

Brazilian agriculture before the Targets Plan: the functionality of agrarian reform during the constrained industrialization period

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Abstract

This article reviews the economic structure of Brazilian agriculture during the years of constrained industrialization, by providing a descriptive analysis of the sector's main economic data. It reconsiders the debate of the 1950s and 1960s on the roles played by agriculture in national economic development; and it shows that the growth of agricultural production in Brazil was hindered by the deterioration of the terms of trade between agriculture and agribusiness, which was also associated with miserly rural wages. These factors rendered agricultural modernization relatively disadvantageous in Brazil, which raises questions as to the functionality of agrarian reform in those years.

Keywords

Agriculture, agricultural development, industrialization, agrarian reform, agricultural innovations, agricultural mechanization, agricultural productivity, rural employment, Brazil

JEL classification

N56, O13, Q16

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I. Introduction¹

In the 1950s and 1960s, it was widely believed that the production structure of Brazilian agriculture was a hindrance to national economic development. According to this approach — disseminated in particular by Celso Furtado (1966), Caio Prado Junior (1963) and many others— the structure of Brazilian agriculture prevented the supply of agricultural products to the cities from keeping pace with the demand generated by the national economy's rapid industrialization and urbanization process.

According to this view, agriculture was not generating sufficient savings to invest in the industrial machinery and equipment needed to advance the industrialization of the national economy, or for the agriculture sector itself to purchase machinery, equipment and consumer goods from the expanding industrial sector. Lastly, the fact that agriculture created few jobs fuelled migration from rural to urban areas, which eroded the standard of living in the cities and restricted the consumer market for agricultural products. This generated a vicious circle of stagnation and economic underdevelopment in Brazil (Furtado, 1966).

Based on these structural problems in agriculture during the national economic development process, authors such as Ruy Miller Paiva (1965) identified four functions that the agriculture sector ought to fulfil in the industrialization process, as shown in table 1.

Table 1
Brazil: the four roles of agriculture in economic development

1	Provision of food and raw materials for industry
2	Generation of savings (profits and foreign exchange) for industry
3	Purchase of machinery, equipment and consumer goods from industry
4	Transfer of rural workers to industry

Source: Prepared by the author on the basis of R. M. Paiva, "Reflexões sobre as tendências da produção, da produtividade e dos preços do setor agrícola do Brasil", *Revista Brasileira de Economia*, No. 20, Rio de Janeiro, July–September 1965.

Authors associated with the widest variety of theoretical approaches at the time believed that the obstacles that agriculture was placing in the way of development made agrarian reform crucial, both to ensure the continuity of the national industrialization process and also for the modernization of agriculture itself. Land reform could increase agricultural output to supply the urban sector and provide savings for industry. It could also raise both rural and urban wages and fuel an expansion of the market for agricultural machinery and equipment.

Overall, the developmental effects of agrarian reform could be expected to boost agricultural output and productivity. It could thus eliminate the obstacles to development imposed by the structure of agriculture, and provide an incentive for agricultural modernization.

Despite the traction gained by this approach in Brazil in the 1950s and 1960s, it was not peculiar to this country, but featured in the debates and writings of various authors both in Latin America and around the world. Examples include Mariátegui (1928) in Peru, Prebisch (1963) at the Economic

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Commission for Latin America and the Caribbean (ECLAC), the initiative of the Kennedy administration in the United States through the Alliance for Progress, and also the experiences of implementing agrarian reform in Cuba, Mexico and Peru.

This Brazilian and Latin American approach would receive a great deal of criticism, including from authors such as Antônio Barros de Castro (1969), and Fernando Henrique Cardoso and Enzo Faletto (1977). In general, the critics viewed the concentration of income and land as fostering agricultural development and modernization, by making it possible to accumulate the savings needed for investment in agricultural and industrial machinery and equipment (Castro, 1969). At the same time, the links and production chains of the agribusiness “complex”, producing agricultural machinery and equipment, have a large multiplier effect on rural and urban business investment (Cardoso and Faletto, 1977).

Because of these virtues, it was considered that investment in agricultural modernization could generate its own effective demand, even though income and the agrarian structure would become even more concentrated. As a result of these critiques, the 1950s approach — which viewed Brazilian agriculture as dysfunctional for national development — became intellectually and politically ostracized. It was viewed as merely an illustration of part of the dreams, utopias and illusions of a specific epoch in Brazilian and world economic history.

More recently, Castro’s (1969) theoretical critique of Furtado’s (1966) thinking has been confirmed empirically by authors such as Delgado (1985), Leite and Palmeira (1998), Bacha (2003), Szmrecsányi (1986) and Graziano (1987), among many others. Moreover, authors such as Delgado (1985), Leite and Palmeira (1998) and Bacha (2003) studied the functionality (or lack thereof) of Brazilian agriculture, by appealing to extra-economic or institutional variables — in particular, the different economic policies adopted throughout the development process.

In contrast, authors such as Szmrecsányi (1986) and Graziano (1987) used the gross value of production (GVP) of agriculture as the unit of analysis, without disaggregating it into prices and quantities. Accordingly, they failed to cross this analytical decomposition with the price elasticity of agricultural supply, which Furtado (1966) considered the main symptom of the structural problems that agriculture posed to the ongoing industrialization process.²

The aim of this article is to test the 1950s approach empirically, on the basis of applied economic theory. Statistical data are used to identify whether or not Brazilian agriculture actually fulfilled its development functions, which, as the other side of the same coin, could justify agrarian reform.

For this purpose, a descriptive analysis is made of economic data on the production structure of Brazilian agriculture during part of the 1940s and 1950s, by analysing the long-term trend of various time series. The article is organized in three sections, including this introduction.

Section II provides an overview of the main macroeconomic variables of the national economy and its industrial structure in those years. In doing so, it also justifies the time frame chosen.

Section III analyses the time series of microeconomic data on the production structure of Brazilian agriculture in the period, to verify whether or not the sector fulfilled its development functions. Lastly, brief conclusions are presented on the empirical test, based on the analysis of the long-term trend of the time series data.

² The analytical decomposition into prices and quantities is also not performed by the total factor productivity (TFP) method, which makes the neoclassical economic assumptions that factors are remunerated according to their productivity and that innovation does not alter the rate of factor substitution.

II. Brazilian agriculture in the period of constrained industrialization

As noted by various authors, until the mid-1950s the Brazilian economy passed through a stage of the industrialization process that Mello (1975) refers to as “constrained industrialization”. Until then, industrialization and the modernization of Brazilian agriculture were limited by the capacity to import machinery and equipment, both for industry and for agriculture. During the constrained industrialization period, capacities to increase industrial and agricultural supply of were both restricted.

In those years, agriculture continued to generate the majority of employment and income in the national economy, alone accounting for almost 60% of these two macroeconomic variables.

During the constrained industrialization period, vigorous industrial growth caused the agricultural share in employment and income to decline. Nonetheless, agricultural output and employment continued to grow in absolute terms, partly stimulated by the industrialization and urbanization process itself.

