A Reassessment of the Soviet Industrial Revolution[1]

by

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Soviet economic performance is usually dismissed as a failure. In contrast, I argue, the Soviet economy performed well. Japan was certainly the most successful developing economy of the twentieth century, but the USSR ranked just behind it. This success would not have occurred without the 1917 revolution or the planned development of state owned industry. Planning led to high rates of capital accumulation, rapid GDP growth, and rising per capita consumption even in the 1930s. The collectivization of agriculture was not necessary for rapid growth--I argue that industrial development would have been almost as fast had the five year plans been carried out within the frame work of the NEP–but it none-the-less nudged up the growth rate.

The rapid growth in per capita income was contingent not just on the rapid expansion of GDP but also on the slow growth of the population. This was primarily due to a rapid fertility transition rather than a rise in mortality from collectivization, political repression, or the Second World War. Falling birth rates were primarily due to the education and employment of women outside the home. These policies, in turn, were the results of enlightenment ideology in its communist variant.

These judgements should not be read as an unqualified endorsement of the Soviet system. Dictatorship was and is a political model to be avoided. Collectivization and political repression were human catastrophes that brought at most meagre economic returns. The strength of central planning also contained the seeds of its own undoing, for it brought with it the need for someone to plan centrally. When plan objectives became misguided, as in the Brezhnev period, the system stagnated.

This reassessment is based on three axes: recalculations of national income from 1928 to 1940 including, in particular, the growth in consumption, the use of simulation models to explore counter factual development trajectories, and the reposition of the debate on Soviet performance in a world-historical context. I next summarize my findings on major issues in Soviet economic history.

Soviet growth in a world-historical context

The communists believed that their economic system would quickly overtake the USA, and the Cold War focused American attention on the same question. While Soviet-American comparisons are important, they are not the most germane for assessing Soviet performance. The biggest fact about world economic development in the last two centuries is income divergence–not income convergence as once thought. The high income countries at

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the beginning of the nineteenth century have grown faster than the low income countries thus increasing international economic disparities. Western Europe and north America were the high income regions in 1800 and in 1913 and have increased their lead over most of the world where growth has been much more modest. Only a few countries (notably the southern cone of South America) that were rich at the beginning of the twentieth century have fallen into the camp of the poor countries, and only a few countries that were poor in 1800 have joined the prosperous. These include Japan, its former colonies South Korea and Taiwan, and the USSR.

Income per head was not the only characteristic that placed Russia among the backward countries of the world in the nineteenth century. Other indicators pointing in the same direction were the predominance of agriculture in the economy, the high fertility demographic regime, and the capriciousness of law and the authoritarianism of the state.

Figure 1 uses Maddison's (1995) data to put Soviet growth into a world context. Growth rates in per capita GDP from 1928 to 1970 are plotted against 1928 income. The OECD countries had a higher average income in 1928 than the rest of the world and grew faster on average. There was income convergence within the OECD as the poorer countries caught up with the richer, and this convergence is represented by the downward sloping OECD catch-up regression line. The large number of points in the lower left of the graph represent the rest of the world falling behind. Japan stands out as the OECD country that performed best. The USSR led the non-OECD countries and, indeed, achieved a growth rate in this period that exceeded the OECD catch-up regression as well as the OECD average. Soviet performance does not look quite as good if the time frame is extended to 1989, but the USSR still did very much better than most countries that were poor early in the twentieth century.

Growth of the Late Imperial Economy

Per capita income rose in many countries in the late nineteenth century including Tsarist Russia. This economic growth raises three questions: What were its causes? Would it have continued in the twentieth century and closed the income gap with the West? Did the pattern of growth play a role in the revolutions of 1905 and 1917?

The long tradition regarding Russian agriculture as a stagnant bottleneck that inhibited growth was exploded by Gregory (1980, 1982) who showed that agricultural output grew rapidly in the late empire. Indeed, my calculations show that over half of the rise in GDP was due to greater farm output plus the increases in transportation and wholesaling services needed to ship the grain. Grain output rose because of integration in the world economy, and the world-wide rise in the price of wheat from 1896 to 1913. Russian wheat output grew like that of Australia, Canada, Argentina, and India.

Russia industrial output also grew because state policy reserved the Russian market to Russian firms. Without tariff protection, Russian cotton spinners might have been able to compete against the English as the Indians did, but heavy industrial output and even the weaving of cotton required tariffs.

Was Russian development robust enough to have closed the gap with western Europe if 1917 had not intervened? The possibility cannot be excluded because one country–Japan–did just that. It grew from a Russian income level in 1913 to a west European level in 1989. Japan, however, was unique, and there is little reason to believe that Russia would have been at the top of the world league table rather than in the middle or the bottom.

Japanese growth was based on institutional modernization that exceeded anything imagined by the Tsars. Without a comparable institutional revolution, Russia would have languished. Certainly, the bases of growth from 1896 to 1913 did not persist through the interwar years. World wheat prices collapsed, and most of the wheat exporters stagnated (like Australia) or declined (like Argentina and India). Canada was an exception, but its growth was bouyed by the demand for manufactures from its much larger farms and by the possibility for its excess population to emigrate to the United States. Latin America, even India--with its slow growth, high tariffs, and inefficient industry--gives a more likely picture of Russia's future.

Not only were the bases of Imperial advance narrow, but the process of growth gave rise to such inequitable changes in income distribution that revolution was hardly a surprise. Real wages for urban workers were static in the late Imperial period despite a significant increase in output per worker (Figure 2). In western Europe at this time, real wages grew apace with total output, and this improvement lay behind the conversion of the working class from revolutionary socialism to social democracy. It was on the periphery of Europe that wages lagged behind GDP, and politics remained focused on class conflict. In Spain, the right won, but the economic fault lines were similar to those in Russia.

Revolution was also a peasant revolt, and the interests of the peasants were different. Average income per peasant household rose in the late empire as wheat prices increased, but the result was still instability. As in the cities, there was no gain in real wages (Figure 3). Instead, rising rural incomes accrued as rising land values. This was typical of frontier regions in all continents. Landownership became a pressing issue, as land became a valuable asset. Increasing returns to scale in agriculture meant that the society of small farms was not in equilibrium and explains the appeal of the equal division of the (increasingly valuable) land.

Growth of consumption, 1928-40

Soviet GDP increased rapidly with the start of the first Five Year Plan in 1928. The most widely accepted view of Soviet development between 1928 and 1940 is that the increased output consisted of investment and military goods, while per capita private consumption declined slightly in the period. While investment certainly increased rapidly, recent research shows that the standard of living also increased briskly.

