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Agriculture in interwar Poland: development in a turbulent time

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Abstract: We measure the value added in agriculture in Poland during the interwar period. Our calculation is based on the bottom-up methodology. We provide estimates on the national and regional levels. Cultivated area, yields and yields per hectare increased during the investigated period. Significant regional convergence, both in the case of prices and value added occurred. In the years 1924 -38 value added increased by 5.35% annually, resulting 4.01% per capita growth rate. However, the yields per hectare grew less than in a majority of other European economies. While less developed eastern regions caught up with more economically advanced western Poland, the leading west lost compared to European peers. Therefore, our assessment of the development of agriculture in Poland in that period remains mixed.

Keywords: agriculture, national income, Poland, Central and Eastern Europe, economic growth, regional convergence

JEL codes: N50, N54, N90, N94

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1. Introduction

In the interwar period in Poland, agriculture employed the majority of the workforce. Therefore the productivity of the sector to a large extent determined the level of income in the country, while long-term economic growth depended on the increase in the value added of the sector combined with the relocation of the workforce to industry. As the intersectoral laborforce flows were largely stopped after the Great Depression the change in the value added in agriculture was extremely important for the overall economic performance of European peripheries in the interwar period.

In this paper, we present the estimate of the value added in agriculture in Poland between 1924 and 1938. We provide the national and regional estimates on the level of 16 administrative provinces. Thus, we are able to discuss the patterns of regional development in the country formed from the lands of three empires after 123 years of partitions. Regional convergence and economic consolidation remained a crucial topic of economic debate in Poland during the interwar period, and even today the regional socio-economic gaps and the legacy of partitions are debated[1].

In our view, the estimates presented here will be beneficial for future attempts to estimate the national income of the country, in a way coherent with the modern standards of historical national accounting. Therefore, this paper corresponds with the recent literature on the reconstruction of national income in Poland and its regions before 1989. While advanced estimates for developed economies have been available for many years, economic historians only recently started to produce modern estimates of national income outside core economies. Bukowski et al. provide an indirect estimate of GDP per capita for the Polish lands in the years 1790 – 1910 based on the link between the urbanization level and GDP estimated for other countries[2]. Their estimates confirm the semiperipheral development of Polish lands and limited convergence towards core economies in the 19th century. Koryś and Tymiński provide a bottom-up estimate of GDP per capita in Congress Poland in the years 1870 – 1913. Contrary to the earlier literature focused on the benefits for the Polish economy resulting from the access

[1] Grosfeld and Zhuravskaya, *Cultural vs. economic legacies of empires: Evidence from the partition of Poland*, pp. 55-75; Zagórski and Markowski, *Persistent Legacies of the Empires: Partition of Poland and Electoral Turnout.*

[2] Bukowski, Koryś, Leszczyńska, Tymiński and Wolf, *Urbanization and GDP per capita: New data and results for the Polish lands, 1790–1910*, pp. 213-227.

to a large Russian market allowing for the specialization in the industry (at least relative to other provinces of Imperial Russia), the authors find that the GDP growth in Congress Poland was similar to other economies of Central and Eastern Europe. Orłowski investigates the regional differentiation of GDP in Poland in 1938 based on proxy estimates and finds that the gap between the poorest and richest regions was not higher than in other countries. However, the fact that the majority of the population lived in poorer areas makes Poland a major outlier in comparison to other European economies[3]. New bottom-up estimates of the GDP per capita in the past have been also recently published for Lithuania[4], and Latvia[5].

The investigated period can be further divided into three subperiods: boom time 1924 – 1928, crisis 1929-1933, and (slow) revival in the late thirties. The crisis period was particularly problematic for agriculture[6]. In the years 1928 – 1933, value added in agriculture declined by 67% in current prices, by 46% in constant prices deflated using the price index, but increased by 16% if measured using constant agricultural prices from 1924. This shows that the detrimental influence of the Great Depression on Polish rural residents mainly resulted from the divergence of the prices of industrial and agricultural goods. The industry was able to partially protect the prices of produced goods by extensive cartelization allowed by a significant market power of main companies, and approval of the government. Largely fragmented agriculture, operating according to the perfect competition model could not influence the market price. Our research suggests that the Great Depression in Poland – at least in the case of agriculture - was mainly a monetary phenomenon. The yields, both on a national level and per hectare continued to increase.