The preponderance of agriculture in the national economy as a whole was relatively similar to the situation in the different production sectors. In the case of manufacturing, in 1950 the sector still mostly produced basic consumer goods, which accounted for about 70% of industrial output. Nonetheless, as with agriculture in relation to the economy as a whole, the production of consumer goods was losing ground to the capital and intermediate goods industries.

In the case of agriculture specifically, economic historians note that the sector ceased to be based on rigid productive specialization in export monocultures, but started to diversify slightly into polycultures oriented towards serving the expanding domestic consumer goods market. However, Szmercsányi (1986) makes an important observation on the “decline” of export agriculture in the years of constrained industrialization, when he states that it was excessively biased towards coffee growing.

According to data from *Estatísticas do Século XX* published by the Brazilian Institute of Geography and Statistics (IBGE), presented in annex A1 of this article, between 1948 and 1955, coffee and rubber exports declined by 22% and 37%, respectively, in volume terms. In the case of coffee, this reflected the policy of directly controlling its supply.

The same data source notes that, unlike coffee and rubber, the volume of soya and cocoa, among other new export crops, increased by 175% and 247%, respectively. Overall, exports of cotton, rubber, cocoa, cocoa cake, coffee, mate, tobacco, orange juice, soya beans and soya bean meal increased by 123% in volume.

Between 1948 and 1955, a partial recovery of export agriculture was associated with an increase in the production price of these agricultural products, averaging 194% measured in current cruzeiros. While the cocoa crop displayed the smallest price increase, of over 104%, the policy of controlling the supply of coffee raised its price by 330%, according to *Estatísticas do Século XX*.

However, as Brazilian exports were heavily concentrated around the coffee monoculture, the effects of the decrease in output and the reduction of employment in this single crop were propagated to the rest of the national economy. Suffice it to note that, in 1956, according to data presented in Giambiagi (2005), coffee growing alone generated 70% of the Brazilian economy's export earnings.³

³ Delfim Netto (1966) argues that economic policy distorted the efficient allocation of production resources in Brazilian agriculture. In particular, the policy of maintaining the income from coffee and other traditional products kept these crops in a comparatively advantageous position, discouraging initiatives pursuing greater diversification of agricultural exports, such as sisal and soya beans, among others.

In contrast to the relative recovery of the export crop sectors, crops destined for the expanding domestic consumer market behaved very differently. According to IBGE data presented in table 2 below and detailed in annex A1, between 1948 and 1955, the average production volume of a basket of seven crops representative of domestic food consumption grew by just 27%, while that of export crops increased by 112%.⁴

Table 2
Brazil: rate of growth of output and prices of agricultural crops destined for export and for domestic consumption, 1948–1955
(Percentages)

Destination of output	Quantity	Price	Elasticity
Export	112	204	56
Domestic consumption	27	151	38

Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

Table 2 also shows that, between 1948 and 1955, the simple arithmetic mean of the producer prices of these same seven crops destined for Brazilian consumers rose by 151%. Although a significant increase in absolute terms, export crop prices rose by 204%.

In microeconomic theory, the relation between output growth and price increases is synthesized in the price elasticity of supply — a topic on which there are major gaps in agricultural research in the period analysed in this article. The relation between agricultural output growth and price increases summarized in table 2 admits three observations on the price elasticity of supply of agricultural goods in the years of constrained industrialization.

Firstly, agricultural supply as a whole is extremely insensitive to prices. While the price elasticity of supply of export crops was 56%, that of crops for domestic consumption was just 38%. In other words, given the structure of production costs in Brazilian agriculture serving the domestic consumer market, for supply to increase by 38%, food prices had to more than double.

Secondly, the price inelasticity of agricultural supply differed greatly according to the destination of domestic agricultural production, whether for foreign or for Brazilian consumers. Overall, the supply of export crops was almost 50% more price sensitive than crops grown for domestic consumption.

The empirical finding (in the IBGE data) that agricultural supply was highly inelastic gives rise to a third and final comment. This relates specifically to the functionality of agrarian reform during the years of constrained industrialization.

The structural rigidity of agricultural supply was merely a symptom of the fact that the sector's economic structure prevented it from fulfilling its role in industrial development, especially in terms of agricultural modernization. It is important to note that this failure could justify the argument that agrarian reform would stimulate greater agricultural production and productivity, which is essential for industrial development. For example, land reform could result in vast pastures of minimal productivity (generally held as a store of value) being divided into small and medium-sized rural farms, which could contribute to increasing the supply of agricultural products for the rapidly expanding cities. At the same time, agrarian reform was also a way of generating employment at a low capital cost, which would make it possible to contain part of the rural-to-urban migration that was swelling the cities.

⁴ The seven crops grown for domestic consumption are: rice, beans, cassava potatoes, onions, wheat and maize (the latter used as feed for poultry, cattle and pigs). A detailed database on the growth of Brazilian agricultural production and prices between 1948 and 1955 is provided in annex A1 of this article. Bacha (2003) tested the role of agriculture as a provider of food for cities, by analysing the per capita production of a basket of agricultural products. Although the author used a reduced basket, excluding onions and maize (despite directly investigating cattle and poultry), this does not substantially alter the result found here.

Rising prices among agricultural products destined for urban consumers was merely a reflection of the fact that supply was not keeping pace with the expansion of demand. In fact, between 1948 and 1955, the output of these products grew by 27%, while urban employment increased by 40%, according to the data from *Estatísticas do Século XX* presented in annex A2.

Rangel (1962) argues that the imbalance between the supply of and demand for agricultural products was merely the result of the agrarian crisis from which the Brazilian economy was suffering. The agricultural imbalance was caused by the fact that the sector was shedding labour faster than its own output was increasing (cf. Maluf, 1992). Thus, for Rangel (1962), the agricultural imbalance stemmed from an agrarian crisis.

In terms of the development functions of agriculture listed in table 1, this meant that the sector was not fulfilling its role as a supplier of agricultural products to the same extent as it was transferring rural labour to the cities.⁵ The greater importance of one or the other function is unequivocally addressed in the specialized literature on the analysis of agriculture in development. According to Castro (1969), of all the functions of agriculture, maintaining a sufficient supply of food for the urban population was its “minimum” contribution to the industrialization process; and Delfim Netto saw this as agriculture’s “main role”. After all...

agriculture’s inability to fulfil this basic task could generate inflationary pressures that inhibit development. Even if this does not happen, the entire process will be subject to increasing social pressures, since the demand for food is price inelastic... [and] these products constitute an large part of the family budgets of the wage earning class (Delfim Netto, Pastore and Carvalho, 1966, p. 12).

In a concrete example, the imbalance between agricultural supply and demand reached dramatic proportions in the case of wheat, a basic subsistence item for the urban population. Under the multiple exchange rate system then in force, wheat was classified as a priority import, despite being a consumer product. At the same time, since 1944, wheat cultivation had been covered by the *Serviço de Expansão do Trigo* production promotion policy.

In this way, economic policy encouraged an expansion of the domestic supply of wheat, while imports were used to curb the excessive rise in wheat prices. This combination of economic policies made wheat the most rapidly expanding and most price-elastic of all crops destined for Brazilian consumers between 1948 and 1955. Nonetheless, its domestic supply was still insufficient to meet the burgeoning demand for it, as was true of agriculture as a whole.

