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UNIVERSITÀ DEGLI STUDI DI MILANO AUGUST 8 - 14

AGRICULTURE IN AN INTERCONNECTED WORLD



Russia's Potential to Increase Grain Production by Expanding Area

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Abstract

Since 2000, Russia has substantially increased grain production and exports. The grain output growth has come from a rise in yields rather than area. After falling heavily during the 1990's, grain area stabilized during the 2000's and has remained flat, at about two-thirds the level of the late Soviet period. Using data on the regional structure of Russian grain production costs, this paper examines the country's potential to increase grain output further by returning the lost grain area to production. The analysis finds that if grain area were to grow beyond a certain level, that is still well below the level of the late Soviet period, production costs would rise steeply. Therefore, any major expansion in grain area would require that world grain prices rise considerably beyond their level in the early 2010's, to cover the high marginal costs of production.

Disclaimer: The views expressed in this paper are those of the authors, and may not be attributed to the Economic Research Service or the U.S. Department of Agriculture.

1. Introduction

Since 2000, the three major grain-producing countries of the former Soviet Union – Kazakhstan, Russia, and Ukraine (KRU) – have become a large grain-exporting region. Gross grain exports by the KRU region during 2011-13 averaged 58 million metric tons (mmt) a year, 20 percent of the world total, with net exports little different at 56 mmt (average annual; USDA PS&D).¹ In contrast, during its last decades, the Soviet Union was a major grain importer, with average annual net imports over 1987-1990 of 31 mmt. Russia specifically has moved from average annual net grain imports over 1987-90 of 22 mmt to net grain exports over 2011-13 (average annual) of 21 mmt (figure 1).

(figure 1)

The emergence of Russia, along with Ukraine and Kazakhstan, as a major grain exporter is important not only for world commercial agriculture, but also could be for world food security. The surge in world agricultural and food commodity prices in 2006-2008 and again in 2010-12 raised concerns about the world's ability to feed an ever-growing population. Increasing the production of grain is central to meeting this challenge, both to provide sufficient food grain and to satisfy the demand for animal feed, especially as income growth in emerging market economies raises demand for meat and other livestock products. Writing in *Science*, Godfray et al. (2010) state that the earth's population is projected to rise to about 9 billion by 2050 (from almost 7 billion in 2010), which could require an increase in food production of 70-100 percent. Food production would rise by a greater proportion than population because growing world affluence increases demand for high value food products, such as livestock goods and processed foods. However, the upward pressure on food prices could hurt the world's poorest food consumers. The diversion of various types of crop output (such as corn and oilseeds) to biofuels production puts further strain on world food prices and supplies. The *World Development Report 2008* by the World Bank argues that to satisfy projected world demand, grain production must increase from 2000 to 2030 by nearly 50 percent.

Many observers see the KRU as a region with strong (and perhaps the most) potential to strengthen world food security by expanding grain production and exports – and especially Russia, the region's biggest grain producer. Although grain output in all three KRU countries

¹ By net KRU grain exports, we mean exports net of trade among the three KRU countries themselves, as well as net vis-à-vis the rest of the world.

has risen substantially since the late 1990's (figure 1 for Russia), Russian grain output over 2011-13 was about a sixth below the levels in the late Soviet period, and overall KRU grain output was also down (over the equivalent time).² A 2008 report by the European Bank for Reconstruction and Development (EBRD) and Food and Agriculture Organization (FAO) argues that the KRU region has strong potential to expand grain production, by increasing both yields and area. As with production, KRU grain yields during transition have also been U-shaped (figures 1 and 2 for Russia). By 2001-2005, the Russian grain yield had risen above that in 1986-90, and since 2005 yields have increased even more. However, KRU grain yields are still below levels in the developed Western countries, prompting the argument that KRU grain production can continue to grow by moving to Western yield levels (EBRD and FAO 2008).

(figure 2)

Grain area in all three KRU countries fell substantially during the 1990's (figure 2 for Russia). In the 2000's, area rose in Ukraine and Kazakhstan, while in Russia it continued to fall during 2001-05, and since then has remained generally flat. Since 2005, Russian grain area has been about two-thirds the level of the late Soviet period. Although the drop in Russian grain area accelerated during the transition decade of the 1990's, grain area had in fact been falling since hitting its peak in the early 1960's as part of Khrushchev's "Virgin Lands" campaign (figure 2). This venture expanded grain production into arid and previously unfarmed regions in Russia and Kazakhstan (see McCauley 1976).

Various observers and specialists (such as Rau 2012) argue that KRU, and especially Russian, grain output can increase by returning lost grain area to production. In a 2012 speech at the Global Forum for Food and Agriculture in Berlin, EBRD President Thomas Mirow stated that "vast areas of land (in Eurasia) can be returned to production at limited environmental costs" (http://www.ebrd.com/pages/news/speeches/mirow_120120.shtml). At the Global Forum in Berlin in 2011, Russian agricultural specialists discussed the possibility that Russian grain area might move to not just the level of the late Soviet period, but to its historical peak during 1961-65 of 80 million hectares, 21 percent above the level of 1986-90 and 78 percent above that in

² Liefert and Liefert (2012, p. 48, Tables 4-5) provide data on grain production, net trade, area, and yield for generally 5-year periods (average annual) from 1987-91 to 2006-10, for each KRU country and the KRU region in the aggregate.

2011-12 (figure 2).³ The Russian government, led by President Putin, has stated that expanding idled farmland will be a priority for the agricultural program covering 2013-20 (Interfax, April 12-18, 2012).

Other analysts, however, are skeptical about Russia's potential to increase cropland substantially. USDA (2008) argues that much of the abandoned land was in risky marginal areas with high production and reclamation costs, such that it would be economically rational for it to remain unused. Based on talks with Russian producers, officials, and independent analysts, that USDA report opines that no more than one fourth of the country's cropland abandoned since 1990 will ever likely return to production. Uzun et al. (2014) supports this view, arguing that most of the country's abandoned cropland lacks the bioclimatic potential for profitable operations, such that production would involve very high costs. Based on projections by EBRD and FAO, Swinnen and Van Herck (2011) contend that of all Russia's agricultural land abandoned since the late Soviet period, only 6 million hectares (and 13 million of total KRU idled land) could feasibly be returned to grain production.

This paper examines Russia's potential to increase grain area, by investigating the country's regional cost structure for grain production. By "potential," we do not mean the pure physical/material ability to do so; if made a priority of state policy backed by strong resources and little concern for costs, returning grain area to the late Soviet level (and higher) is almost certainly possible. Rather, we mean whether a major expansion of grain area is economically rational and thereby likely. Russia's vastness and regional variation result in large differences in grain production costs between regions. After first examining the regional production cost structure, the paper analyzes how high Russian grain prices would have to increase to motivate a return of most of the idled land to production, with the high prices needed to cover rising output costs.

The paper is organized as follows. The second section discusses why Russian grain production and exports have grown substantially since 2000. The third section investigates the potential for Russia to expand grain area by analyzing the regional cost structure of production, while the fourth section (prior to the Conclusion) examines the increase in grain prices that might be necessary to return idled Russian grain area to production.