Estimation of regional value added allows us to study regional convergence. Firstly, we document an increase in market integration extending the earlier work of Wolf and Trenker[7]. We also find the yields per hectare converged significantly. Eastern provinces with lower agricultural productivity at the beginning of the period experienced the strongest increase in yields per hectare, while the productivity of most developed western provinces, previously

[3] Orłowski W., *The level and regional differentiation of Poland's GDP in the interwar period*, pp. 349–367.

[4] Klimantas and Zirgulis, *A new estimate of Lithuanian GDP for 1937: How does interwar Lithuania compare?*.

[5] Klimantas, Norkus, Markevičiūtė, Honningdal Grytten and Šiliņš, *Reinventing perished "Belgium of the East": new estimates of GDP for inter-war Latvia (1920–1939)*.

[6] Janicki., *The impact of the crisis on the Polish agriculture (1929–35)*, pp. 155-167.

[7] Trenkler and Wolf, *Economic integration across borders: The Polish interwar economy 1921–1937*.

exporting agricultural products to industrial regions of Germany stagnated. Thus, the eastern regions increased their share in total agriculture value added.

Overall, our assessment of the development of Polish agriculture in the years 1924 – 1938 is positive. The value added per capita (measured in constant prices) increased by 4.0% annually. The studied period includes the deepest crisis of modern capitalism exuberated by the macroeconomic policy of the Polish government. In this difficult time, the agricultural sector not only succeeded in keeping pace with the rapidly increasing population of the country but also increased its value added per capita by 74%. The poorer regions successfully implemented modern production techniques, which allowed them to partially catch up with the rest of the country. Increasing market integration may be seen as an important success for the country, which needed to integrate provinces, that for over a century remained parts of three different empires. On the other hand, in other European countries yields per hectare were increasing even faster than in Poland. While regional gaps in agricultural productivity declined, the productivity in leading, western regions stagnated, contributing to the relative productivity loss of these regions and Poland as a whole compared to major European economies and peer economies of the region.

The remainder of the paper proceeds as follows. The literature on the economy of interwar Poland is reviewed in Section One. Data and estimation methods are discussed in Section Two. Estimation of inputs (yields, prices, intermediate consumption, etc.) are presented in Section Three. In Section Four, we introduce and discuss our estimate of the value added, its change, and regional convergence. Then, we compare the performance of agriculture in Poland to European peers. In Section Five we compare our estimates with the previous literature and provide sensitivity analysis. The last section concludes and provides directions for future research.

2. Polish economy during the interwar period

The main synthesis of the economy of Poland in the interwar period was prepared in the years 1967 – 1989 by Zbigniew Landau and Jerzy Tomaszewski[8]. The last monographic work on the situation of agriculture was published in 1983[9]. Although the authors provide a thoughtful and detailed description of economic trends, their works do not meet the criteria of modern quantitative research in economic history/historical economics/cliometrics. They focus on the estimates of production in natural units and do not provide any estimates of value added. The authors only partially explore statistical data published by Statistics Poland in the interwar period, usually focusing on the national level or division into three or four major regions. Koryś offers an up-to-date survey of the economic history of Poland[10], while Łazor & Murgescu provide an excellent discussion of the economic development of Central Eastern Europe between 1918 and 1939[11]. Gorzelak discusses the development of agriculture in Poland in the 20th, however, he also focuses on the production expressed in the natural units[12].

Poland was among the countries with the highest economic losses in World War I. War operations directly affected approx. 90% of the country's area. Much devastation was done by occupant armies as a result of sabotage during the retreat[13]. The crop cultivation area in 1918/19 was 30-50% lower than before the war, whereas the decrease varied across partitions and crop types. On average the yields per hectare declined by 20-50%. The size of livestock dropped significantly during the war, the number of pigs in 1918 was approximately 50% lower than in 1914. Other sectors were also affected. In the counties of Congress Kingdom 20-40% of buildings were damaged[14]. In 1918, the employment in industry in the Congress Kingdom was below 20% of the pre-war level[15]. Moreover, immediately after regaining its independence, Poland had to defend itself against the Soviet Union, which further negatively impacted

[8] Landau and Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939*, vol. 1-4.

[9] Mieszczankowski, *Rolnictwo II Rzeczypospolitej*.

[10] Koryś, *Poland from Partitions to EU Accession. A Modern Economic History, 1772–2004*.