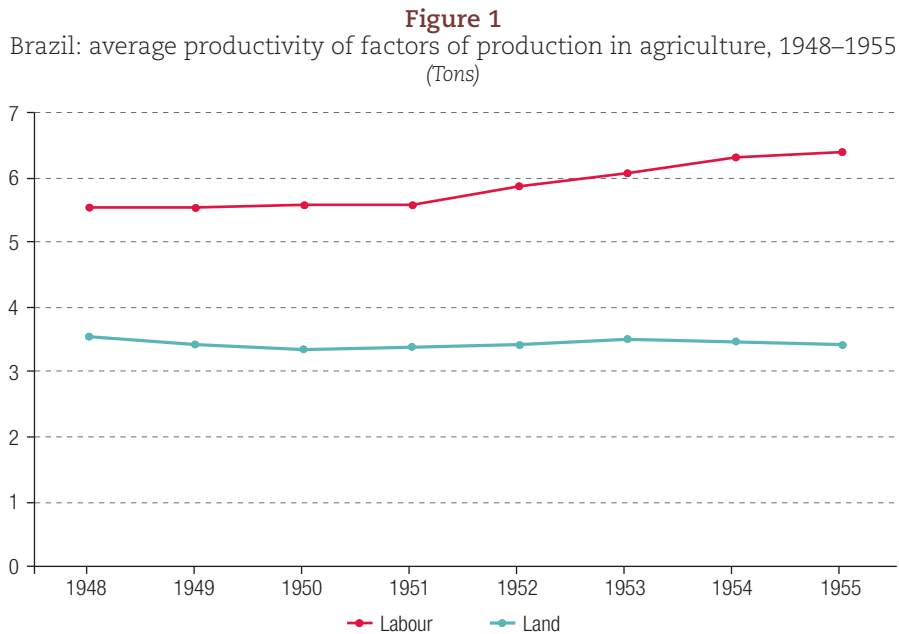
According to *Estatísticas do Século XX*, between 1948 and 1955, wheat production expanded by 172%, that is more than four times as fast as the urban population, which grew by 40% in the same period. As a result, as from 1948, the share of wheat imports in national consumption dropped by 10 percentage points. Nonetheless, in 1955, imports still supplied more than 76% of national wheat consumption, according to calculations based on the same data source.

⁵ Bacha (2003) uses the same IBGE data source, but considers the total increase in population of 22% between 1948 and 1955, rather than just urban population growth of 40% (the difference between urban and total population growth reflects the rural exodus). In other words, this article assumes —as also do countless others, including Graziano (1987)— that agricultural products destined for consumption by the rural population did not pass through the market during the period, so they were not part of the production recorded in IBGE’s research into agricultural GVP. Despite all of these methodological differences, the key aspect worth noting is that Bacha (2003) states clearly that Brazilian agriculture fulfilled its role as a food supplier in 1946–1964, since the production of vegetables, cattle and milk outpaced population growth in those years. This chronological time frame is similar to that of many other authors, including those of the Campinas school, such as Szmrecsányi (1986), who uses the 1920–1970 period. However, meticulous analysis of the data produced by Bacha himself (2003) shows that if one considers the period 1947–1955 in the years of limited industrialization, annual per capita food production was stagnant at around 370 kg per person, or had even dropped to 330 kg per person, that is less than 0.905 kg per day.

Lafer (2002) states that, in the first half of the 1950s, the continued imbalance between wheat production and consumption made this staple food of the urban population one of the top three items on the limited list of imports. The author notes that wheat imports were second only to vehicles (trucks, tractors, and others) and ahead of petroleum.

For Szmrecsányi (1986), the imbalance between agricultural supply and demand could be due to the fact that agricultural output was increased, essentially, by expanding the planted area. This pattern of agricultural output growth entailed extending the agricultural frontier, with only a minor increase in the productivity of rural labour and an even smaller increase in the productivity of cultivated land.

The scant increase in the productivity of agricultural factors of production is illustrated in figure 1; and a detailed database on the sector's production structure is presented in annex A2.



Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

In fact, as shown in figure 1, between 1948 and 1955 the average output per hectare cultivated basically flatlined, with even a slight downward trend, fluctuating around 3.45 tons per year. During the same period, the average output per rural worker increased by over 15%, from 5.5 to 6.4 tons per year.

Using the same data source as in figure 1, between 1948 and 1955 the total cultivated area expanded from 15.6 million to 20.8 million hectares. This is equivalent to an increase of over 34%, closely matching the 35% growth in total agricultural output.

As noted by Graziano (1987), until the late 1950s, nothing changed in agriculture except “what was produced” —for example, with the old coffee plantations being replaced by rice or beans, among other crops. There were very few changes in the way agricultural production was practised (the “how”). Essentially, agriculture continued to be based on adding land and labour. The sector used little capital, and made few technical changes to modernize practices by investing substantially in the use of agricultural machinery and chemical equipment, such as tractors and fertilizers, among other items.

Until the mid-1950s, although the production-side determinants of the expansion of Brazilian agriculture had shifted towards the domestic market, the sector was still linked to the external market in terms of transforming its technical base, since modernization depended on its capacity to import machinery. In other words, the demands of the domestic market gradually controlled the trend of “what” to produce, but not “how” to produce, in other words the instruments of production (Graziano, 1987).

For authors in the Campinas school tradition, such as de Mello (1975), Szmrecsányi (1986), Graziano (1987) and others, the slow pace of agricultural modernization reflected the fact that access to these capital goods in agriculture remained limited by the economy’s import capacity. According to Lago (1979), in the years of constrained industrialization, the volume of capital goods imports was restricted by the scarcity of foreign exchange, despite receiving preferential foreign exchange treatment under the multiple exchange rate system that was in force after 1953.

The 1950 demographic census reported just 8,372 tractors in use in Brazil, equivalent to an average of 1 tractor for every 2,045 hectares of cultivated area.

This indicator of agricultural modernization revealed the extent to which tractor use was confined to very few segments of Brazilian agriculture. The international comparisons, reported for the same year in table 3, show that Argentina had one tractor for every 667 hectares cultivated, while France had one tractor for 232 hectares and the United States had one for every 169 hectares.

Table 3
Brazil and selected countries: hectares cultivated
per tractor in use, 1950

Country	Hectares per tractor
United States	169
France	232
Argentina	667
South Africa	1 820
Brazil	2 045

Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), demographic census 1950; J. Pawlak, “Tractors and harvester threshers in selected countries the second half of the XX century”, Olsztyn, Warmia and Mazury University and I. Cavlak, *Diplomacia, integração e desenvolvimento: Brasil e Argentina (1950–1962)*, Assis, Editora UNESP, 2010.

Measured by this indicator of agricultural modernization, Brazilian agriculture was even lagging behind commercial agriculture in economies such as South Africa, which in 1951 had an average of one tractor in use for every 1,820 hectares under cultivation.⁶ As with the low productivity of rural labour and land, the low density of tractors per hectare cultivated was another clear indicator of the potential existence of a structural obstacle to increased production and productivity in Brazilian agriculture, which discouraged large investments in agricultural machinery and equipment for its modernization.