³ Although only power-points rather than papers were presented at this session (titled "Russia's Role in World Food Supply"), the session titles and presenters can be found at <http://www.aht-group.com/index.php?id=348>.

2. Growth in Russian Grain Production and Exports since 2000

Liefert and Liefert (2012) provide an overview of Russian (and to a lesser degree all KRU) agriculture during the country's past two decades of transition from a planned to a market economy, while Liefert, Liefert, and Luebehusen (2013) examine why Russia (and the KRU region more generally) emerged in the 2000's as a major grain exporter. There were two main reasons for the latter. The first was an overall restructuring of these countries' agricultural production, consumption, and trade as they moved to (fairly) open market economies in the 1990's. This restructuring reduced the livestock sector by over half (both herds and animal inventories), which substantially reduced the countries' demand for animal feed. Rather than importing grain, soybeans, and soybean meal to feed an over-expanded and high cost livestock sector, Russia became a large meat importer and, by the 2000's, a large grain exporter. The decreased need for animal feed was so great that Russia (and the KRU region) was able to move from a big grain importer during the Soviet time to an exporter in the 21st Century, despite a large drop in grain production in the 1990's (figure 1 for Russia), and with grain output even by 2011-13 still below the level of the late 1980's. (Throughout this paper, all numbers given for Russian grain production, area, yields, and trade cover all grain products, including rice, sorghum, and pulses.)

The second reason Russia (and the other KRU) has become a big grain exporter is substantial growth in grain production since 2000, which has provided surpluses for export. As discussed earlier, the Russian output increase has been driven by rising yields rather than area (figure 2). It appears that the yield growth resulted from rising input productivity in Russian agriculture. Bokusheva, Hockmann, and Kumbhakar (2012) calculate that between 1999 and 2008, total factor productivity (TFP) in Russian agriculture grew by about 25 percent, while Swinnen, Van Herck, and Vranken (2012) compute that between 2000 and 2007 agricultural TFP rose by 54 percent. These two studies, however, cover all Russian agriculture rather than just the grain economy. Liefert, Liefert, and Luebehusen (2013) estimate that in the Russian grain sector factor productivity increased from 1996-2000 to 2001-05 by at least 20 percent.

What farm-level changes might have generated the productivity growth? During the 1990's, the large former state and collective farms of the Soviet period remained pretty much intact. Although most officially reorganized as corporate farms owned by their managers and

workers, during the 1990's they remained largely unreformed in structure, managerial practice, and operations. Individual farm households had the opportunity to take a share of their parent farm's land to operate as an independent producer (called private family farms), but most declined to do so. By 2012, these private farms, which typically range in size from 50 to 150 hectares, produced less than 10 percent of Russia's total agricultural output (Liefert and Liefert, 2012).

However, in the 2000's a new type of agricultural producer emerged, which Rylko et al. (2008) call "new operators." These tend to be large enterprises that bring investment, new technology, and superior managerial practices into the sector. They are market-oriented and profit-driven, and they cut waste and costs. A particular class of these new operators is the very large agroholdings, which are vertically integrated enterprises that typically combine primary production, processing, distribution, and sometimes retail sale (Gataulina et al. 2005; Serova 2007; Rylko et al. 2008). The agroholdings usually acquire a number of existing agricultural enterprises and try to improve them. They and the other new operators appear to represent current best production practice in Russian agriculture, and therefore are a likely key force behind the growth in Russian agricultural productivity since 2000, as well as the rise in grain production and export.

3. Russian Grain Production Costs and the Potential for Area Expansion

Given that grain yields have been rising in Russia since 2000, what is the potential for the country to achieve the double thrust for grain production from also increasing grain area? To address this question, we examine the structure of grain production cost within Russia by region, using data from the late Soviet period.

The 1996 annual publication by the Russian Ministry of Agriculture provides the *sebestoimost'* of producing a metric ton of grain in all 70+ of the country's governmental regions (mostly called *oblasts*) in 1990. *Sebestoimost'* (translated as "production cost") was the standard Soviet measure of the cost of producing goods, and included the value of labor, material inputs, such as fertilizer and fuel for agriculture, and capital depreciation. Although *sebestoimost'* excluded an interest charge on physical capital, it covered the bulk of costs that market-generated prices would encompass (Bornstein 1987).⁴

⁴ The reason *sebestoimost'* excluded a capital charge is because it was based on the Marxian labor theory of value,

The Soviet planning and pricing system generally assigned the same price to any specific material input allocated to state and collective farms throughout the country, with the addition of a variable (by region) transportation charge. The average (sebestoimost') cost of producing grain or any other commodity within a region was calculated as the average cost of production among all producers within the region. A commodity's production cost within a region served as the basis for the good's state-set price, with price generally equaling cost plus a profit markup (which could be interpreted as covering the interest charge on physical capital used in production). Liefert (1990) and Liefert (1991) are examples of published research that used sebestoimost' as the basis for determining economically meaningful cost-generated values for Russian agricultural goods, and then employed these values in empirical economic analysis.

As we explain later in this section, our analysis requires and uses, not absolute grain production costs within regions, but rather relative costs between regions. The sebestoimost' values of Soviet grain production between regions can therefore serve as proxies for these relative productions costs for the "current" time (the early 2010's).

We construct a curve that gives the relationship between (1) the sebestoimost' of producing grain in 1990 (henceforth abbreviated to *cost*) and (2) grain area (figure 3). On the vertical axis, we put the cost of grain production by region. We order the regions from lowest cost to highest cost. The plot gives each region's area at its average cost. As a result, any point on the curve identifies the cumulative (sum of) area from all the regions that produced at an average cost less than or equal to the production cost associated with that point. For example, figure 3 identifies that in the late Soviet period, 61 million hectares of area produced a ton of grain at an average cost less than or equal to 200 rubles.

(figure 3)

Although the grain area numbers are average annual values over 1986-90 (Russian Ministry of Agriculture and Food 1994), the grain production costs in figure 3 are for 1990 alone. This is because we could find grain production cost data by region for only that year.

Figure 4 gives the corresponding relationship between Russian grain production cost (sebestoimost') in 1990 by region and grain output over 1986-1990 (average annual), again

which claimed that only labor can add value to goods. The value of material inputs and capital depreciation covered the past (or embodied) labor required to produce these goods. In the late 1980's, the share of labor in total value-added in the Soviet economy was estimated at 50-55 percent (IMF et al. 1991). However, labor's share was apparently higher in agriculture, with CIA (1990) calculating labor's share at six times that of capital.

ordering the regions from low production cost to high cost. For example, figure 4 shows that in the late Soviet period, 99 mmt of grain were produced at an average cost less than or equal to 200 rubles.