Calories are the most basic dimension of the standard of living, and their consumption was higher in the late 1930s than in the 1920s. The UN Food and Agricultural Organization has estimated per capita calorie availability for many countries since the 1950s, and I have applied its methodology to Russia and the Soviet Union in earlier years. In 1895-1910, calorie availability was only 2100 per day, which is very low by modern standards. By the late 1920s, calorie availability advanced to 2500. It dropped in 1932 to 2022 calories due to the output losses during collectivization. While low, this was not noticeably lower than 1929 (2030) when there was no famine: the collectivization famine, in other words, was the result of the distribution of calories (a policy decision) rather than their absolute scarcity. By the late 1930s, the recovery of agriculture increased calorie availability to 2900 per day--a significant increase over the late 1920s. The food situation during the Second World War was severe, but by 1970 calorie consumption rose to 3400, which was on a par with western Europe.

A second dimension of the standard of living is longevity. According to the population reconstruction of Andreev, Darskii, and Kar'kova (1990), the life expectancy of

the average Soviet men increased by three years during the 1930s, and the life expectancy of the average woman increased by five years. Greater food availability and the extension of medical services were the causes.

The third dimension of the standard of living is consumption of goods and services generally. There has been no debate that 'collective consumption' (principally education and health services) rose sharply, but the standard view was that private consumption declined. Recent research, however, calls that conclusion into question. Figure 4 summarizes the estimate of per capita consumption implicit in Hunter and Szyzmer's (1992) recent work as well as mine. Consumption per head rose about one quarter between 1928 and the late 1930s according to both series. While the two reassessments are based on different valuation procedures, both aggregate agricultural and industrial output series that were not available to Bergson (1961) and other early investigators. Aggregation of output presents fewer analytical problems than deflating nominal consumer spending which is the alternative procedure.

Like other investigators, I find that the real wage fell in most urban and industrial occupations between 1928 and 1940. How can falling wages be reconciled with rising consumption? The answer is that most of the urban population in the late 1940s were migrants from the countryside, and 1940 urban consumption greatly exceeded 1928 rural consumption. In other words, most of the increase in aggregate consumption between 1928 and 1940 accrued to those who migrated from country to city. Lesser gains accrued to urban residents who shifted to higher wage occupations, successful Stakhanovites, and employees in public administration, health, and education, that is, the educated proletarians whom Fitzpatrick (1979, 1994) has identified as the beneficiaries and supporters of Stalinism.

Causes of Rapid Growth, 1928-40

How were investment and consumption pushed up concurrently during the 1930s? The main reason was that otherwise unemployed farm labour was put to work in the urban economy. The theoretical possibility is shown in Figure 5. In 1928, the Soviet Union was at a point like D inside its production possibility frontier PPF. As jobs were created for unemployed rural workers, the output of both consumer and producer goods was increased as the economy moved to E. The increased production of producer goods was allocated disproportionately (but not exclusively) to further increase the production of producer goods. As a result, the production possibility frontier shifted outward in an unbalanced way to PPF'. The output of producer goods rose sharply, but the output of consumer goods also increased.

To establish the possibilities of agricultural modernization, I have compared farming in the fifty provinces of European Russia in 1913 and to that in climactically similar parts of the USA and Canada in 1920/21 (namely the states of North and South Dakota, Montana, and Wyoming and the provinces of Manitoba, Saskatchewan, and Alberta). Biological indicators like the yield per hectare of grain or milk production per cow showed little difference between Russia and similar parts of North America. Indeed, the yield of wheat in Russia and the USSR has been comparable to that in climactically similar parts of North America as the comparison of Russian and North Dakota yields in Figure 6 shows. The main difference between Russia and North America was in farm size and labour productivity. In the 1920s, the average North America farm was eight times large than the average Russian farm. Mechanization was part of the answer, but the Soviet farm population was excessive even in terms of traditional technology. This was the labour reserved mobilized by rapid capital

accumulation.

This theoretical model of Figure 5 was implemented empirically with a fifty equation multisectoral simulation model of the Soviet economy inspired by the Fel'dman growth model. This model was used to investigation three policies: the collectivization of agriculture, the concentration of investment on the expansion of heavy industry, and the use of soft-budget constraints and output targets (rather than profit maximization) to direct industry. The results of simulations of GDP are shown in Table 1. The first row shows actual 1928 GDP (in 1937 prices), and the last row shows 1939 GDP. The intervening rows show simulated 1939 values of GDP produced by alternative investment strategies indexed by e, the proportion of producer goods output allocated to the producer goods sector. In my accounting e ranged from .07, the proportion of the 1920s, to .23, the proportion characteristic of the mid1930s. The columns correspond to alternative agricultural and employment policies. The left most column shows collectivized agriculture and soft-budget constraints. The simulations in this column correspond to actual Soviet institutions. The middle column shows what would have happened if investment had been increased within the institutional framework of the NEP, and the right most column shows the effect of alternative investment strategies with hard budgets, i.e. where industrial employment is set to the level where the wage rate equals the marginal product of labour (the capitalist employment relationship).

Consider the following thought experiment. We begin with the economy least like the Soviet Union in the 1930s, i.e. with the capitalist employment relation and an investment strategy that simply replicates the consumer goods oriented capital stock of the 1920s (i.e. e=.07). That economy would generate a 1939 GDP of 240.6--not much above the 1928 starting value of 200.9 and no increase on a per capita basis. Now let e rise to .23. In that case, 1939 GDP equals 290.3--a jump of 21%. The strategy of investing in heavy industry pays off. Next replace the hard budget constraint with the soft budget constraint. Simulated GDP rises to 348.3 in 1939--a further gain of 20%. The soft budget constraint also pays off. Finally, imagine that the free market relationship between agriculture and industry that characterized the NEP were replaced by the obligatory deliveries and state imposed prices that characterized collectivization. Simulated GDP would again rise but only to 364.6--an additional gain of 5%. There is little pay-off to collectivization. Since the simulated level of GDP is within 5% of the actual 1939 value of 344.9, the thought experiment shows that the investment strategy and the soft-budget constraint comprise a complete explanation of Soviet growth--it is not necessary to invoke other factors to account for what happened.

Fairly similar conclusions obtain if the other aggregate indicators are analyzed in the same way, although collectivization appears to be mildly more important when nonagricultural value added is the standard of assessment and downright counterproductive when consumption per head is the criterion for judging economic performance. As with GDP, collectivization gives only a tiny boost to capital accumulation.