[11] Borodziej W., Holubec S., von Puttkamer J., *The Routledge History Handbook of Central and Eastern Europe in the Twentieth Century*, vol. 1.

[12] E. Gorzelak, *Polskie rolnictwo w XX wieku. Produkcja i ludność*. OW SGH: Warszawa

[13] Wolf, *Economic integration in historical perspective: the case of interwar Poland, 1918- 1939*.

[14] Landau and, Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939*, vol. 1, pp.150-153.

[15] Koryś, *Poland from Partitions to EU Accession. A Modern Economic History, 1772–2004*, pp. 202.

agriculture in eastern regions and destroyed wide areas of the country. The indirect consequence of this struggle was hyperinflation as the government of the reborn state, too weak to collect enough taxes, resorted to money printing. In the years 1920-1923, inflation was up to 7,000%, while deficits amounted to up to 80% of government spending[16]. War destruction reduced income inequality, but it started to increase relatively soon[17]. The wealth distribution was dominated by the small, oligarchic elite (the top 0.01% controlled 15% of national wealth), while the middle class remained weak[18].

The agriculture was also dominated by large landed estates. Limiting land concentration and distributing land to small farmers and landless people was one of the most important structural reforms undertaken by the Polish government in the 1920s. The reforms implemented in 1920 and 1925 assumed among others the parcellation of all state land including the land purchased from large landowners, as well as division of church property. The land was granted primarily to landless and small farmers, with priority given to war invalids and agricultural workers. These reforms contributed to the reduction of social inequalities and improved the overall economic situation in rural areas although by 1939 only 58% of the reform had been implemented and about 20% of the land belonging to landed estates was parceled out. In eastern regions of the country, the land reform was slower due to the resulting transfer of land from Poles (large landowners) to ethnic minorities. In the East, land reform was implemented in a way beneficial to former soldiers, who often arrived from the Weast & Central Poland taking part in the military colonization.

Apart from land reform the macroeconomic stabilization and currency reform introduced in 1924 were especially important for agriculture allowing farmers to produce in a much more predictable macroeconomic environment. Therefore the mid-1920s are generally positively assessed as a period of strong growth in many sectors including agriculture. The fragmented market started to integrate, and according to Trenkler & Wolff, the negative impact of partition borders largely disappeared[19]. This rapid economic development was stopped and reversed by the beginning of the Great Depression. As an agrarian economy, Poland was strongly impacted by the fall of world prices of agricultural products, especially as the strong

[16] Ibidem; Wroński M., *Wealth inequality in interwar Poland.*

[17] Bukowski and Novokmet, *Between communism and capitalism: long-term inequality in Poland, 1892–2015*.

[18] Wroński M., *Wealth inequality in interwar Poland*.

[19] Trenkler and Wolf, *Economic integration across borders: The Polish interwar economy 1921–1937*.

attachment of the Polish government to the gold standard increased the length and the severity of the recession[20]. Capitalist farming in western Poland responded to the decline of prices by reducing production, while eastern regions, to a larger extent dependent on subsistence agriculture reacted by increasing the production. Farmers reducing their spending, including spending on fertilizers, and machinery. Modern estimates of the value of national output are missing, however contemporary estimates suggested a decline of the national income by approx. 40% from 26-28 billion *złotys* (zł) in 1929 to 14-16 billion *złotys* in 1934/35. The most negative estimates suggest a decline in the nominal national income by over 50%[21]. These estimates are based on current prices and thus overstate the size of the Great Depression. State interventions aiming to increase agricultural prices were limited by budgetary constraints and generally failed. The economic revival in the late 1930s is currently seen by historians as rather weak, dependent on state investment, and broken by the German invasion in 1939.