(figure 4)

Figures 3 and 4 show that in the late Soviet period, the bulk of Russian grain was produced in regions with fairly low cost. Of the 104 million metric tons (mmt) of grain produced during 1986-90, 89 mmt (86 percent) was in regions with a per ton average production cost of 140 rubles or less, and with regional average cost varying between only 80 and 140 rubles (figure 4). Correspondingly, of the 65 million hectares of total grain area during 1986-90 (average annual), 54 million (83 percent) was in regions with a per ton average cost of 140 rubles or less (figure 3). However, as production moves into regions with per ton cost above 140 rubles (beyond the 54 million hectare mark), output cost increases substantially, and especially so after production moves into regions with per ton cost above 200 rubles (the 61 million hectare mark). The rise in grain area from 54 to 65 million hectares increases the average production cost in the highest cost region from 140 rubles to above 400 rubles.

The reason the cost-output curve in figure 4 is steeper than the cost-area curve in figure 3 in the high cost regions is because as production moves into these regions, yields fall (the inverse relationship between productivity and costs). The percent increase in output is therefore less than the percent increase in area.

In the centrally planned command economy of the Soviet Union, the geography of production and consumption of both industrial and agricultural goods was determined not by markets, but by the planners. For industrial sectors, Soviet planners tended to concentrate production in a few key regions (or even just a few mammoth plants). In agriculture, however, the opposite approach of regional self-sufficiency rather than specialization was generally pursued, whereby regions tended to produce a wide array of products that met the bulk of their consumption needs. Cost minimization and comparative advantage were not among the main drivers of regional agricultural production. The agricultural policy of regional self-sufficiency and non-specialization helps explain why Russian grain production (and overall agricultural output) fell so heavily in the 1990's, once central planning could no longer mandate production in high cost regions. Yet, although planners' preferences rather than consumer demand-driven markets determined what agricultural goods were produced and where, and with consumer

demand not playing a role in price formation, Soviet-calculated production costs can serve as the basis for economically meaningful cost-based prices and values of these goods.⁵

During 2011-12, average annual Russian grain area was 44 million hectares.⁶ In the rest of the paper, we define *low cost regions* as those that had an average cost of production in 1990 less than or equal to 140 rubles. This is the 1990 production cost associated in figure 3 with 43-54 million hectares of grain area during 1986-1990 (average annual). We define *high cost regions* as those that had an average cost of production in 1990 greater than 140 rubles. Grain area has declined since the late Soviet period such that all “current” (2011-12) area could be within the country’s low cost regions.

However, the data show that grain production has not ceased entirely in the high cost regions, nor has all the decrease in Russian grain area and production since the Soviet period occurred in just those high cost regions. The high cost (less productive) grain area during 1986-90 totaled 11.5 million hectares. Of this amount, 7.5 million hectares went out of grain production by 2011-12, while 4.0 million hectares (35 percent) still remained in production. Of the 53.6 million hectares of low cost grain area during 1986-90, 39.4 million hectares remained in grain production by 2011-12, while 14.2 million (26 percent) went out of grain production (Russian Federal Service of State Statistics (a)).

Although the high cost regions lost a much greater share of their grain area than the low cost regions (65 versus 26 percent), it might seem puzzling that grain area in the low cost regions fell by as much as a quarter. Part of the explanation is that some of the grain area lost since the Soviet period did not become idle, but rather was switched to other crops, specifically oilseeds (EBRD and FAO 2008). Oilseeds are the only crop group for which Russian area has increased since the Soviet period. Average annual oilseeds area during 2011-12 was 10.3 million hectares, almost triple the 3.7 million during 1986-1990 (Russian Federal Service of State Statistics (b)).

⁵ The Soviets followed a policy of regionally differentiated prices for agricultural commodities, whereby regional output costs determined regional prices. Output in high (low) cost regions were assigned correspondingly high (low) prices (Bornstein 1987). This price system allowed the command economy to extract the rents that low cost producers could potentially earn from favorable production conditions (such as soil and weather).

⁶ Although total Russian grain area and output data were available to the authors through 2013 (as reflected in figures 1 and 2), area and output data by region were available through only 2012. This is why in our regional-based analysis, the most recent (and what we sometimes call “current”) period for which we give area and output data is 2011-12. However, the difference in total (average annual) Russian grain area during 2011-12 (44.0 million hectares) and during 2011-13 (44.6 million) is slight.

Oilseeds production requires good soil and climatic conditions. Given that the Soviet regime expanded crop production on to much high cost marginal land, it is highly likely that virtually all the increase in Russian oilseeds area since 1990 has come from taking quality area from other crops rather than bringing virgin land into production. It is also quite likely that almost all the oilseeds' area growth came at the expense of grain. No other crop group comes as close to oilseeds in terms of the physical conditions (soil and weather) conducive to production. After grain, sugar beets and potatoes are the next closest. In addition to using land not very suitable for oilseeds production, from 1986-90 to 2011-12 these crops combined lost only 1.3 million hectares of area.

The third strong likelihood is that virtually all the switch in area from grain to oilseeds occurred in the low cost grain regions. The only oilseed for which we could find production data by region (from the Russian Federal Service of State Statistics) is sunflowerseed, though that commodity accounted for about 70 percent of Russian oilseeds production in 2011-12. From 1986-90 to 2011-12, over 99 percent of the increase in Russian sunflowerseed area came in the grain low cost regions.

From the data and previous analysis, we can conclude that of the 21.7 million hectare drop in total grain area from 1986-90 to 2011-12, a little over one third was in high cost regions and became idle land, a little over one third was in low cost regions and also became idle, and a little under one third was land in low cost regions that switched from grain to oilseeds production.

Figure 5 gives the percent decline in grain area from 1986-90 to 2011-12 for the major geographic divisions of Russia. The Russian Federal Service of State Statistics (Rosstat) groups the country's regions into 8 divisions: the Northwest, Central, South, Northern Caucasus, Volga (which covers the mid and upper Volga), Ural, Siberia, and Far East. In figure 5, we reduce Rosstat's eight divisions to five: the South, Central, North, Ural, and Siberia. Our South division combines the South and Northern Caucasus divisions from Rosstat; our Ural division is exactly the same as the Ural from Rosstat; and our Siberia division combines Siberia and the Far East from Rosstat.

(figure 5)

Our Central and North divisions are a regrouping (to better reflect climatic differences) of Rosstat's Northwest, Central, and Volga divisions, with their composition determined as follows.

The latitudinal line to which the city of Moscow is closest is the 56th parallel. The Central division covers those European regions between the South and the 56th parallel, while the North division covers the European regions north of the 56th parallel. For regions cut by the 56th parallel, a region is included in the Central (North) if more than half of its area is south (north) of the 56th parallel. With this approach, all of Rosstat's Northwest division goes into our North, while some regions within Rosstat's Central and Volga divisions go to our North and some to our Central. Our North, Central, and South divisions are all within European Russia.

In figure 5, the right side axis identifies the average cost of grain production within each division in 1990. In the North, average cost of grain production in 1990 was 235 rubles, and from 1986-90 to 2011-12 it lost 72 percent of its grain area. The average 1990 grain production cost in the South, which contains Russia's best grain-producing land, was 93 rubles, and over the equivalent time, grain area within the division dropped by only 9 percent. From 1986-90 to 2011-12, area for sunflowerseed alone increased in the South by more than the area decrease for grain of 1.0 million hectares. This shows that grain area in the South declined not because costs for some volume of output were too high for production to be sustained, but rather because some land switched from grain to competing oilseeds.

