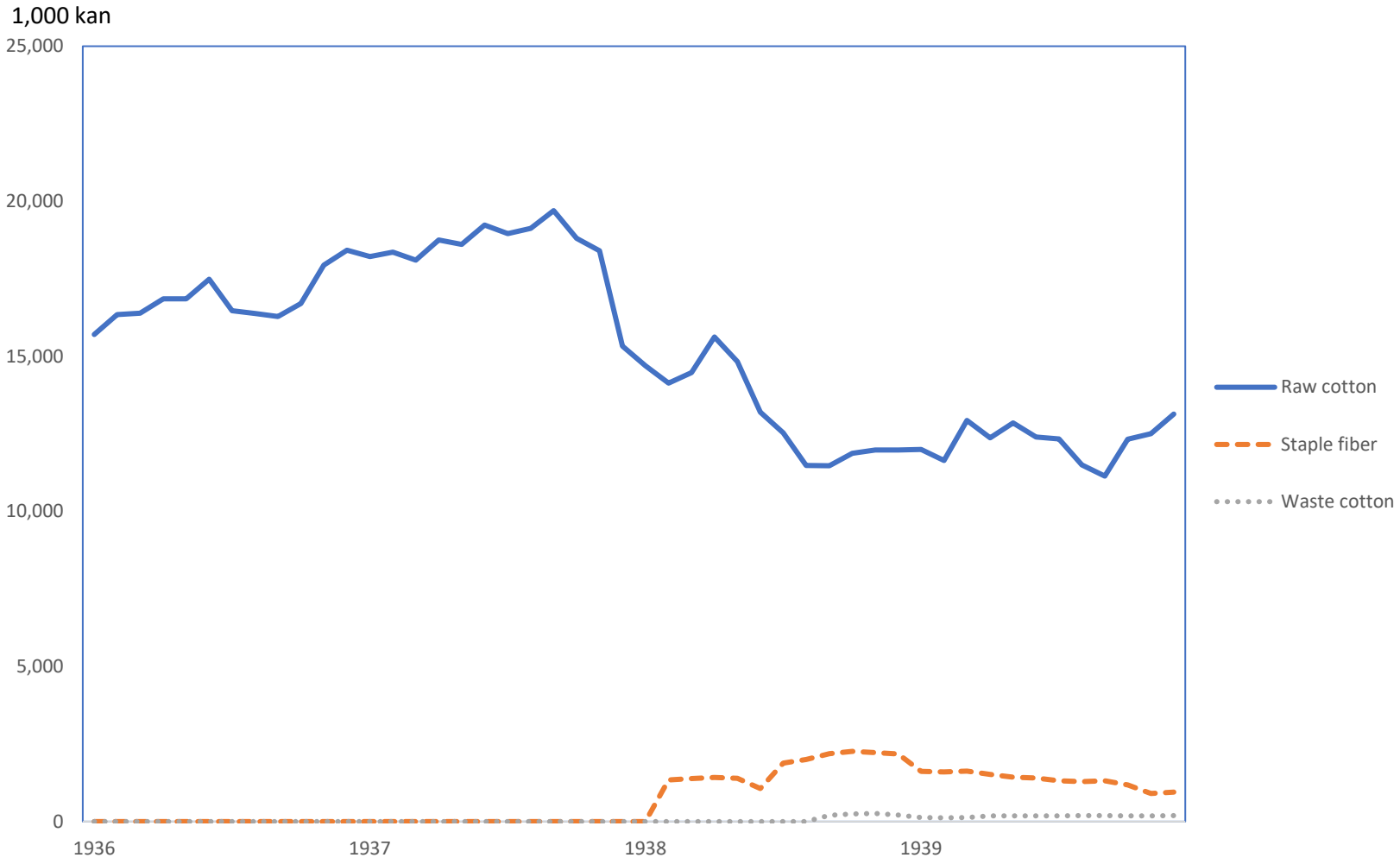
B. Export

million yen



Source: Toyo Keizai Shinpo-sha (1991), pp.178-181; Japan Spinners' Association, Menshi Boseki Jijo Sankosho (Handbook of the Cotton Spinning Industry), various issues.

Figure 4 Consumption of raw materials for spinning



Source: Boren, Menshi Boseki Jijo Sankosho (Handbook of Cotton Spinning), various issues.
Note: "kan" is a unit of quantity, equals to 3.75 kg.