A possible explanation for this fact could be found in the economic variables that influenced the farmer’s own cultivation decision, which generally involves comparing the price of different crops with the cost of investing in machinery and other equipment.

Between 1948 and 1955, the average price of the simplest tractor model available for Brazilian agriculture, the 42 horsepower Fordson, increased from 33,329 to 220,000 cruzeiros,⁷ in other words by over 560%.

⁶ Another indicator of agricultural modernization is the value of intermediate consumption (mainly of chemical fertilizers) relative to total agricultural GVP (Graziano, 1987).

⁷ The data on tractor prices were taken from Sanders Jr. (1973), which, in turn, was based on data obtained directly from agribusiness from the classic “*Livro vermelho*”: Instituto de Economia Agrícola-IEA. *Desenvolvimento da agricultura paulista*, IEA/SAA, IEA (1972). This data series began in 1953 and was extrapolated to 1950 by Sanders Jr. himself (1973) on the basis of the IEA/SP index of agricultural machinery prices. Lastly, the series was completed up to 1948 on the basis of the wholesale price index-global supply (IPA-OG) of agricultural machinery (see [online] ipeadata.gov.br).

This increase in the price of the tractor far outpaced inflation in the prices of agricultural products for domestic consumption (+151%) in the same period; and it even exceeded the significant increase in agricultural export prices (+194%).

The disadvantage implied by the terms of trade of agriculture relative to agribusiness was seen not only in its trend through time, but also in absolute terms. In 1955, while it cost 220,000 cruzeiros to import a tractor, the simple arithmetic mean price of export crops was close to 22,000 cruzeiros per ton, according to the IBGE data presented in annex A2.

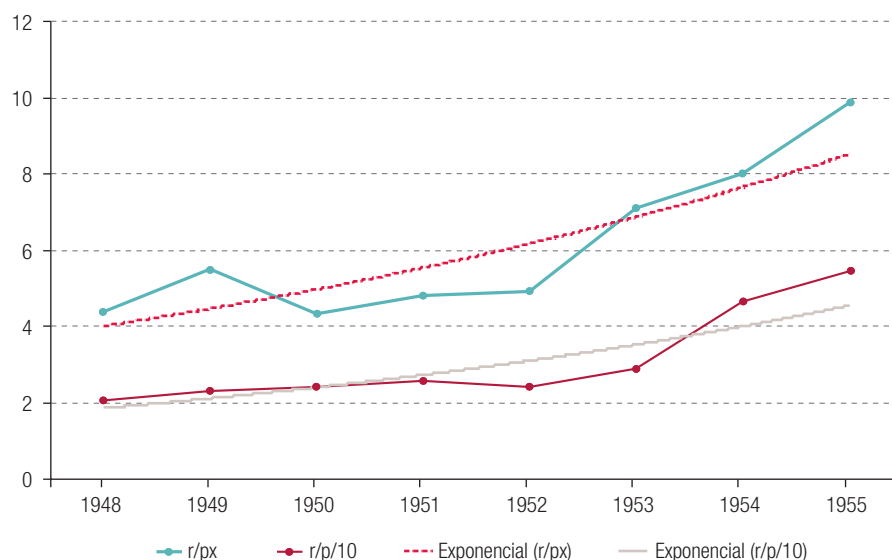
Also according to IBGE, the price was well below 20,000 cruzeiros per ton in the case of other crops, including those typically sold to the Brazilian consumer, such as rice and beans (4,000 and 5,000 cruzeiros, respectively) or cassava, which was priced at a derisory 454 cruzeiros per ton.

Figure 2 compares the agricultural price data summarized above in table 2 with the investment cost of tractor purchase. The figure shows the respective long-term trend lines of the terms of trade of tractor agribusiness (r) with that of export agriculture (px) and agriculture for domestic consumption (p) (the latter is presented in decimal form because of the difference in scale).

Figure 2 reveals a structural deterioration in the terms of trade between agriculture and the tractor agribusiness between 1948 and 1955. In the case of export crops, in 1948 the tractor cost more than four times a ton of product; but by 1955 the ratio had increased to almost 10 times. In the case of crops for domestic consumption, the ratio increased from about 20 to almost 50 times in the same period.

This structural trend of deteriorating terms of trade made agricultural modernization less and less economically advantageous. In terms of the functions of agriculture in national development listed in table 1, this provided empirical verification that the sector was not fulfilling the function of transferring savings (profits and foreign exchange) to the extent necessary for investment in machinery, equipment and consumer goods for industry.

Figure 2
Brazil: terms of trade between agribusiness and agriculture for export and domestic consumption, 1948–1955



Source: Prepared by the author, on the basis of John Sanders Jr. *Mechanization and employment in Brazilian agriculture, 1950–1971*, University of Minnesota, 1973 and Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

Note: Tractor agribusiness (r), export agriculture (px) and agriculture for domestic consumption (p).

Thus, the analysis of whether the terms of trade is advantageous or disadvantageous for agricultural modernization relates to farmer's annual gross income or the revenue required for agricultural modernization. The terms-of-trade comparison provides an explanation grounded in economic theory for the fact that agricultural modernization was confined to half a dozen export crops, since only these crops generated the minimum level of income needed for such an investment.

The reason why agricultural modernization did not spread through Brazilian agriculture as a whole can be explained through analytical modelling based on microeconomic theory in terms of production cost minimization, as set out in economics textbooks such as Varian (1987). Using the microeconomic modelling of Paiva (1965), based on Schultz (1964), it is necessary to analyse not only the demand for agricultural goods, indicated in the structure of the terms of trade between agriculture and agribusiness illustrated in figure 2, but also the supply side, specifically productivity and relative prices of factors of production in agriculture.⁸

The marginal productivity of capital and labour employed in agriculture between 1948 and 1955 is shown in table 4.⁹

Table 4
Brazil: marginal productivity of factors of production
in agriculture, 1948–1955
(Tons per year)

Factor of production	Tons per year
Agricultural tractor (PMgK)	1 048
Rural labour (PMgL)	13
Relative factor productivity (PMgK/PML)	81

Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

Table 4 shows that, between 1948 and 1955, the marginal productivity of the tractor employed in Brazilian agriculture was 1,048 tons of agricultural output per year, while the marginal productivity of the Brazilian rural worker was 13 tons per year.¹⁰

⁸ The Paiva-Schultz model is based on neoclassical economic theory. An external critique of neoclassical assumptions applied in the specific case of Brazilian agriculture is provided in a recent paper by Xavier and Costa (2006). These authors consider that, when deciding what crop to plant, the Brazilian farmer does not make the economic comparison between productivity, prices and rural wages that microeconomic theory manuals preach. Using the post-Keynesian approach, Xavier and Costa (2006) question the assumptions and premises of neoclassical economic theory; namely that there is perfect, or at least symmetric, information on prices, wages and the productivity of agricultural factors of production; and that farmers are totally rational. It should be noted that more recent international economic historiography has also used the production cost differential to explain the British Industrial Revolution by. In addition to cultural, behavioural and institutional factors, Allen (2011) explains the Industrial Revolution in terms of energy abundance and labour scarcity in Britain, as opposed to energy scarcity and labour abundance in China. According to Paiva, instead of considering factors of more general validity, such as education, research and credit, among others, the analysis focuses exclusively on the economic aspect of that transformation, assuming that a farmer's decision to switch from traditional to modern agriculture depends exclusively on the economic possibilities offered by the two processes (Paiva, 1965).