The move of some area from grain to oilseeds production also helps explain why the Central division experienced such a large drop in grain area from 1986-90 to 2011-12 of 36 percent. Between these two periods, sunflowerseed area in the Central division rose by 3.2 million hectares, and rapeseed area also increased somewhat. If this switch to oilseeds had not occurred, grain area in the Central division would have declined by about a quarter.

Our analysis and results are consistent with the study of Russian land abandonment by Ioffe, Nefedova, and De Beurs (2012). That study focuses on the two oblasts of Kostroma and Samara. Kostroma is situated to the northeast of Moscow, consists mainly of forest, has poor soil and a short grain growing season, and is included in our North division. Samara is on the middle Volga, has much better soil and weather conditions for grain production (though not Russia's best), and is included in our Central division. Ioffe finds that from 1990 to 2010, Kostroma lost well over half of its total sown agricultural land, while Samara lost less than half. The cost of grain production (sebestoimost') in Samara in 1990 was 110 rubles per ton, and in Kostroma almost three times as high at 320 rubles. From 1986-90 to 2011-12, grain area in Samara fell by 49 percent, while in Kostroma it declined by 84 percent. Ioffe, Nefedova, and De

Beurs also provides an informative examination of the specific issues and challenges that these two regions have faced involving land abandonment.

Another qualification to our analysis involving the relationship between regional grain production costs and changes in grain area is that the absolute costs of grain production almost certainly changed from the late Soviet period to the early 2010's. On the other hand, it is unlikely that relative grain production costs between regions have altered substantially since the late Soviet time. The main cause of the differences in regional production costs is disparities in soil quality and climatic conditions for production, such as temperature and precipitation, with most of the high cost regions being in the northern and eastern parts of the country, and the low cost regions in the south and west (though we put western regions into our Central division). Ioffe et al.'s study of land abandonment in Kostroma and Samara oblasts demonstrates these points well. The natural conditions affecting crop and grain production across regions probably changed little between the beginning and end periods of our analysis.

Two observations follow from figures 3 and 4. The first is that Russian grain area and output have dropped from the Soviet period in a way consistent with (predictable from) the country's regional production cost structure, whereby after a certain level of area use, production costs begin to escalate sharply. The second is that in order for the lost grain area to return to production, world grain prices would have to rise considerably from their level in the early 2010's, to cover production costs in these higher cost regions. In addition, some of the grain area decline has occurred not from land going idle but rather switching to oilseeds (mainly sunflowerseed) production. This former grain area might be permanently lost to that crop, unless grain prices were to rise substantially *relative to* prices for oilseeds.

The analysis in this section indicates that the economic potential, or likelihood, for Russia to expand grain area to a major degree, such as to the level of the late Soviet period, appears small. This conclusion is consistent with the views discussed earlier of USDA (2008), Swinnen and Van Herck (2011), and Uzun et al. (2014). Furthermore, returning grain area to the historical peak level during 1961-65 of 80 million hectares would require tremendously higher prices to cover the apparently huge production costs.

4. Higher Grain Prices Needed to Expand Grain Area

In this section we provide a deeper analysis of the extent to which grain prices would

have to rise to return the lost grain area to production. We first examine an approach that has the benefit of being fairly precise, though requiring some strong assumptions not sufficiently supported by the data, and then an approach that is more general but also more realistic. We begin with the first approach because it provides the analytical basis for the second.

The first approach requires some assumptions, mainly involving production costs. However, we begin with some background discussion concerning the costs of grain/crop production. Following conventional economic terminology, the marginal cost (MC) of producing grain is defined as the cost of producing one additional unit of output, such that when a production season is over, MC is the cost of producing the *last unit of output*. Within countries, the MC of crop production typically increases with output, a major reason being that some regions have more favorable natural conditions of production. As production moves from the more to less favorable regions, output costs rise.

However, the MC of grain/crop production can also vary within regions, such that it rises with additional output within a given region. This is mainly because once sowing is completed, area is fixed, and producing more output on a set amount of land requires increasing amounts of variable inputs, such as labor and fertilizer. Also, soil quality can differ within regions, which also generates rising MC of output as production moves to less fertile land.

Our first assumption in this analysis is that although the MC of grain production can rise within regions, MC values do not overlap between regions; that is, the highest MC value within a region is below the lowest MC value of the next higher cost region (ordering regions from lowest to highest cost). With this assumption, figure 3 shows the general relationship between MC and area for the entire grain economy, and figure 4 gives the general MC of grain production.⁷

The next assumption (alluded to earlier) is that *relative costs* of grain production between regions are unchanged from 1990 (which does not require the assumption that absolute production costs within regions are unchanged). This assumption means that although the exact position of the current cost-area curve as presented in figure 3 (or say the curve for 2011-12) differs from that for 1990, its general shape is the same. In particular, the percent increase in costs associated with an increase in area of a given percentage would be the same in the current time as in 1990.

⁷ The one qualification is that if MC rises within regions, the horizontal stretches of the curves in figures 3 and 4 should not be horizontal but rather have some upward slope.

The last assumption is that the grain sector is competitive. Consequently, producers will maximize profit if they produce at the volume where the output price equals MC. With this assumption, figure 3 can be used to present not only MC as a function of grain area, but also area as a function of the grain output price (the two curves derived from these functions coincide).

As mentioned earlier, during 2011-12 average annual Russian grain area was 44 million hectares. This area was generated by producers' responses to grain prices during that time. Using figure 3, we index these prices at the value of 140, the per ton ruble cost of production (sebestoimost') associated in figure 3 with 44 million hectares (though spanning 43 to 54). Given the above assumptions, in order for Russia to return to the late Soviet grain area of 65 million hectares,⁸ grain prices would almost have to triple from an index of 140 to about 400 to cover the high costs of production.

The assumption that MC values within each region do not overlap with MC values in any other region means that all the area (and output) in regions with an AC greater than 140 rubles in 1990 should have been eliminated by 2011-12. In addition, regions with AC less than 140 rubles in 1990 should not have lost much if any grain area. The data, however, contradict both of these points. Most high cost regions within Russia continued to produce some output over the period 2011-12, while all but five of Russia's 70+ regions lost some grain area between the late Soviet period and 2011-12. As we presented earlier, of the 11.5 million hectares of high cost grain area during 1986-1990, 4.0 million hectares continued in production during 2011-12, while of the 21.7 million hectares of lost Russian grain area between the late Soviet period and 2011-12, 14.2 million was in low cost regions (Russian Federal Service of State Statistics (a)).