It is a prima facie paradox that collectivization could increase GDP in view of the significant reduction in farm output that it entailed. Two factors resolve the paradox. First, by the late 1930s, agricultural output had recovered. Second, collectivization pushed up growth by speeding up the rate of rural-urban migration. Even though soft budget constraints meant that the marginal product of labour in Soviet industry was less than the wage, marginal labour productivity was still greater than zero, so increased migration increased output. Growth was always slowest with capitalist employment relations (hard budget constraints) since they implied unemployment in a surplus labour economy.

As several revisionists have argued, rapid urbanization led to rapid growth in the demand for food. The result was such extreme inflation in food prices on the collective farm market that agriculture's terms of trade improved despite the low procurement prices offered by the state (Barsov 1969, Ellman 1975, Millar 1970, 1974). This important discovery, however, does not refute the old view that agriculture was a source of saving for industrial investment. First, the gap between retail and procurement prices accrued to the state as turnover tax receipts and financed the investment boom. Second, while agriculture's terms of trade improved, they would have improved even more without the rising wedge of the turnover tax. Third, if retail prices (net of processing costs) are used to value agriculture's sales to the rest of the economy, agriculture becomes an important saver. Fourth, simulations show that an investment boom in a collectivized economy lowered the incomes of peasants, while the same boom in an NEP-style economy did not. Stalinism really was Preobrazhensky in action.

These findings point toward three important conclusions about institutions and Soviet economic development. First, the New Economic Policy, which involved the preservation of peasant farming and a market relationship between town and country, was a conducive framework for rapid industrialization. Collectivization made little additional contribution to this system of organization. Second, the autarchic development of the producer goods sector was a viable source of new capital equipment. Exporting wheat and importing machinery--i.e. following comparative advantage--was not necessary for rapid growth. Third, the central planning of firm output in conjunction with the soft budget constraint was effective in mobilizing otherwise unemployed labour. This additional employment made a significant contribution to output as well as distributing consumption widely.

Soviet demographic history

Output per head could be increased by reducing the number of heads as well as by increasing GDP. Between 1928 and 1989, the population of the USSR rose by 70%, compared to the three to five fold increases realized by countries at a similar level of development in the 1920s. The question is why the USSR did not suffer the same fate.

The Soviet Union escaped a population explosion for two reasons. The first was the excess mortality due to collectivization and war. A demographic simulation model was used to gauge the long term impact of these losses, and they did, indeed, have a persistent effect, as Figure 7 shows. However, these effects were not large enough to explain the difference between the USSR and south Asia or Latin America.

The main reason that the USSR did not have a population explosion was the rapid decline in fertility, which was the second and more important check on the population. The rapid fertility transition was due to the education of women, rapid economic development, and increased food availability after agriculture recovered from collectivization. This result is established by simulating Soviet population with fertility equations estimated from developing country data as well as from the Russian and Soviet censuses of 1897, 1939, and 1959. If Russian women had not been educated or industrialization had been slower, then the USSR would have had a late fertility transition (as in India) or no fertility transition (as in Pakistan). Simulation of these possibilities shows that the population would have reached one billion in 1989 (Figure 7). A population expansion of that order would surely have cut the growth in per capita GDP.

The Soviet Growth Slowdown

After the Second World War, the Soviet economy resumed rapid growth. By 1970, the growth rate was sagging, and per capita output was static by 1985. Poor performance had several causes, one of which was the exhaustion of surplus labour. The link between full employment and slow growth, however, was multi-faceted.

Weitzman (1970) proposed a technological link between the two. He estimated a CES (constant elasticity of substitution) production function with data from the 1950s and 1960s and concluded the elasticity of substitution between labour and capital was .4, a value confirmed by Easterly and Fischer (1995). This is considerably less than value of unity often estimated for advanced countries.

A low elasticity of substitution implies an integrated account of both the success and failure of the Soviet economy. Figure 8 is a diagram that tells the story of Soviet history in a simplified form. The depiction is starker than Weitzman's because the isoquants assume fixed proportions--an elasticity of substitution of zero rather than .4--but the logic is more clearly revealed. In this framework, a rise in the investment rate caused rapid growth in the 1930s and 1940s as surplus labour was put to work. By the 1950s, structural unemployment was eliminated and growth slowed down as capital accumulation ran into diminishing returns.

The diagram presupposes that fixed quantities of capital and labour are required to produce a unit of GDP as indicated by point Y_1. These proportions are preserved along the diagonal OY_2. More labour (L_2) or capital (K_2) yields no extra output so long as the quantity of the other is fixed. Constant returns to scale is assumed so that doubling the capital (from K_1 to K_2) and labour (from L_1 to L_2) doubles output (from Y_1 to Y_2).

In 1928 the Soviet Union was at a point like A. Output was limited to one unit (Y_1) by the available capital (K_1) and L_2-L_1 units of labour were in surplus. In this case, accumulating capital increased output by moving the economy upwards along a vertical line from A to Y_2; indeed, in this period output and capital grew at the same rate. Surplus labour was correspondingly reduced. This shift corresponds to the period 1928-1970 when the USSR grew rapidly by accumulating capital.

The era of high speed growth ended, however, when the economy reached Y_2, and surplus labour was exhausted. Thereafter, capital accumulation failed to generate growth. As the economy accumulated capital it moved upward along the vertical part of the isoquant where capital was in surplus and labour constrained production. In that case, output failed to grow. Indeed, there was a quick transition from fast growth to stagnation. In real time, the transition occurred in the late 1960s and early 1970s. One indicator of the change is unfilled vacancies on the first shift, which rose from 1% in 1960, to 4.9% in 1970, to 7.3% in 1975, then to 9.9% in 1980, and finally hit 12.2% in 1985 (Rumer 1989, pp. 199-200). In the 1970s, a Gosplan research director reported that 10-12% of the increment in real fixed capital was unutilized due to a shortage of labour (Rumer 1989, p. 202), and that proportion could only have increased in the 1980s. The capital stock rose without a corresponding rise in GDP because there was no labour to operate the new capacity.

The numerical implications of a more realistic version of Figure 8 can be derived by embedding Weitzman's production function in a Solow (1956) growth model and simulating the growth in per capita GDP. (This simulation is simple and deals with World War II by leaving it out, so that the simulated capital stock and GDP for 1940 are projected into 1948.) Figure 9 contrasts the actual course of real GDP per head and the simulated value, and they follow each other closely: rapid growth was followed by a quick transition to stagnation. In

this model, the fall in the growth of per capita GDP is due to the rapid growth in the capital stock which runs into rapidly diminishing returns as 'full employment' of labour is achieved.