⁹ In the decision to invest in agricultural modernization, the comparison between the cost of the factors of production, capital and labor, in agriculture does not include income from land. This exclusion is justified because it is subtracted from the other factor incomes, in other words it is a *residuum*, as Marshall (1890) puts it. Moreover, Baiardi (1990) notes that the price of land has historically not been taken into account in the decision to invest in Brazil, since agricultural land is used as a store of value (cf. Romeiro, 2001).

¹⁰ Microeconomic theory is based on marginalist logic: the addition of one more factor of production (in this case, a tractor or a rural worker) is considered at the margin, or at the limit, of the need for agricultural production. In this reasoning, the comparison between the price of the tractor and the rural wage does not take into account the rate of depreciation of agricultural machinery. Similarly, the existence or absence of a rural credit market is irrelevant for the calculation, which concerns the current value of the tractor. Lastly, for the same reason, the existence or absence of an insurance and rental market for agricultural machinery —exemplified by General Motors in the United States— has little influence on this decision because it is a long-term investment that follows the trend of the national economy.

Consequently, the productivity of capital in agriculture was 81 times that of labour. This corroborated the obvious fact that the physical productivity of the tractor was much higher than that of labour. Thus, on exclusively technological or agronomic grounds, there would be no reason not to invest in this modern technology that was more than 80 times as productive as the rural worker.

However, the formula of production cost minimization applied to agriculture by the Paiva-Schultz model requires the agronomic comparison between the physical productivity of capital and labour to be compared also with the economic relationship between the cost of investment in the tractor and the cost of rural labour. Between 1948 and 1955, the median annual pay received by temporary rural labourers (“*boia fria*”) employed on some farms in São Paulo¹¹ was a paltry 7.30 cruzeiros, which in 1955 had risen to 21.90 cruzeiros (assuming full rural employment in the 360 days of the fiscal year).¹² Thus, despite being at a miserable level, rural wages rose by 200% between 1948 and 1955.

The tripling of the rural wage in São Paulo in the reference period might give the impression that the agricultural worker’s standard of living was improving, so that the economic disincentive to modernization was diminishing. The rural wage was rising faster than the prices of agricultural products for domestic consumption (+151%) and almost as fast as export prices (+204%), as shown in table 2 above. However, this impression is not corroborated when comparing the rural wage with the price of the tractor, as shown in figure 3.

Two comments can be made with respect to figure 3. Firstly, in 1948 the price of the tractor was equivalent to 4,570 times the rural wage in São Paulo; and by 1955, it had risen to more than 10,000 times. Consequently, in this period, agricultural modernization became relatively twice as disadvantageous in São Paulo and, by extension, in Brazilian agriculture in general.

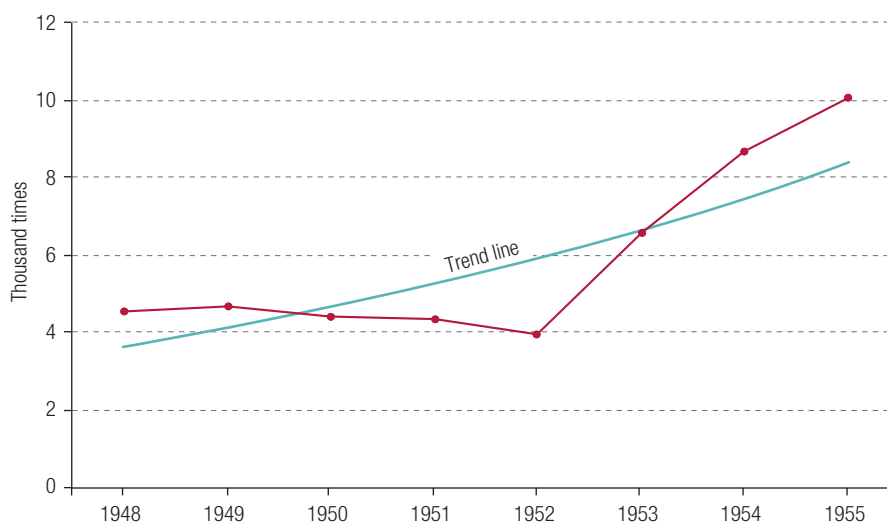
Secondly, and more importantly, the figure also shows the long-term trend line of the relative price of factors of production in São Paulo agriculture and, by extension, across Brazil. This line reveals the clearly deteriorating long-term trend of the ratio between the value of capital and labour in agriculture.¹³

¹¹ The rural wage was measured in annual terms, since the comparison with the price of agricultural products was also made in terms of the annual crop harvest. Data on the rural wage were taken from Bacha (1979), which sourced data from the IEA/SP research conducted by Sendin (1972), who collected the information directly from farm records between 1948 and 1968. With assistance from two DIRA socioeconomic advisors in each Regional Agricultural Division (DIRA) of São Paulo, two agricultural properties were selected that had wage records spanning 1948–1968. The criteria used in this selection were the existence of the data and the confidence of the local agronomist in their reliability (Sendin, 1972). The importance of São Paulo for the national agricultural sector is based on Szmrecsányi (1986). Although small, it can be considered to have a relatively representative sample of wage data for Brazilian agriculture as a whole, especially with respect to agricultural modernization and the issue of land reform in Brazil. If the wage of the São Paulo rural seasonal worker was low, it is perfectly plausible to expect the value of rural labour in the other regions to be even more miserly. Moreover, empirical research by Baiardi (1986, under the guidance of Szmrecsányi himself), finds robust evidence that the trend of rural wages in São Paulo was quite similar to that observed in other agricultural regions of Brazil. Examples include workers employed in rice cropping in the municipality of Campanha (Rio Grande do Sul), sugar cane cultivation in Piracicaba (São Paulo), and cocoa plantation in Cacaueira (Bahia). It is therefore feasible to extend the results obtained for this sample of São Paulo farms to Brazilian agriculture as a whole.

¹² As a comparative example, the median pay of a bricklayer working in the urban civil construction industry in the municipality of Rio de Janeiro —then the Federal District— amounted to 2.89 cruzeiros per month (assuming full urban employment in the 30 days of the accounting month), according to data in Bacha (1979). By contrast, according to IBGE, in 1955, the minimum wage officially set by the government was 2,300.00 cruzeiros (almost 1,000.00 reais in 2016 values). It should also be noted that following its institution in 1940, the minimum wage was only increased in 1943, 1952 and 1954, always in relation to the increase in the urban cost of living, especially reflecting the inflationary pressure derived from the prices of agricultural products for domestic consumption. Owing to the brutal difference between the official minimum wage and other wages such as that of the temporary rural labourer or the bricklayer, Szmrecsányi (1986) considers that the heterogeneity of the Brazilian economy mainly involved an institutional segmentation between workers covered by union and social security legislation, and those who were not; and less in the productivity difference between agriculture and industry, the latter being only a part of the former.