According to Maddison Project Database (Update 2020) GDP per capita in Poland was equal to: 3 000 USD'2011 in 1920, 3 374 USD'2011 in 1929, 2 590 USD'2011 in 1935, and 3 478 USD'2011 in 1938[22]. In 1929 GDP per capita in Poland equaled only 70% of Czechoslovakian GDP per capita, 52% of German GDP per capita, and 38% of the GDP per capita in the United Kingdom. According to these estimates, Poland experienced limited economic growth in the 1920s, and a close-to-zero increase in the GDP in the 1930s.[23]. However, this data applies to Poland within its modern border. Moreover, the estimation method is not entirely clear. In particular, Łazor & Murgescu do not agree with many estimates of the GDP per capita in interwar Central and Eastern Europe included in the Maddison Project Database[24] although according to the conventional view of Polish historiography, it is often claimed that national income in 1938 was probably smaller than in 1913[25]. As declared in the introduction, we hope to provide complete and robust measures of the GDP per capita in

[20]; Don-Siemion, *We'll give up our blood but not our gold: money, debt, and the balance of payments in Poland's Great Depression;* Knakiewicz, *Deflacja Polska: 1930-35*; Staniewicz, *Deflacja polska w latach 1929 – 1936*; Leszczyńska, *Polska polityka pieniężna i walutowa w latach 1924-1936 W systemie Gold Exchange Standard*.

[21] Landau., *National Income in Historical Research*.

[22] Bolt and van Zanden., *Maddison style estimates of the evolution of the world economy. A new 2020 update*.

[23] Koryś and Tymiński, *Od socjalizmu do socjalizmu. Koncepcje reform gospodarczych w PRL po wybuchach społecznych w 1956 i 1980 r*.

[24] Ibidem.

[25] Landau and Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939*, vol. 4.

interwar Poland in the future. In this paper, we focus on the largest sector of the country's economy - agriculture.

Although the general assessment of the economic growth during the interwar period remains rather negative, the quality of life improved more than monetary metrics suggest. Due to improvements in public health, preventive medicine, and sanitation, the anthropometric indicators of well-being improved significantly[26]. Better education and longer life expectancy resulted in higher improvements of the Human Development Index, than in the case of GDP per capita. Here, the story of Poland is similar to the rest of Eastern Europe. Despite limited economic growth, Augmented HDI (AHDI) in Eastern Europe in 1938 was nearly 50% higher than in 1913, mainly due to better schooling and life expectancy[27]. In interwar Europe convergence of HDI was stronger than the convergence of GDP per capita[28].

3. Data and method

To estimate the value added in agriculture we rely on bottom-up methodology. Our estimates presented in this paper are based on data on the cultivated area, yields, and prices published by Statistics Poland in the interwar period. We mainly utilize data published in *Statistical Quarterly, Agrarian Statistics*[29]*, and Price Statistics*[30]. The data on the intermediate consumption is based on the estimates published by the State Scientific Institute of Agriculture in Puławy[31].

We provide annual estimates of the value added in agriculture at the level of 16 administrative provinces, and total national estimates for the years 1924 - 1938. The whole estimation is performed at the regional level. The map of Poland is provided in Figure 1. We start the estimation in 1924 because in the years 1918 – 1921, the public statistics was still in infancy and the data was extremely limited and not comparable. The data for the years 1922,

[26] Kopczyński and Rodak, *The Polish interbella puzzle: the biological standard of living in the Second Polish Republic, 1918–39;* Wroński, *The full distribution of adult height in Poland: Cohorts born between 1920 and 1996. The biological cost of the economic transition*; Kopczyński*, Between the Great War and the Great Depression: preliminary observations on the 'missing lin*k *in the history of human stature in Poland*; Ogórek, *'Niezatarte piętno? Wpływ I wojny światowej na ludność miasta Krakowa'*.

[27] de la Escosura, *Human Development and the Path to Freedom. 1870 to the Present,* pp. 271-272.

[28] Broadberry and O'Rourke., *The Cambridge Economic History of Modern Europe'*, pp. 253 – 258.

[29] *Kwartalnik Statystyczny, vol. 1924 - 1930 (Statistical Quarterly) (*Statistics Poland)*;* Statystyka Rolnicza (*Agrarian Statistics), vol. 1930/1931 – 1937/1938* (Statistics Poland).

[30] *Statystyka Cen (Price Statistics)* (Statistics Poland).

[31] *Badania and Opłacalnością Gospodarstw* Włościańskich, vol. 1927/1928 – vol., 1935/6 (State Scientific Institute of Agriculture in Puławy)

and 1923 is available, but estimates of the value of production are plagued by hyperinflation. Relative prices changed too often to provide any robust estimates of the production value. The data ends in 1938 because, in September 1939, Poland was invaded by Germany and statistics for 1939 are not available.