We therefore take a more general and less assumption-based approach in assessing how high Russian grain prices would have to rise to return the lost grain area to production. Although this method is less precise, it is consistent with the data, and provides a reasonable idea of the magnitude of the required price increase. We argue that the "current" national MC of grain production in Russia is *roughly revealed* in figure 3 by production cost in the regions associated with 44 (43-54) million hectares. Consequently, to return to the 65 million hectares of grain area of the late Soviet period, grain prices (of the early 2010's) would have to more than double to

⁸ From 1986-90 to 2011-12, grain area in five of Russia's regions (all in the European South) rose rather than fell, by a total of about half a million hectares. This means that if the grain area lost in all the country's other regions were returned to grain production, and the increased area in these five regions were retained, total grain area would be higher than in 1986-90 by half a million hectares.

cover the high costs of production.

The only assumptions we retain from the previous approach are that the relative cost structure of regional grain production (that is, regional production costs relative to each other) is unchanged since 1990, and that the Russian grain market is generally competitive. Although the first assumption certainly does not hold completely, one can argue that relative grain production costs between regions probably have not changed substantially since the Soviet period. As discussed earlier, the differences between regional production costs result mainly from disparities in soil quality and climatic conditions for grain production.

However, this assumption involving unchanging relative regional production costs requires a major restatement. Recall the definition given earlier for the MC of grain production, that once the producing season is over, MC is the cost of producing the last unit of output. Using this definition, regional relative MC values almost certainly *have changed* between 1990 and 2011-12. This is because area in the high cost regions has decreased considerably, which we discussed previously, as production in high cost regions could not be maintained in the new market economy. As output in high cost regions has declined, MC in those regions has fallen, thereby altering regional relative MC values. Therefore, the appropriate statement of the assumption concerning regional production costs is that if all the area lost to grain production *were returned to production* in all regions, the relative marginal costs of grain production between regions would be pretty much unchanged from 1990.

The previous assumption that we drop is that the MC values of grain production do not overlap between regions. Yet, without that assumption, how can we argue that the current national MC of Russian grain production in Russia is given even roughly in figure 3 by production cost in the regions associated with 43-54 million hectares? In order for the argument to hold, we must reconcile it with the fact that higher cost regions in 2011-12 were still producing grain on 4 million hectares of area.

Our main argument is that these high cost regions most likely had some lower cost output, just as low cost regions probably had some higher cost output. More specifically, we mean that in regions with 1990 AC greater than 140 rubles, some output in those regions had MC less than 140 rubles, while in regions with AC less than 140 rubles, some output had MC greater than 140 rubles. The consequence would be that as total grain area fell from the late Soviet period to 2011-12 from 65 to 44 million hectares, it would still be economically rational for the

low cost area within the high cost regions to remain in production, such that the high cost regions continued to produce some grain. Likewise, it would be rational for the high cost output in the low cost regions to be eliminated (as the high cost area went out of production). Low cost grain regions having some high cost output also helps explain why these regions have lost grain area since the Soviet period (in addition to ceding some area to oilseeds production).

There are two other likely reasons why high cost regions continued to produce some grain during 2011-12, or in other words, why production should continue to occur even on some high cost area within these high cost regions (AC greater than 140 rubles in 1990). One reason is government subsidies to agriculture. Although Russian budget subsidies to agriculture fell during transition from the high level of the late Soviet time, they began to rise in 2006. From 2005 to 2012, total government support to agriculture increased in real terms by 166 percent (Russian Federal Service of State Statistics (b)). Subsidies can allow output to occur in areas that otherwise would be not be price-competitive based on high production costs. Over half of agricultural subsidies come from regional governments (as opposed to the federal budget), and regional authorities continue to be concerned about both the viability of farms and food availability within their jurisdictions (Interfax).

The other likely reason why many of the high cost regions produced grain during 2011-12 on some high cost area is that they were net grain importers (given that high cost regions would tend to be net importers and low cost regions net exporters). Consequently, producers in high cost regions were protected by the transport and transaction (TT) costs of importing grain from lower cost regions within the country. Most of the high cost regions are in remote parts of the country in the north and east. Market competition would result in production cost in an importing high cost region equaling production cost in the region(s) from which it imports grain, plus the TT cost. TT costs therefore would allow these importing regions to produce at higher cost than low cost regions.

Both government subsidies and the TT required to ship grain to remote high cost regions can generate some grain production/area in high cost regions at a cost above what otherwise would be the highest, or marginal, cost of production within the country (which we argue during 2011-12 was given roughly by cost in the regions whose average cost per ton in 1990 equaled 140 rubles).

Given that figure 3 provides a basis for assessing how Russian grain area could respond

to future prices, what are the projections for future grain prices that could motivate an area increase? OECD and FAO (2014) project that real (inflation-adjusted) world grain prices (including for wheat, corn, and barley) will fall from 2012 to 2015, and then rise a bit, though prices in 2023 will not exceed those in 2012. USDA (2014) projects that U.S. real grain prices (which should closely track, and influence, world prices) will generally behave the same as OECD and FAO project, with real 2023 prices again not above those in 2012. If these projections are correct, there will be no output price incentive for Russian (as well as other KRU) grain area to grow.

These projected grain prices reflect the assessment that world market forces will not provide the pressure for grain prices to rise by much (if at all) over the next decade. Yet, figure 3 shows that if future world grain prices were to increase, they would have to rise considerably (say double from the level of the early 2010's) to motivate substantial growth in Russian grain area.

Although the grain output price is probably the key variable in determining grain area, other factors and variables also play a role, in particular technology. Productivity-increasing technological change, as well as farm-level managerial improvements, could increase the demand for grain area. On the other hand, returning abandoned land to production would require a high fixed cost of initially clearing the land and making it suitable for farming. Russia also would have to invest heavily in improving the physical and commercial infrastructure for storing and transporting the additional grain, especially if the area expansion were in remote areas.

The abandonment of grain and other crop area within many regions has understandably coincided with a decline in these regions' labor force and rural depopulation, especially in the northern and eastern parts of the country (Ioffe, Nefedova, and De Beurs, 2012). Labor (especially skilled) in high cost agricultural regions might leave the sector not only because of their employing farm's poor performance, but also because of better employment prospects elsewhere, their region's social and cultural isolation and drabness, and the overall demoralization of local life, as indicated by widespread property theft and alcoholism (Ioffe, 2005). Whatever the reasons, in order for workers to be lured back to agriculture in these regions, they must receive higher wages/incomes than before to compensate them for their otherwise more desirable life elsewhere. Likewise, farms in regions which had a serious shortage of skilled and motivated agricultural labor to begin with would have to provide higher

pay to recruit such workers. However, higher wages would increase production costs.

5. Conclusion

Since 2000, Russia has substantially increased grain production and exports. The grain output growth has come from a rise in yields rather than area. Grain area fell steadily during the transition period, such that during 2011-12 it was about one-third below the level of the late Soviet period. The drop in grain area has motivated some observers and specialists to argue that Russia could expand grain output further by returning the lost area to production.