¹³ Although figure 3 displays a small break in the trend in 1952–1953, two clarifications are necessary. Firstly, between 1948 and 1952, it is difficult to speak of an improving trend in relative factor prices, since the trend is more one of stability. Secondly, in a historical comparison of what would happen immediately after the Targets Plan, in the early 1960s there would be a much more accentuated and abrupt structural break than in 1952–1953. For these reasons, the entire 1948–1955 period can be characterized by a structural trend towards a worsening of the relative cost of factors of production in agriculture (illustrated by the long-term line in figure 3), which made agricultural modernization increasingly disadvantageous economically.

Figure 3
Brazil and São Paulo: relative cost of factors of production capital
and labour in agriculture, 1948–1955



Source: Prepared by the author on the basis of John Sanders Jr. *Mechanization and employment in Brazilian agriculture, 1950–1971*, University of Minnesota, 1973 and E. L. Bacha, “Crescimento econômico, salários urbanos e rurais: o caso do Brasil”, *Pesquisa e Planejamento Econômico*, vol. 9, No. 3, Rio de Janeiro, December 1979.

Table 5 summarizes the data on the structure of agricultural production in the period analysed. It highlights the empirical finding in the microeconomic data that the productivity of capital was 81 times that of labour, while the ratio between their prices was over 10,000.

Table 5
Brazil: structure of agricultural production, 1948–1955
(Prices in cruzeiros at current prices)

Microeconomic variable	1948	1955
Farm tractor price (r)	33 328.69	220 000.00
Rural wage (w)	7.30	21.90
Relative factor prices (r/w)	4 566	10 046
Marginal tractor productivity (PMgK)		1 048
Marginal productivity of labour (PMgL)		13
Relative productivity (PMgK/PMgL)		81

Source: Prepared by the author on the basis of John Sanders Jr. *Mechanization and employment in Brazilian agriculture, 1950–1971*, University of Minnesota, 1973; E. L. Bacha, “Crescimento econômico, salários urbanos e rurais: o caso do Brasil”, *Pesquisa e Planejamento Econômico*, vol. 9, No. 3, Rio de Janeiro, December 1979 and Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

In short, the production and productivity gain that could be obtained from the use of an additional tractor in agriculture was easily nullified by its very high cost compared to employing additional rural labour. As a result, the structure of production costs provided no economic incentive for the farmer to invest in agricultural modernization and employ more rural labour-saving technologies, such as tractors and fertilizers.

As a further example, between 1950 and 1955 the marginal productivity of a ton of nitrogen compound fertilizer was 98 tons of agricultural product, according to calculations made from *Estatísticas do Século XX*. In 1955, this type of fertilizer cost approximately 1,300 cruzeiros per ton on average, according to data from *Boletim Mensal da Câmara de Comércio Exterior do Banco do Brasil* (CACEX, 1945–1956). Thus, while the marginal productivity of nitrogen fertilizer was almost 25 times greater than that of rural labour, it was almost 60 times more expensive than the rural wage.

At this point it should be noted that the foregoing calculations, using data produced by government agencies, provide empirical support for the belief of authors in the 1950s and 1960s, such as Furtado (1966) and Prado Jr. (1963), that the economic structure of Brazilian agriculture meant that agricultural modernization was relatively disadvantageous. The dysfunctionality of agriculture in relation to technological development could justify an agrarian reform with a view to modifying its economic structure, particularly the miserly rural wages. This structural change could provide an economic incentive for investment in labour-saving technologies in agriculture, such as the tractor and other agricultural machinery and equipment.

Given the structure of prices, wages and productivity in agriculture, as empirically verified in table 5, it is unsurprising that there was a strong economic incentive to continue increasing agricultural output by expanding the amount of land and rural labour employed. The growth of supply, with scant increase in productivity through investment in machinery and equipment to modernize practices, failed to keep pace with the vigorous expansion of the domestic consumer market for agricultural products, thereby exacerbating scarcity among the urban and rural population.

Owing to the structure of production costs in agriculture, Paiva (1965) found that the economic potential of modern agriculture in Brazil was “small”. Empirically, the author found that modern inputs were very expensive compared to the prices of agricultural products and labour (Paiva, 1965). According to Schultz (1964); it was therefore understandable that the Brazilian farmer considered fertilizer to be unprofitable.

In the 1950s and 1960s, authors such as Furtado (1966), Prado Jr. (1963) and Rangel (1962) related the scant increase in agricultural productivity to Brazil’s highly concentrated agrarian structure. Following the tradition of agrarian authors of the time, Szmrecsányi (1986) links the deepest roots of the miserable value of rural labour — which made agricultural modernization economically disadvantageous — to the structure of land ownership and labour relations in agriculture.

In the case of the agrarian structure, Szmrecsányi (1986) notes that the 1950 demographic census data showed that the historical and overwhelming minifundio-latifundio binomial, with few medium-sized farms, was largely preserved. Measured by the Gini coefficient, the author calculates a slight increase in the concentration of land, from 83.3% to 84.4% between 1940 and 1950.

The specialized literature usually draws on two types of data on rural land concentration to analyse the agrarian structure. The first is the proportion of rural establishments of different sizes, which is shown in figure 4; and the second is the proportion of rural establishments of different sizes in the total area, shown in figure 5.

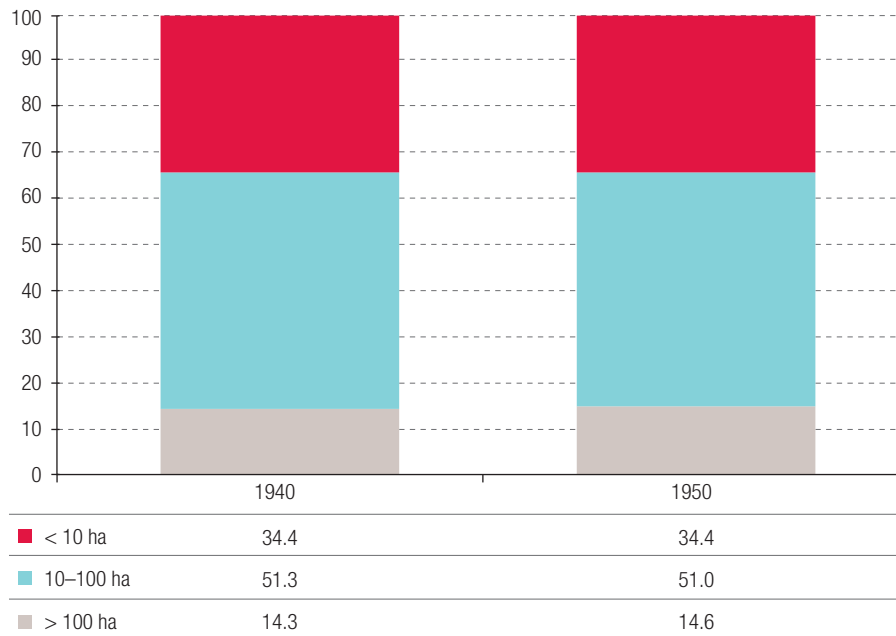
Figure 4 reveals an impressive degree of stability in the size distribution of rural establishments, since between 1940 and 1950 there was only a miniscule reduction (of 0.3 percentage points) in the proportion of medium-sized farms, in favour of large estates of more than 100 hectares.