Figure 9 is an elegant summary of Soviet history, but it faces a challenge: why was the elasticity of substitution much lower in the USSR than in advanced capitalist countries? The difference was not on the factory floor, for the history of Soviet factory design suggests considerable substitutability between capital and labour. The difference was organizational, but it was not simply a question of plan versus the market. The real issue was the vision of development that lay behind the plan and which emphasized the preservation of existing capacity and a focus on heavy industry and resource development. The USSR behaved 'as if' the aggregate production function had little substitutability between capital and labour, but this appearance reflects massive errors in Soviet investment strategy rather than a real difference in technology. It was not purely happenstance that these errors occurred in the 1970s and 1980s, for the end of the surplus labour economy posed new management problems, and the party leadership bungled them.

The 1960s saw two changes in investment policy that were highly deleterious: First, investment shifted from the construction of new manufacturing facilities to the modernization of old ones. Second, the depletion of old oil fields and mining districts led to a redirection of investment from Europe to Siberia. Both changes involved huge expenditures, and these cumulated into a rapid growth in the capital stock. However, the massive accumulation did not lead to more output since the investment was largely wasted. It was as if the United States had decided to maintain the steel and auto industries of the midwest by retooling the old plants and supplying them with ore and fuel from northern Canada instead of shutting down the Rust Belt and importing cars and steel from brand new, state of the art plants in Japan supplied with cheap raw materials from the Third World. What the country needed was a policy to close down old factories and shift their employees to new, high productivity jobs, reductions in the use of energy and industrial materials, and increased involvement in world trade.

The Cold War was an additional factor that lowered Soviet growth after 1968. The creation of high tech weaponry required a disproportionate allocation of R & D personnel and resources to the military. Innovation in civilian machinery and products declined accordingly. Half of the decreased in the growth rate of per capita GDP was due to the decline in productivity growth, and that decrease provides an upper bound to the impact of the arms race with the United States.

The interpretation of the Soviet decline offered here is the reverse of the analyses which emphasize incentive problems and the resulting failure of managers to act in accord with the plans. On the contrary, the plans were implemented; the problem was that they did not make sense. The strength of Soviet socialism was that great changes could be wrought by directives from the top. The expansion of heavy industry and the use of output targets and soft-budgets to direct firms were appropriate to the conditions of the 1930s, they were adopted quickly, and they led to rapid growth of investment and consumption. By the 1970s, the ratio of good decisions to bad was falling. Perhaps the greatest virtue of the market system is that no single individual is in charge of the economy, so no one has to contrive solutions to the challenges that continually arise. The early strength of the Soviet system became its great weakness as the economy stopped growing because of the failure of imagination at the top.

Table 1

Actual and Simulated GDP
(Billions of 1937 rubles)

	collectivized soft budget	NEP soft budget	capitalist employment hard budget
1928, actual	200.9	200.9	200.9
1939, simulated			
e			
.07	270.1	284.8	240.6
.12	293.5	303.6	252.8
.17	321.6	324.0	268.6
.23	364.6	348.3	290.3
1939, actual	344.9	344.9	344.9