Using data on the regional structure of Russian grain production costs during the late Soviet period, this paper examines the country's potential to increase grain output by moving grain area to the level of the late Soviet time, or perhaps to the even higher peak magnitude of the early 1960's. The analysis finds that if grain area were to grow beyond a certain level, that is still well below the magnitude of the late Soviet period, production costs would rise steeply. This means that any major expansion in grain area would require that world grain prices increase considerably to cover the high marginal costs of production. Based on the data available to us, we argue that world prices might have to more than double from the level of the early 2010's in order for grain area to return close to the magnitude of the late Soviet period. It therefore appears unlikely that in the foreseeable future Russian grain area would move to that level, much less beyond it. Also, some grain area from the Soviet time has probably shifted irrevocably to oilseeds production.

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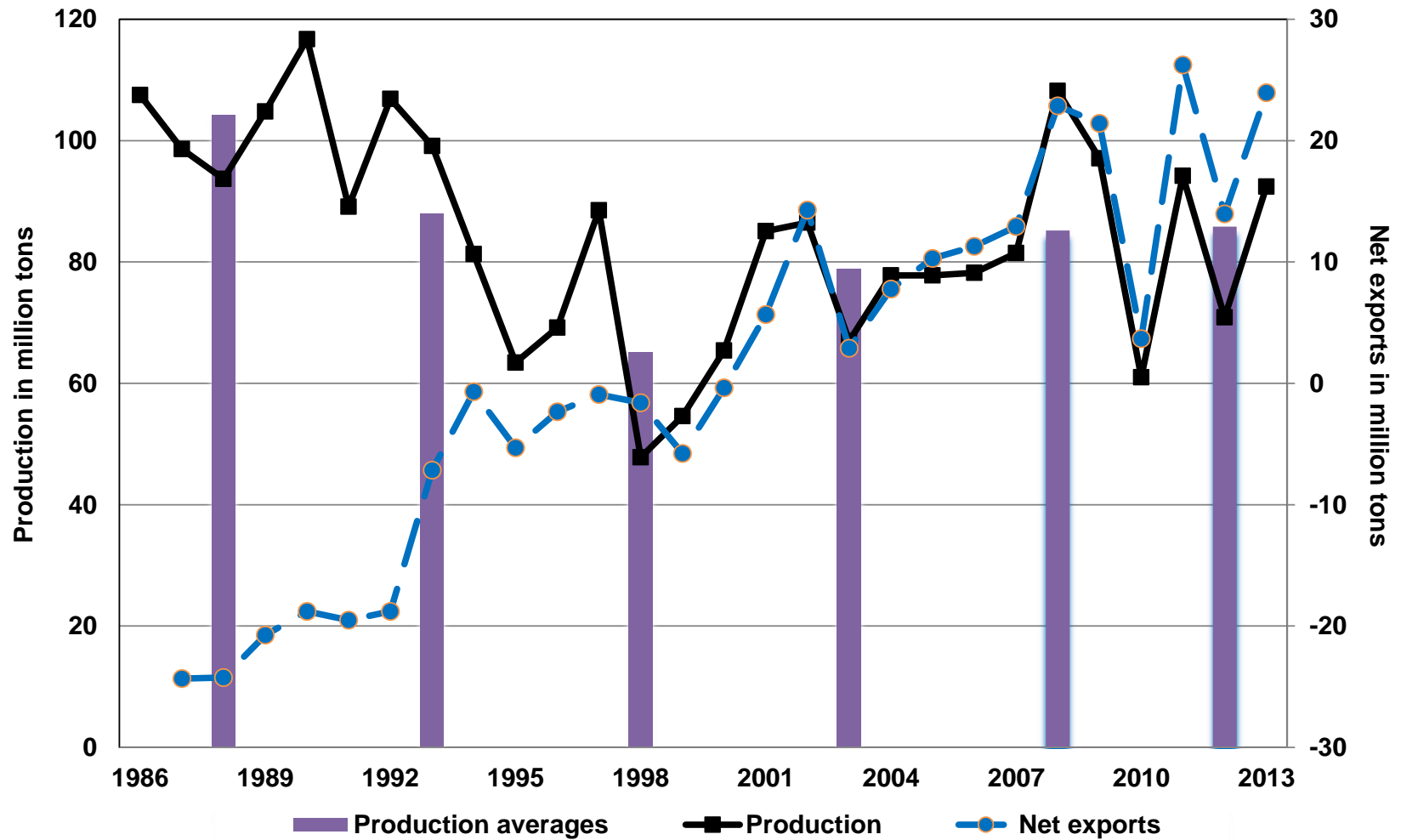
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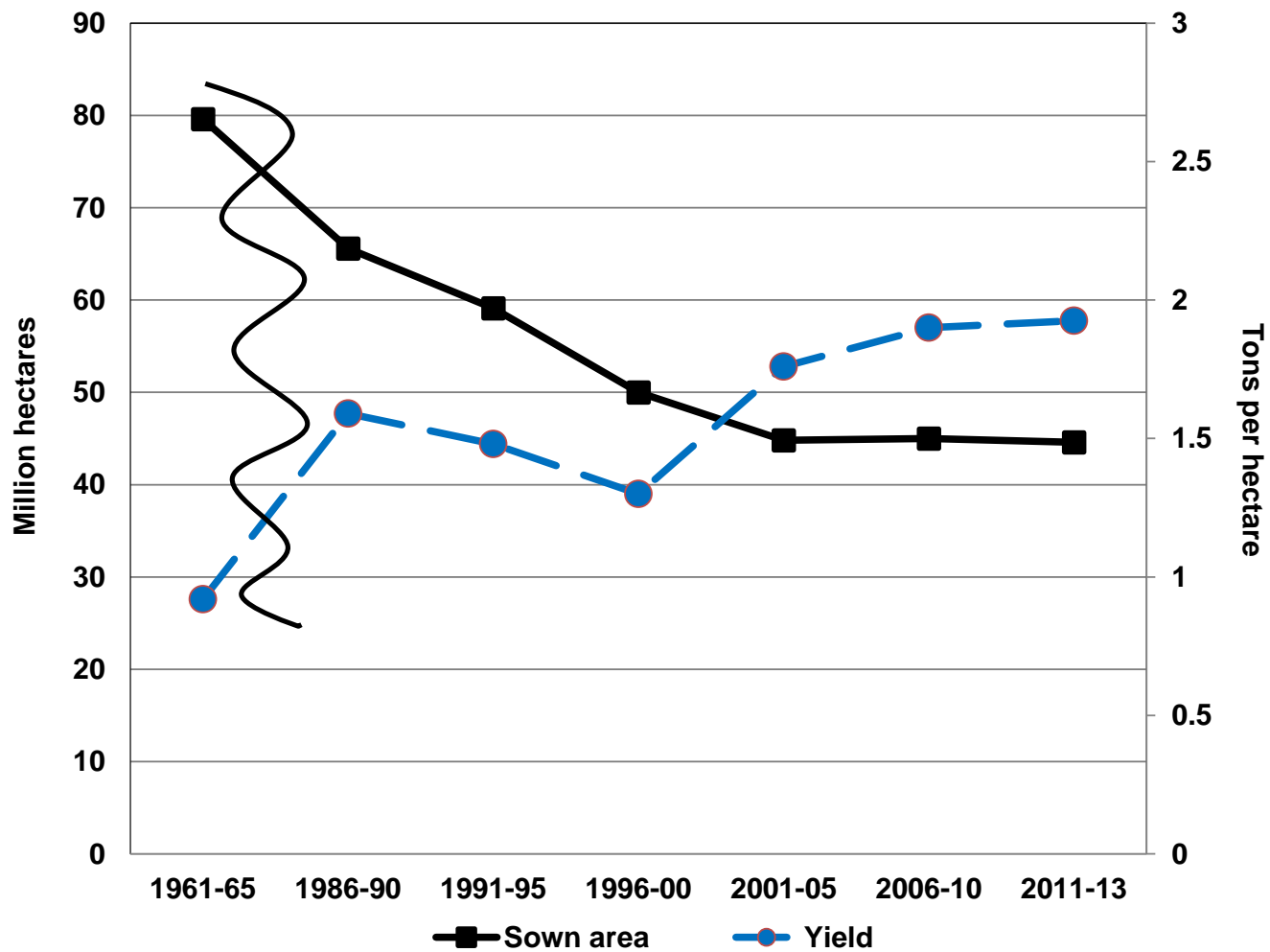
Figure 1. Russian Grain Production and Exports