Table 1 "Import capacity" for the Material Mobilization Plan

Period covered	Month decided	Import capacity		
		Total	Raw cotton	
		Million yen	Million yen	(%)
1938.1-12	Jan. 1938	3,057	586	(19.2)
1938.1-12	June 1938	2,665	425	(15.9)
1939.1-3	Dec. 1938	2,231	366	(16.4)
1939.4-1940.3	May 1939	2,395	364	(15.2)

Nakamura and Hara eds. (1970), p.1xvii, 291,316,345 and 396.

Note: The original figures for 1939.1-3 are multiplied by four to be converted to annual data.
The figures in parentheses are the parcentage of the import capacity allocated to import of raw cotton.

Table 2 Structure of cotton weaving industry in Japan as of 1936

		Integrated firms	Nonintegrated firms
Number of firms		45	n.a.
Number of plants		111	46,804
Production	million square yard	2,203	4,357
Weaving machine	loom	86,745	306,196
Workers	person	39,395	200,486
Workers per plant	person	354.9	4.3
Production per plant	million square yard	19.847	0.093
Production per worker	million square yard	0.056	0.022

Source: Japan Cotton Spinners' Association, Menshi Boseki Jijo Sankosho (Handbook of the Spinning industry) , the first half and the second half issues of 1936; Ministry of Commerce and Industry (1937).

Notes: Ministry of Commerce and Industry (1937) covers all the plants of non-integrated and integrated firms in Japan. We obtained the data on non-integrated firms by subtracting the data on integrated firms from the total.

Table 3 Supply and demand of cotton yarn in Japan

1,000 kg

	Supply			Demand						
	Production	(Import of raw cotton)	Import	Export			Domestic consumption			
				Total	Yen bloc	Non-yen bloc	Total	Self-consumption by integrated spinning firms	Others	Subcontractors of spinning firms
1936	324,270	507,447	1,205	10,839	2,760	8,079	314,636	86,458	228,178	-
	330,267	407,383	1,417	9,214	2,188	7,026	322,470	88,013	234,458	-
1937	362,162	604,000	1,326	10,017	1,954	8,063	353,471	93,811	259,661	-
	357,465	221,895	772	13,521	3,822	9,699	344,716	90,962	253,754	-
1938	234,726	265,608	267	7,676	2,457	5,219	227,317	70,996	156,322	-
	228,263	297,039	121	11,423	46	11,377	216,961	73,021	143,940	58,429
1939	238,890	292,629	3	17,494	281	17,213	221,399	80,912	140,486	88,161
	233,904	312,976	142	20,381	4,361	16,019	213,665	74,520	139,146	85,429

Source: Boren, *Menshi Boseki Jijo Sankosho (Handbook of Cotton Spinning)*, various issues.

Note: Cotton yarn in this table includes the yarn with raw cotton and staple fiber.

Table 4 Supply and damand of cotton fabric

Yen

	Supply				Demand			
	Production			Import	Export			Domestic consumption
	Total	Integrated firm	Nonintegrated weaving firm		Total	Yen bloc	Non-yen bloc	
1936	410,703	155,289	255,414	608	229,417	32,648	196,769	181,894
	454,296	166,157	288,139	376	254,174	42,906	211,269	200,498
1937	523,952	203,785	320,167	459	269,454	42,336	227,117	254,957
	514,816	205,687	309,129	334	303,611	46,957	256,654	211,539
1938	386,256	142,123	244,133	208	220,554	71,108	149,446	165,910
	273,405	127,885	145,521	28	183,685	8,202	175,482	89,749
1939	292,822	135,166	157,656	4	182,893	6,803	176,090	109,932
	278,637	126,446	152,191	45	221,053	10,869	210,184	57,628

Source: Japan Cotton Weaving Industry Cooperatives Association, Menkoren Tokei Geppo (Statistical Monthly Bulletin of Japan Cotton Weaving Industry Cooperatives Association), March 1939 issue, p.96 and March 1940 issue, p.96; Ministry of Commerce and Industry, Menorimono oyobi Kinuorimono Nenpyo (Annual Statistics on Cotton and Silk Fabrics), pp.2-3, Japan Spinners' Association, Menshi Boseki Jijo Sankosho (Handbook of Cotton Spinning), various issues.

Note: Production of integrated firms is obtained by converting quantity to value using unit export price.