Figure 1

Economic Growth, 1928-1970

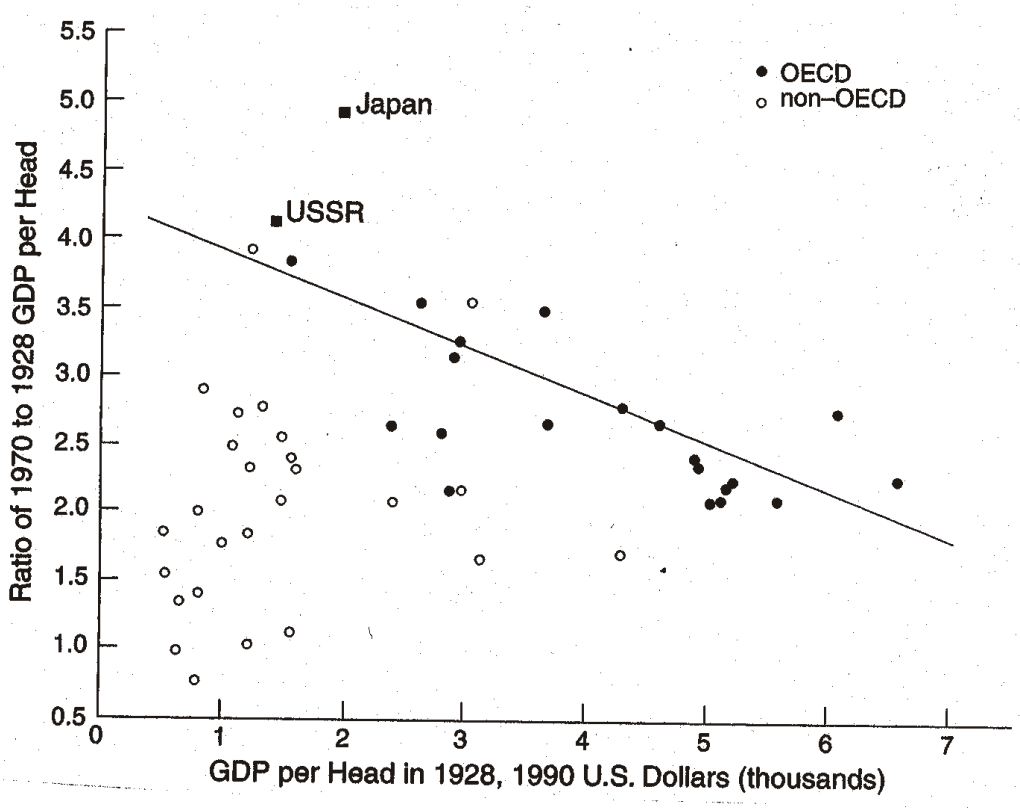


Figure 2

Real Wages, 1885-1913

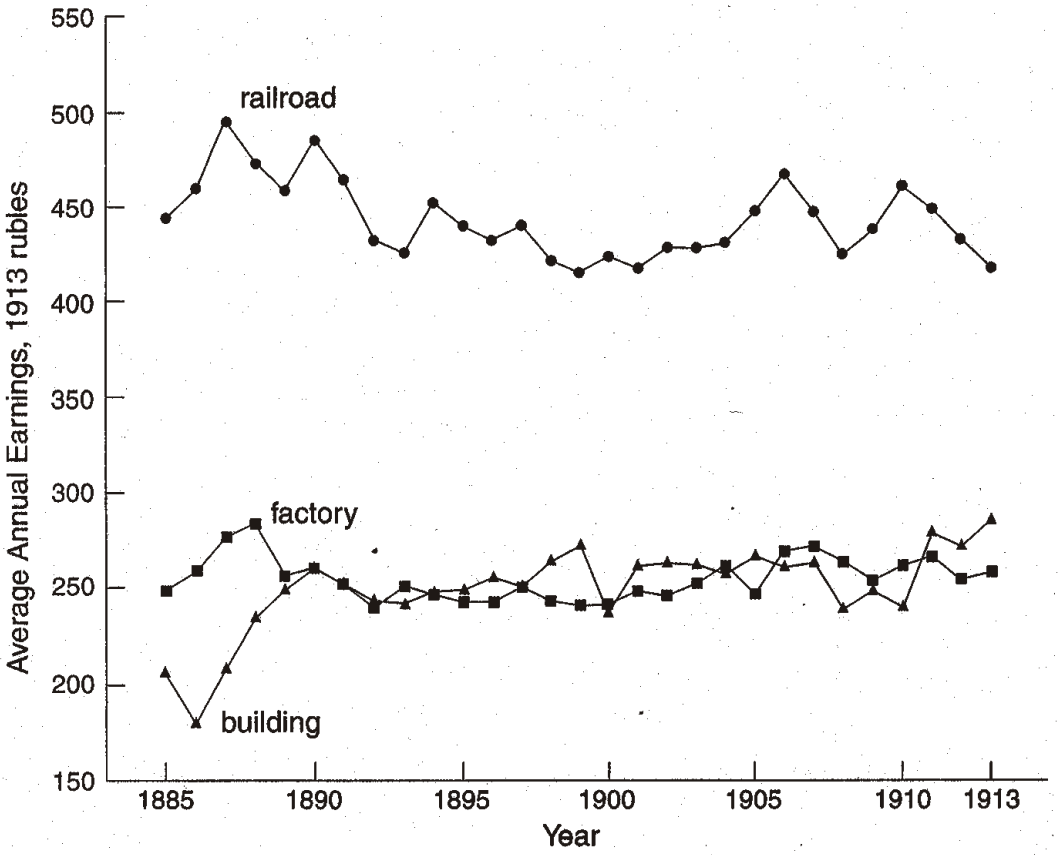


Figure 3

Real Earnings in Agriculture, 1885-1913