Note: The bars give average annual grain production over the periods 1986-1990, 1991-95, 1996-2000, 2001-05, 2006-10, and 2011-13. Negative net grain exports are net imports.

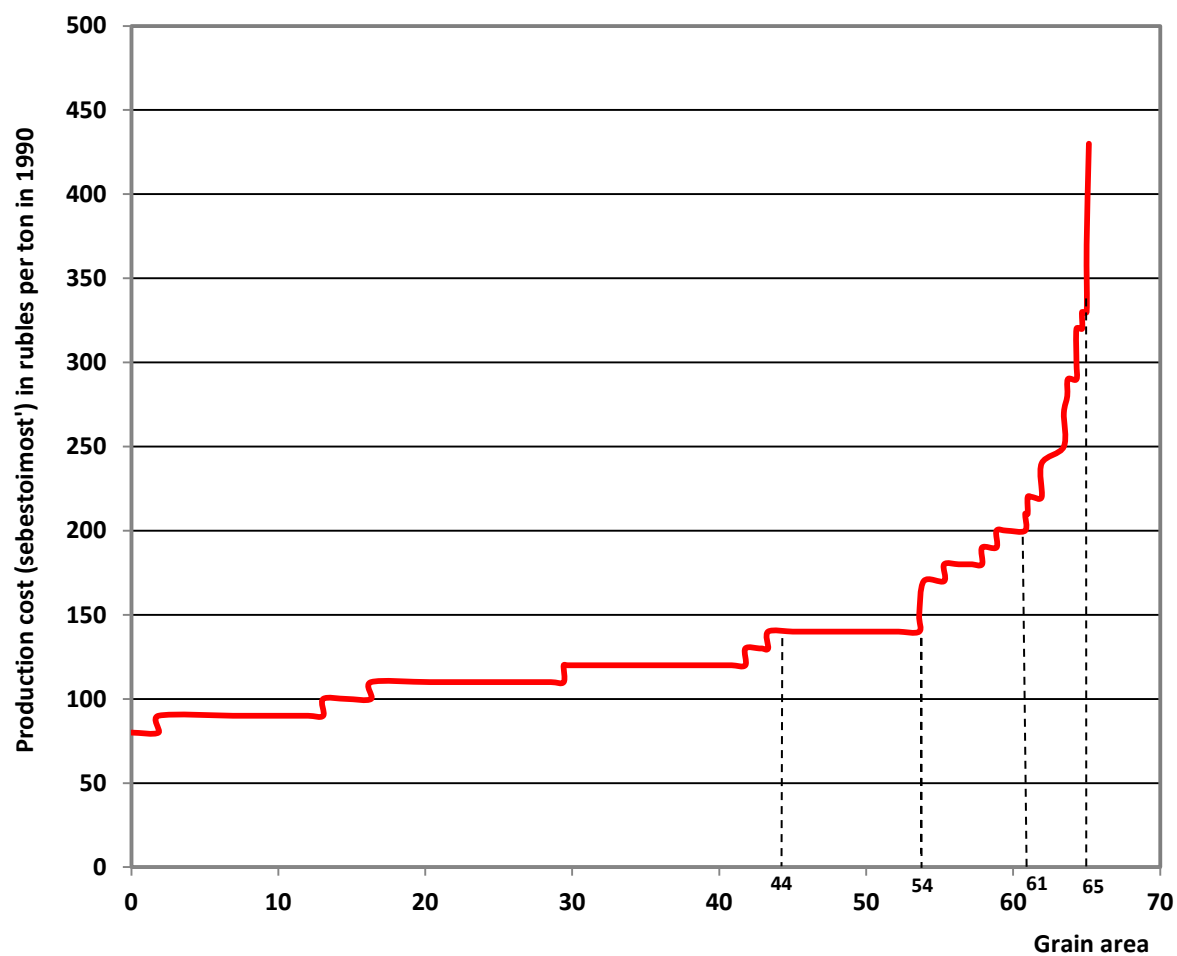
Source: Russian Federal Service of State Statistics; USDA PS&D.

Figure 2. Russian Grain Area and Yield



Note: The squares and dots in the curves give average annual values over the periods identified.
Yield is for sown, not harvested, area.
Source: Russian Federal Service of State Statistics.