Table 5 Basic statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
y	1,090	13.104	1.462	6.555	16.564
k	1,090	18.570	1.459	12.024	21.959
l	1,090	14.162	1.258	8.897	17.430
COUNT	1,090	25.232	9.878	5.200	78.800
NONCOTTON	1,090	0.041	0.088	0.000	0.855
working days	1,090	152.494	20.793	14.000	239.000
working hours	1,090	16.320	1.871	8.300	17.100
male wage	1,090	1.415	0.271	0.850	2.710
female wage	1,090	0.791	0.127	0.500	2.600
number of operating spindles	1,090	114,881.700	196,434.100	425.000	1,289,762.000

Table 6 Estimation results of the production function

	(1)		(2)	
Dependent variable: y_{it}				
k_{it}	0.899	(0.054) ***	0.825	(0.052) ***
l_{it}	0.144	(0.056) ***	0.213	(0.053) ***
$COUNT_{it}$	-0.039	(0.003) ***	-0.038	(0.002) ***
$NONCOTTON_{it}$			-1.395	(0.273) ***
Half year dummies				
1932 II	-0.022	(0.009) **	-0.019	(0.009) ***
1933 I	-0.004	(0.010)	0.001	(0.010)
1933 II	-0.011	(0.012)	-0.005	(0.012)
1934 I	0.008	(0.013)	0.014	(0.013)
1934 II	-0.022	(0.017)	-0.017	(0.017)
1935 I	-0.033	(0.014) **	-0.027	(0.014) *
1935 II	-0.048	(0.017) ***	-0.044	(0.016) **
1936 I	0.023	(0.021)	0.027	(0.021)
1936 II	-0.032	(0.029)	-0.028	(0.028)
1937 I	0.018	(0.019)	0.024	(0.019)
1937 II	-0.004	(0.031)	0.000	(0.031)
1938 I	-0.109	(0.031) ***	0.004	(0.045)
1938 II	-0.200	(0.029) ***	0.052	(0.060)
1939 I	-0.179	(0.032) ***	0.035	(0.049)
1939 II	-0.224	(0.030) ***	-0.045	(0.041)
const.	-4.583	(0.281)	-4.217	(0.283)
R^2	0.983		0.983	
Obs.	1,090		1,090	

Note: 1932 II , 1933 I , etc. are the half year dummies. 1932 II is the dummy for second half of 1932, while 1933 I is the dummy for the first half of 1933, for example.
Standard errors clustered at firm are in parentheses.
*** Statistically significant at 1% level.
** Statistically significant at 5% level.
* Statistically significant at 10% level.

Table 7 Relationship between productivity and production growth

	(1)		(2)		(3)	
Period	1932 I -1936 II (Period 1)		1937 I -1938 II (Period 2)		1938 I -1939 II (Period 3)	
Dependent variable: ady_{it}-ady_{it-1}						
TFP_{it-1}	-0.035	(0.202)	-0.786	(0.351) **	-0.426	(0.278)
ady_{it-1}	-0.077	(0.027) ***	-0.057	(0.031) *	-0.029	(0.025)
MERGER			0.164	(0.061) ***	0.278	(0.122) **
EXIT			-0.249	(0.065) ***	-0.738	(0.508)
const.	1.066	(0.366) ***	0.93	(0.439) **	0.410	(0.366)
R^2	0.159		0.378		0.227	
Obs.	559		204		226	
	(4)		(5)		(6)	
Period	1932 I -1936 II (Period 1)		1937 I -1938 II (Period 2)		1938 I -1939 II (Period 3)	
Dependent variable: ady_{it}-ady_{it-1}						
LP_{it-1}	0.282	(0.125) **	-0.388	(0.147) ***	0.333	(0.074) ***
ady_{it-1}	-0.087	(0.026) ***	-0.053	(0.048)	-0.064	(0.030) **
MERGER	0.102	(0.079)	0.213	(0.103) **	0.246	(0.124) **
EXIT	-0.337	(0.184) *	-0.200	(0.051) ***	-0.708	(0.526)
const.	1.078	(0.342) ***	1.085	(0.715)	0.703	(0.439)
R^2	0.174		0.180		0.195	
Obs.	559		204		226	

Note: 1932 I and 1936 II are the first half of 1932 and the second half of 1936, respectively, for example.

Table 8 Decomposition of labor productivity change

	Total	Within	Reallocation				
			Total	Between	Covariance	Exit	Entry
1932 I -1936 II (Period 1)	0.019	0.012	0.007	0.001	0.000	0.000	0.007
	(100.0)	(65.0)	(34.9)	(2.7)	(-1.5)	(-1.4)	(35.1)
1937 I -1938 I (Period 2)	0.012	0.012	0.000	-0.003	0.003	0.002	-0.001
	(100.0)	(98.4)	(1.6)	(-27.1)	(22.7)	(12.7)	(-6.8)
1938 II -1939 II (Period 3)	0.019	0.008	0.011	0.003	0.008	0.000	0.000
	(100.0)	(42.1)	(57.6)	(14.7)	(43.5)	(-0.7)	(0.0)

Note: Change in the labor productivity per one year.
Percentage in parentheses.