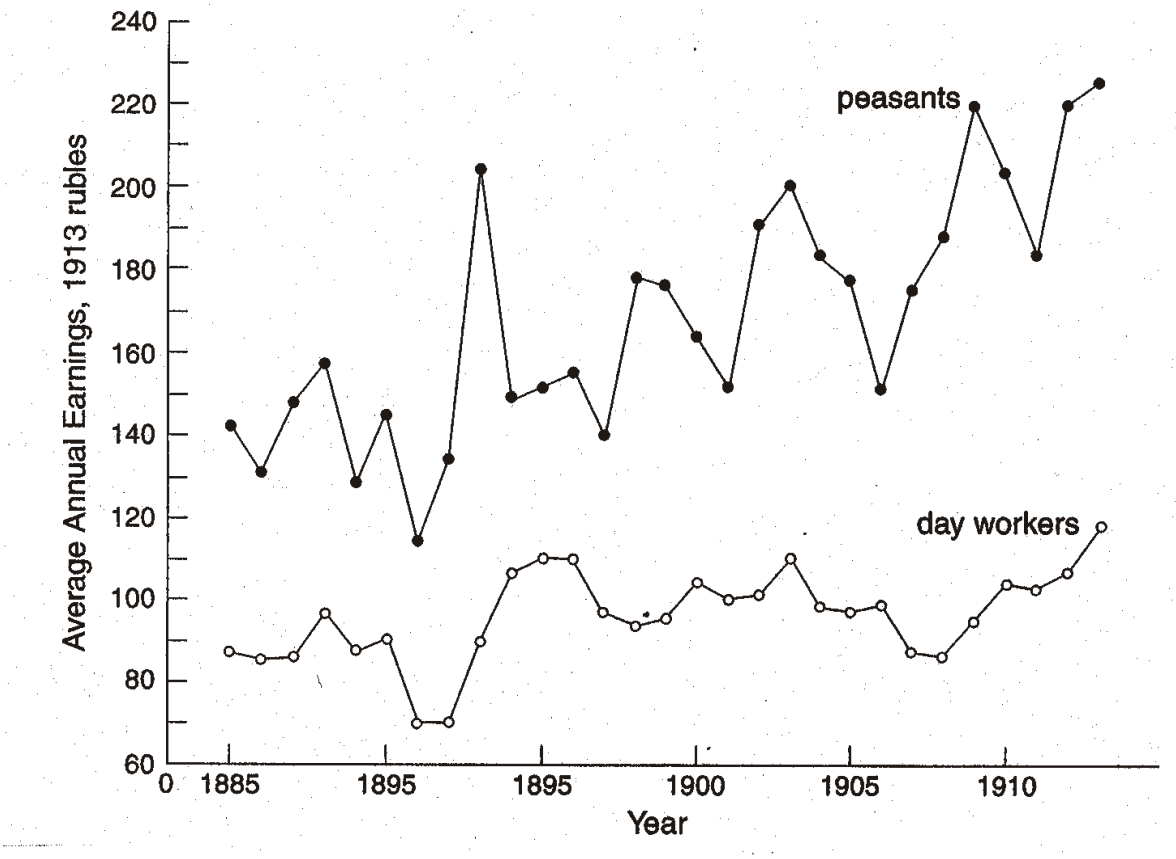


Figure 4

Consumption per Head, 1928-1940

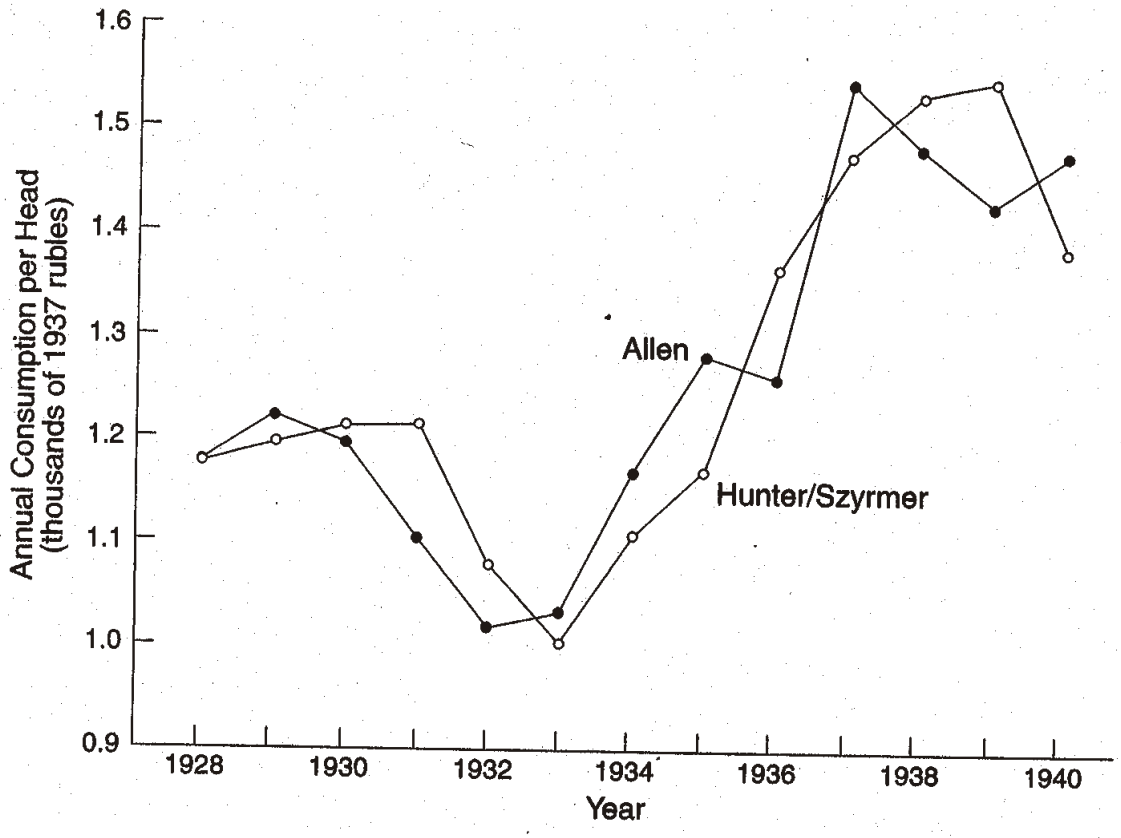


Figure 5

Model of Soviet Development

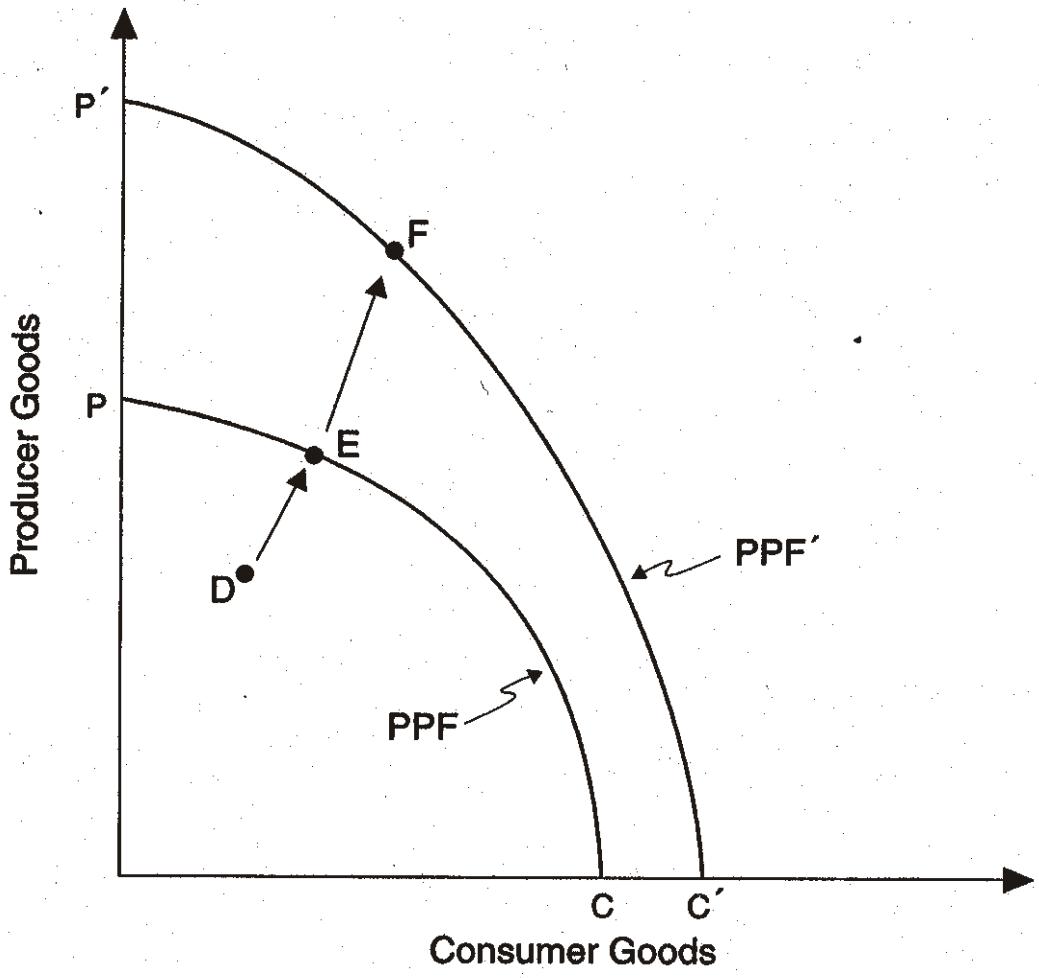