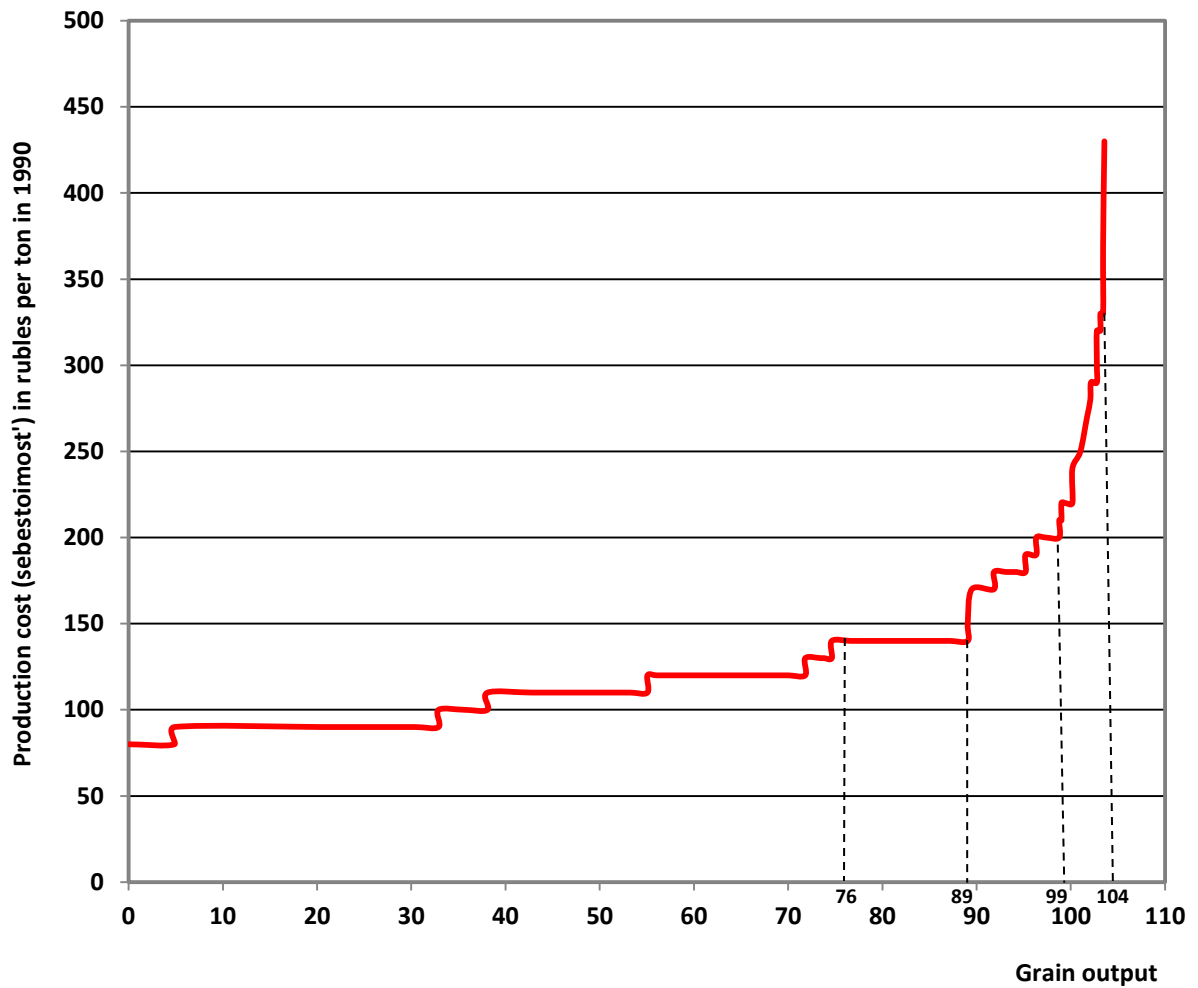
Figure 3. Russian Grain Production Cost and Area



Note: Grain area is millions of hectares, and average annual over 1986-90. The curve gives the total Russian grain area (1986-90) where the average cost of production (sebestoimost') in rubles per ton was equal to or less than the corresponding cost value in 1990.

Source: Russian Ministry of Agriculture and Food.

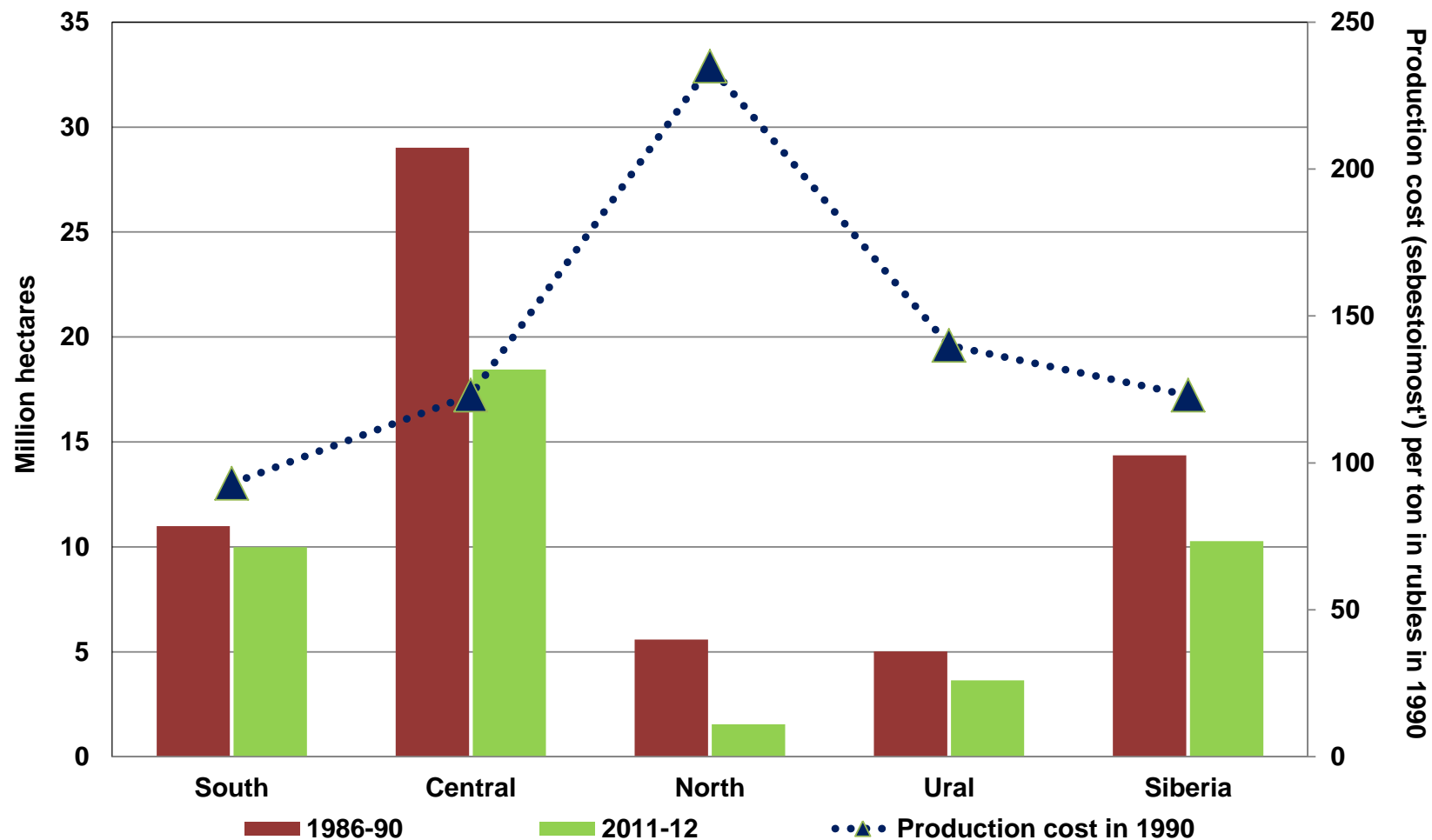
Figure 4. Russian Grain Production Cost and Output



Note: Grain output is millions of tons, and average annual over 1986-90. The curve gives the total Russian grain output (1986-90) for which the average cost of production (sebestoimost') in rubles per ton was equal to or less than the corresponding cost value in 1990.

Source: Russian Ministry of Agriculture and Food.

Figure 5. Change in Grain Area by Geographic Division of Russia



Note: The South, Central, and North divisions are in Europe, though the South includes the northern Caucasus. Siberia also covers the Far East. The bars give average annual area over the period. The triangles give average production cost within the division in 1990.

Source: Russian Ministry of Agriculture and Food; Russian Federal Service of State Statistics.