Slight changes in the concentration of land in Brazilian agriculture can also be discerned in the proportion of rural establishments of different sizes in the total area. This is shown in figure 5.

Figure 5 shows that, between 1940 and 1950, the area occupied by large estates grew slightly from 81.8% to 83.4% of the total. This concentration of rural land is mainly due to a reduction in the area of medium-sized farms, the share of which dropped from 16.7% to 15.3%.

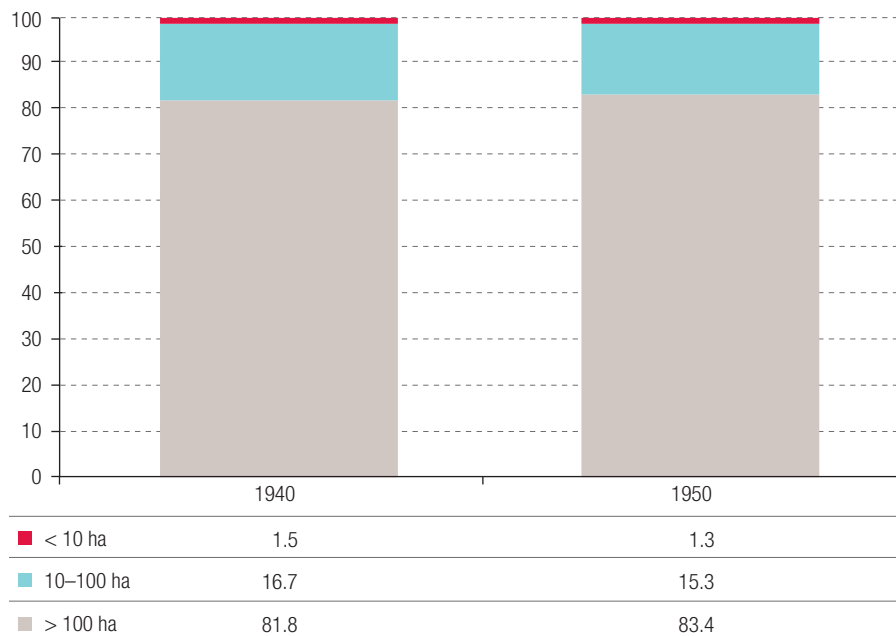
Overall, figures 4 and 5 indicate a reduction in the share of medium-sized farms in both total number and area. In other words, the IBGE demographic censuses reveal a strengthening of the historical minifundio-latifundio binomial in Brazilian agriculture.

Figure 4
Brazil: rural establishments by size category, 1940s and 1950s
(Percentages and hectares)



Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

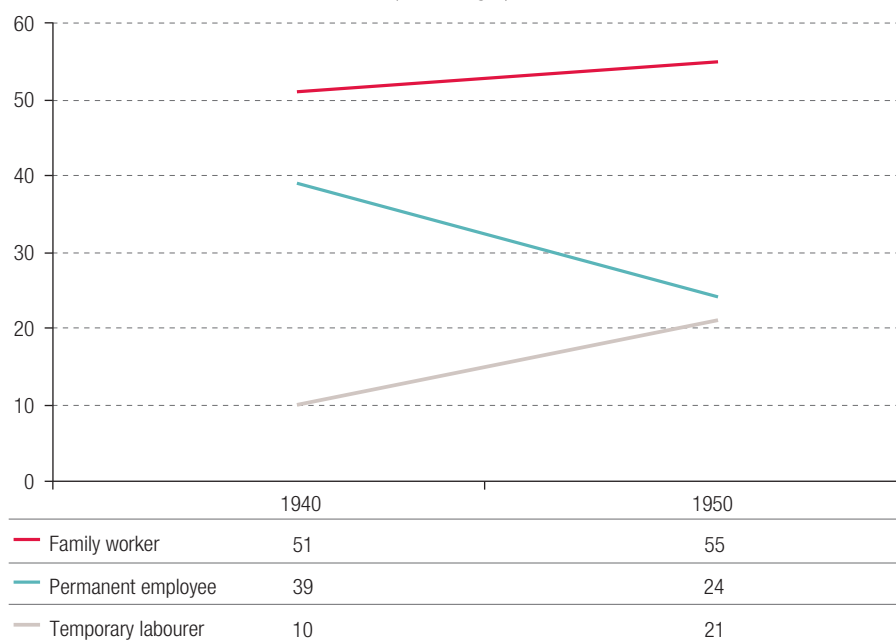
Figure 5
Brazil: area of rural establishments according to size, 1940 and 1950
(Percentages and hectares)



Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

Lastly, with respect to labour relations in the rural domain, the changes experienced show that the basic means of subsistence had become much more precarious for the vast majority of the population who still employed in predominantly agricultural activities. These changes are illustrated in figure 6.

Figure 6
Brazil: labour relations in rural areas, 1940s and 1950s
(Percentages)



Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria>.

Figure 6 shows that, between 1940 and 1950, the share of permanently employed rural workers fell drastically, from 39% to 24% of total agricultural employment. This permanent labour force was partly replaced by temporary labour, which increased from 10% to 21% of the total. In the same decade, agriculture based on unpaid family labour increased its share of the total number of rural workers by about 4 percentage points.

According to Prado Jr. (1946), the data on the agrarian structure during the years of constrained industrialization presented through figures 4, 5 and 6, suggest that permanent employees —who predominated in the relatively declining export crops— were being displaced from their productive activities. Instead, these rural workers became temporary labourers or smallholders (especially growing crops to meet the needs of expanding domestic consumption).

Overall, the data presented in figures 4, 5 and 6 on the agrarian structure and labour relations reveal the existence of significant scope for agrarian reform. This could alter the production structure summarized in table 5, which prevented agriculture from fulfilling its development functions, so as to improve the terms of trade and relative costs and thus provide incentives for agricultural modernization.

The rationale for the above is that agrarian reform could raise the cost of rural labour and fuel an expansion of the domestic consumer market. The twin effect of agrarian reform could stimulate the development of labour-saving technologies in agriculture and, in particular, foster a domestic industry producing intermediate goods and capital goods, such as tractors and fertilizers, among other items.

It can therefore be concluded that in the years of constrained industrialization, agrarian reform could have transformed the economic structure of Brazilian agriculture, making it relatively advantageous for sector modernization.

In the second half of the 1950s, however, the Targets Plan would transform the economic structure of Brazilian agriculture, with effects on agricultural modernization and, hence, also (and especially) on the issue of agrarian reform. This is a topic for another article.

III. Conclusion: the functionality of agrarian reform in the constrained industrialization period

This article has provided a descriptive analysis of the functionality of agriculture and agrarian reform during the constrained industrialization period. In those years, the capacity to increase long-term supply in the national economy was restricted.

During the period in question, agriculture continued to be the main contributor to national employment and income, accounting on its own for about 60% of these two key macroeconomic variables. However, the sector lost relative share in national employment and income owing to the vigorous industrial growth experienced by the Brazilian economy.

Nonetheless, agricultural output and employment continued to grow in absolute terms, including through the stimulus provided by the process of industrialization and urbanization that was unfolding in the national economy. In 1950, Brazilian industry still mainly produced basic consumer goods, which accounted for approximately 70% of industrial output; but the shares of capital goods and intermediate goods industries were increasing.