Figure 6

Wheat Yield, Russia/USSR and North Dakota, 1885-1990

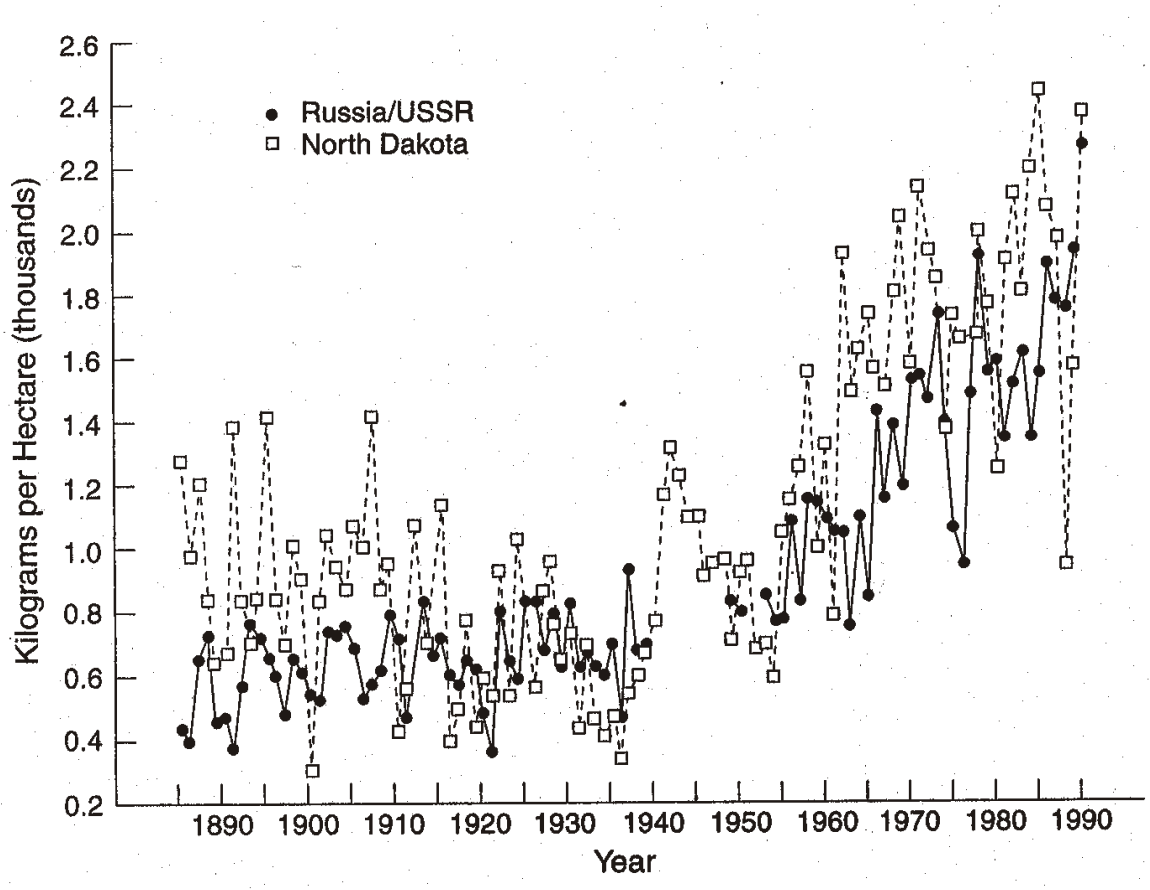


Figure 7

Effect of Collectivization, War, and Fertility Transition
on the Soviet Population