In agriculture specifically, the sector ceased to be based on export monocultures and started to diversify into polycultures serving the growing domestic consumer market. However, the decline in export agriculture was concentrated in coffee growing; and this single crop continued to account for nearly 70% of foreign exchange earnings.

In terms of agriculture serving the domestic market, between 1948 and 1955 the total production of a typical basket of food products increased by 27%, while the urban population grew by 40%. The failure of agricultural supply to keep pace with the burgeoning demand fuelled inflation. As a result, agriculture for domestic consumption registered a price elasticity of just 38%, while that of export crops rose to 56%.

In the years of constrained industrialization, the weak responsiveness of agricultural supply was the main symptom of the sector's failure to contribute to development. The supply capacity of the Brazilian economy — especially that of agriculture — was restricted. This is why some authors of the period, such as Celso Furtado (2000), believed agrarian reform could make the production structure of Brazilian agriculture more conducive to development, by contributing to increased agricultural production and productivity.

The dysfunctionality of agriculture for development could be verified empirically in the sector's economic structure. Between 1948 and 1955, agricultural productivity per cultivated hectare stalled at around 3.45 tons per year. Thus, the growth of total agricultural production, 35% over that period, was practically identical to the increase in area cultivated, of 34%.

International comparisons show that productivity growth through the use of modern agricultural machinery and equipment was confined to very few segments of Brazilian agriculture. While in South Africa there was one tractor in use for approximately 1,800 hectares cultivated, in Brazil the ratio was one tractor for every 2,000 hectares.

Economic theory explains the scant use of agricultural machinery and equipment through the terms of trade between tractor agribusiness and agriculture, and also in terms of the relative productivity and cost of factors of production.

In the case of the terms of trade, in 1948 the price of a tractor was more than four times that of a ton of export crops; but, by 1955 it had risen to almost 10 times. In the case of crops for domestic consumption, the multiple increased from about 20 to almost 50 in the same period.

In terms of productivity and the relative cost of factors of production, in 1948 a tractor cost 4,570 times the rural wage in São Paulo, and by 1955 the relative price had increased to more than 10,000 times. In contrast, the marginal productivity of the tractor was only 81 times that of a rural worker.

In other words, the productivity gain that could be obtained with the tractor was cancelled out by its high cost relative to the rural wage. So the structure of production costs in Brazilian agriculture discouraged agricultural modernization, and thus prevented the sector from fulfilling its role in national economic development. The dysfunctionality of agriculture could justify the implementation of an agrarian reform policy to alter this economic structure so as to provide an incentive for agricultural modernization.

This is because Furtado's (1966) approach blames the agrarian structure for making the economic structure disadvantageous for agricultural modernization. Taken together, the data on labour relations and land concentration indicate that a large segment of permanent rural employees in relatively declining export crops were becoming temporary labourers or else smallholders growing crops for the burgeoning domestic consumer market.

Increasingly precarious labour relations and worsening land concentration revealed the existence of significant scope for agrarian reform. This would be able to alter the production structure of Brazilian agriculture so as to improve the terms of trade and relative factor costs, making them comparatively advantageous for agricultural modernization.

This advantage could emerge to the extent that agrarian reform, by raising the cost of hiring rural labour, would induce substitution of this factor of production with labour-saving technologies (such as agricultural machinery and equipment), thereby stimulating development of the domestic capital goods industry. At the same time, and no less important, agrarian reform could also have an impact on industrial development by expanding effective demand consistently with the increase in agricultural productivity, through the growth of rural employment and income.

However, in the second half of the 1950s, the Targets Plan would produce a structural transformation in the Brazilian economy, affecting not only industry but also the basic variables of agriculture (rural wages, agricultural demand, terms of trade and factor productivity) analysed above. This would have repercussions on agricultural modernization and, as the other side of the coin, also on the issue of agrarian reform.

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Annex A1

Table A1.1
Brazil: growth rates, inflation and elasticity of export agriculture
and domestic consumption, 1948–1955
(Percentages)

Crop		dq	dp	Elasticity dq/dp
Export	Rubber	-37	171	-22
	Mate	12	316	4
	Tobacco	11	150	8
	Soybean	175	155	113
	Cocoa	290	104	238
	Coffee	-22	330	-7
Domestic consumption	Rice	46	184	25
	Potato	53	103	52
	Onion	59	179	33
	Bean	30	139	22
	Cassava	19	140	14
	Maize	19	156	12
	Wheat	172	154	111

Source: Prepared by the author on the basis of Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/>.

Annex A2

Table A2.1

Brazil: time series data on the economic structure of agriculture, 1948–1955

Perspective	Structure of demand				Structure of the offer					
	Economic variable	Urban population	Tons exported	Agricultural prices		Tractor price	Rural wages	Economically active rural population	Tons harvested	Tractors in use
Domestic consumption				Export						
Notation	C	X	p	px	r	W	L	Q	K	R
1948	17 190 324	427 666	1 614	7 605	33 329	7.30	9 982 540	55 208 850	7 374	15 558 434
1949	17 952 163	395 144	1 613	6 764	37 369	8.03	10 117 175	56 097 971	7 873	16 348 605
1950	18 782 891	389 903	1 619	9 031	39 000	8.76	10 254 000	57 273 614	8 372	17 122 197
1951	19 687 169	386 680	1 658	8 935	43 000	9.86	10 440 315	58 449 256	19 339	17 209 887
1952	20 666 515	213 793	2 041	9 992	49 000	12.41	10 630 016	62 291 931	26 702	18 168 144
1953	21 721 694	363 704	3 073	12 557	89 000	13.51	10 823 163	65 533 563	28 856	18 723 975
1954	22 853 496	555 411	3 346	19 371	155 000	17.89	11 019 820	69 416 602	41 114	19 957 829
1955	24 062 745	455 429	4 050	22 323	220 000	21.90	11 220 050	71 643 509	46 459	20 854 088

Source: Prepared by the author, on the basis of information from the Institute for Applied Economic Research (IPEA) for C; T. Szmrecsányi, "Desenvolvimento da produção agropecuária (1930–1970)", *História Geral da Civilização Brasileira*, B. Fausto (org.), vol. IV, São Paulo, Difusão, 1986, for L; Brazilian Institute of Geography and Statistics (IBGE), *Estatísticas do Século XX* [online] <https://seculoxx.ibge.gov.br/economicas/tabelas-setoriais/agropecuaria> for p, px, X, Q, K and R; E. L. Bacha, "Crescimento econômico, salários urbanos e rurais: o caso do Brasil", *Pesquisa e Planejamento Econômico*, vol. 9, No. 3, Rio de Janeiro, December 1979, for w; Banco do Brasil Chamber of Foreign Trade (CACEX), *Boletim Mensal da Câmara de Comércio Exterior do Banco do Brasil*, Rio de Janeiro, Ministry of Finance/Brazilian Institute of Geography and Statistics (IBGE), various issues, 1948–1950; and J. Sanders Jr., *Mechanization and employment in Brazilian agriculture, 1950–1971*, University of Minnesota, 1973, for r.