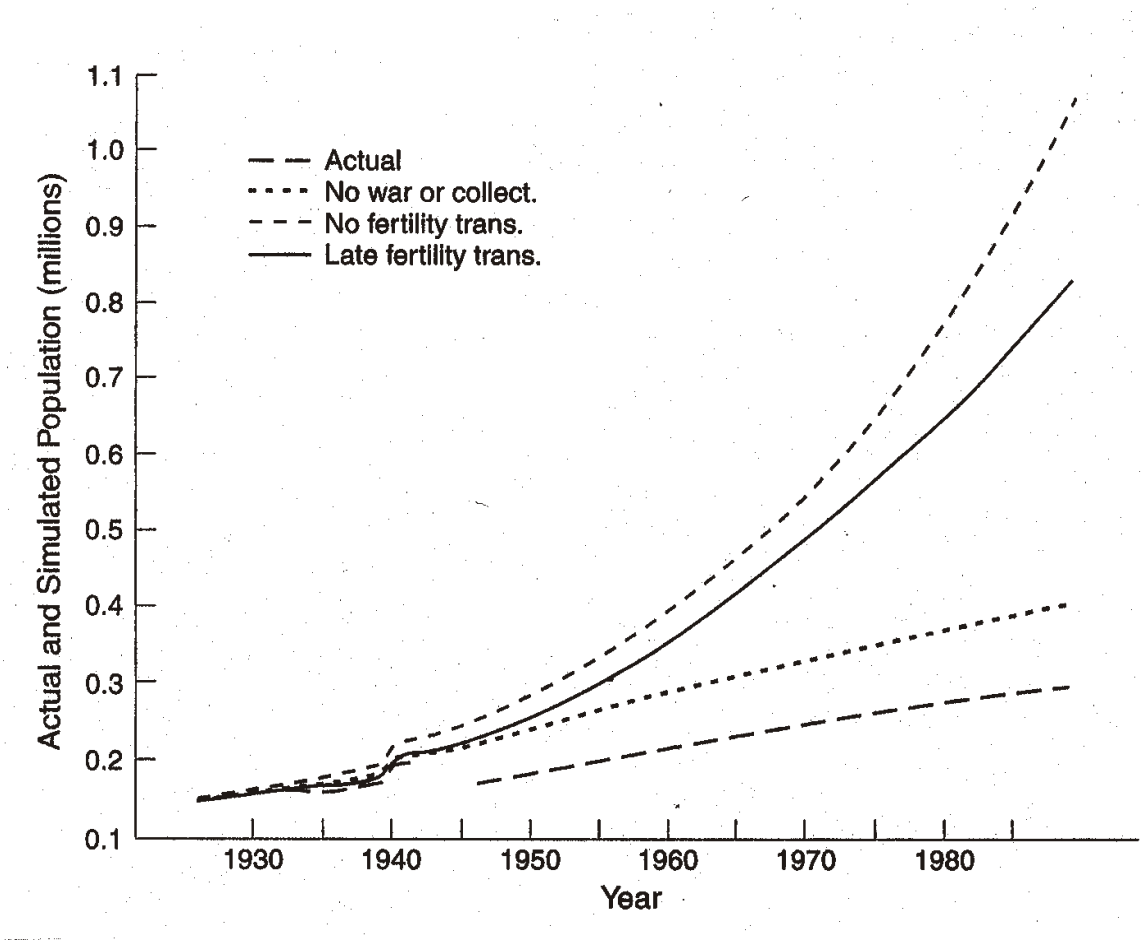


Figure 8

Stylized Version of the Weitzman Model of Soviet Growth and Stagnation

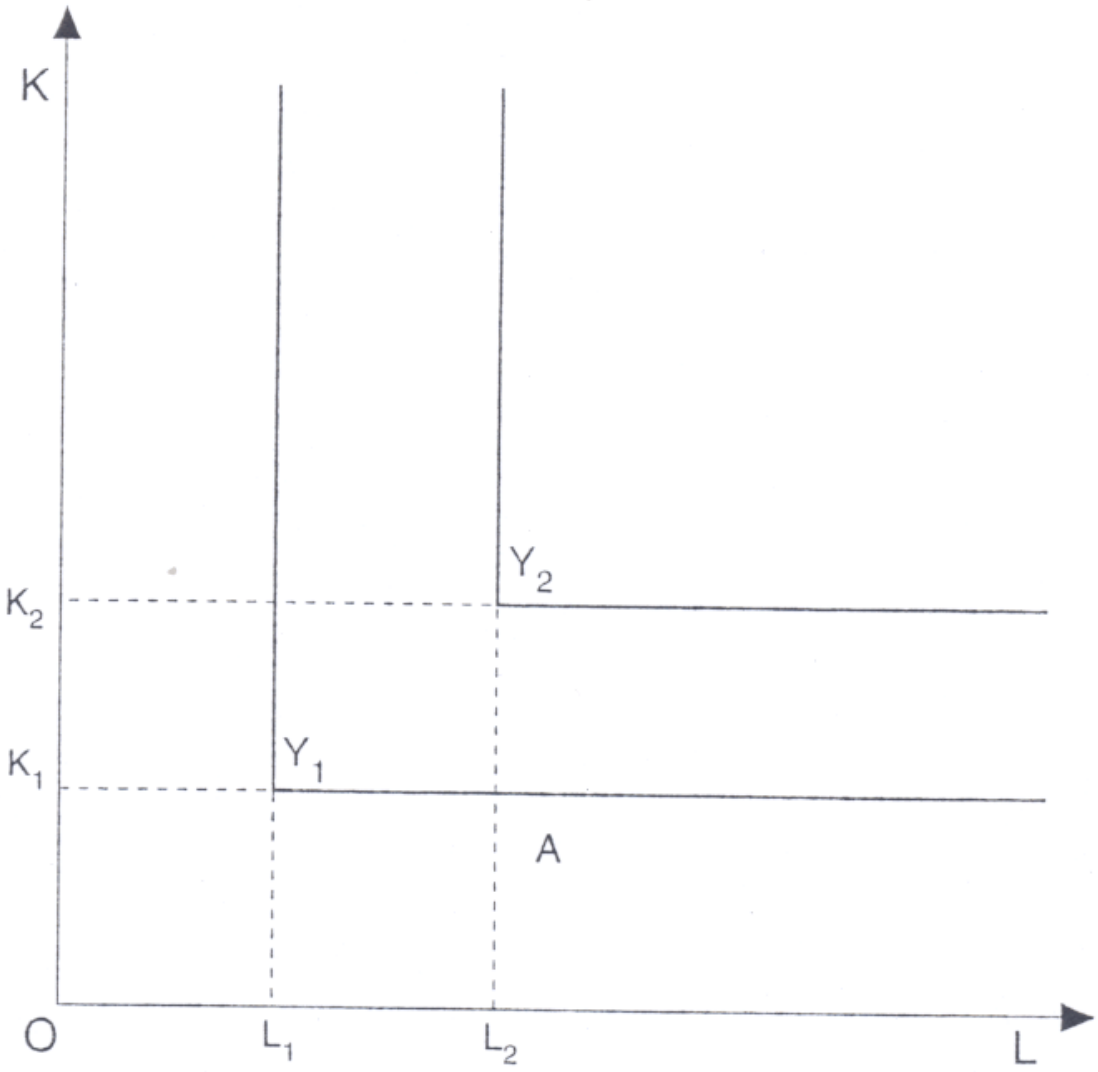
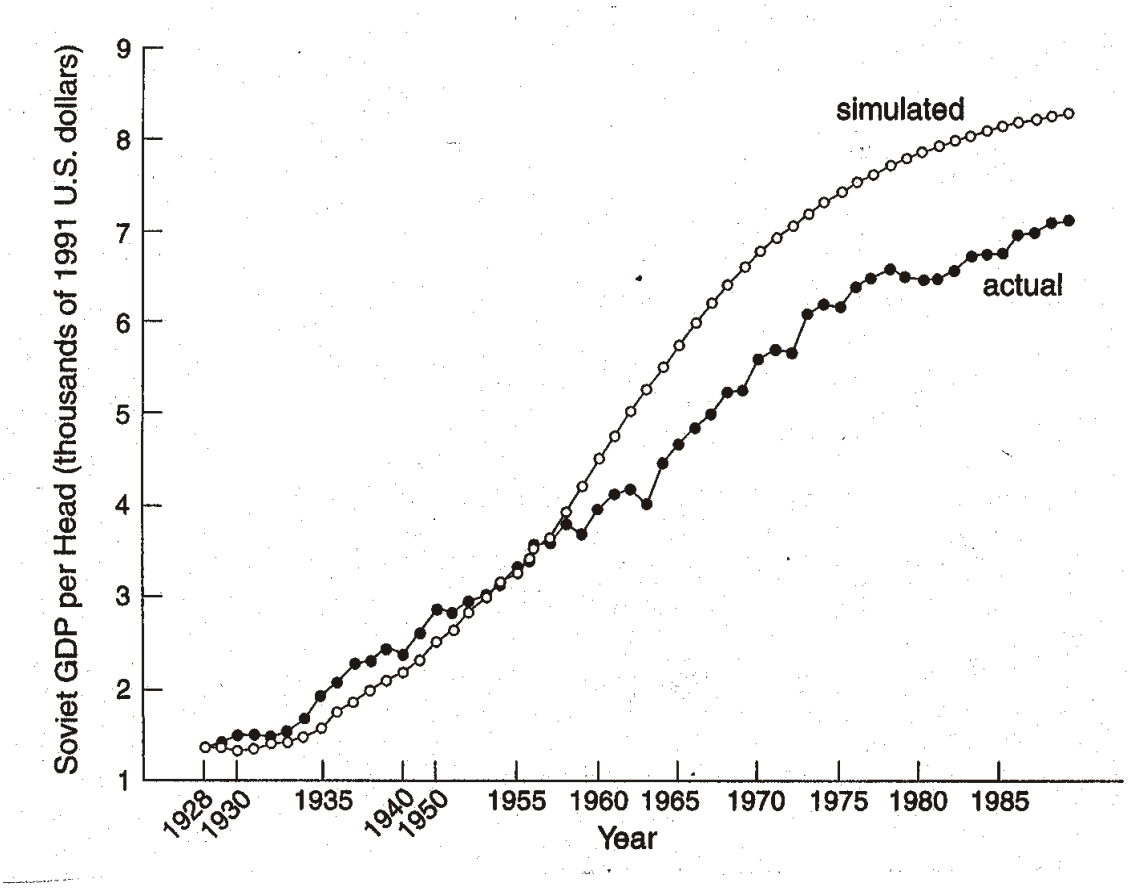


Figure 9

Actual and Simulated Soviet GDP per Head, 1928-89



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