Our estimate is composed of five components: 11 major crops, animal production, fishing, forestry, and fruits & vegetables. We separately calculate the values for each subsector and then sum them up to obtain the values for total agrarian production. To obtain the estimate of the value added, comparable with modern national accounts concepts we subtract the value of intermediate consumption. The estimation is done in five steps.

Step One: Estimate the value of the production of 11 major crops (direct estimate)

We have detailed statistical data on area, yields and prices for 11 crops: wheat, rye, barley, oat, potatoes, sugar beets, buckwheat, millet, pea, flax and hay. For each crop, we have annual and regional data on total cultivated area, yields, and price. The data for the first five crops is of very high quality, the data on remaining crops is limited for the 1920s. We estimate the value of production for each crop by multiplying total yields by price The national annuals are the sums of regional values.

Figure 1. The Voivodships of II Republic.

Note: Inside the Voivodship of Warsaw there is also a separate capital city of Warsaw.

Source: own

Step Two: Estimate the value of animal production (mixed estimate)

This subsector includes a wide range of animal products (e.g., meat, milk, eggs, honey, wool). We have annual data on the size of the livestock – the number of horses, cattle, pigs, sheep, and goats. Official statistical data on animal production is unfortunately limited to the number of slaughtered animals in a few interwar years. Therefore our calculation of the value of animal production is based on the mixed approach.

We refer to an estimate made by Ponikowski who was an economics professor and one of the leading agricultural economists of the interwar era. In 1929, he published a detailed estimate of the value of agrarian production in the country in the previous year. According to his estimate, the total value of animal production was equal to 59% of the production of 11 major crops. Ponikowski provides his estimate only for one year (1928), and only on the national level[32].

To calculate the annual, and regional value of animal production we proceed as follows. We take the ratio between the value of production of 11 major crops and animal production provided by Ponikowski (59%) and multiply the value of production of 11 major crops to obtain the national value of animal production. To obtain regional estimates we allocate, the national total to regions proportionally to their share in total livestock. To compare different animals we refer to the formula provided by Dederko[33], another Polish economist active in the interwar period, who analyzed the evolution of livestock size. He assumed that 1 horse = 1 cattle = 4 pigs = 10 goats = 10 sheep. Thus, to obtain the total size of livestock we add horses and cattle, 25% of pigs, 10% of goats, and 10% sheep. Then, we allocate national animal products in 1928 to each region proportionally to the region's share in the national livestock.

To obtain estimates for other years, we need to account for two factors: change in the size of livestock, and change in prices. However, animal production includes dozens of different products of varying quality. The data on prices is unfortunately limited. Thus, we assume the constant ratio between the prices of animal products and 5 major crops with high-quality price data (wheat, rye, barley, oat, potatoes). Statics Poland published price indices for cereals,

[32] Ponikowski, *Próba obliczenia wartości produkcji rolniczej w Polsce w roku gospodarczym 1927/28*.
[33] Dederko, *Zagadnienia produkcji i zbytu artykułów owczarskich.*.

slaughter animals, and dairy products for the years 1928 – 1937[34]. The correlation of indices is very high, which validates our approach. The correlation coefficient calculated for cereals and slaughter animals is 0.84, and the correlation for cereals and dairy is 0.90. We do not employ indices directly because they are available only for some years, some categories of animal productions, and are not available at the regional level.

In consequence, the ratio between the value of animal production and the value of 11 major crops is changing annually based on the relative dynamics of crop yield and livestock size. As a consequence, the share of animal production in the value added increases if livestock size increases at a faster rate than the yields.

Step Three: Estimate the value of production of forestry (direct estimate)

In the interwar period, 46% of forest area belonged to the state and was governed by one state enterprise. We have detailed accounts of *State Forests* (enterprise) for the years: 1924 – 25 and 1932 – 1937. We use this data source to estimate the value added in the forests belonging to the state. As the accounting data for private forestry is missing, we estimate the value added in the whole subsector by multiplying the estimate for publicly owned forests by 2.17 (1/0.46). We allocate national estimates to regions based on the share of each region in total forest area. Thus, we assume the same profitability of forests in all regions. This may be seen as a simplifying assumption, but we do not have data to further differentiate the regional output.

We did not find detailed accounts of *State Forests* for the years 1926 – 1932. Thus, we cannot estimate the value added this year using the same method. However, we have information on the contribution of *State Forests* to the state budget each year. We assume that the value added in forestry changed proportionally to this contribution.

Step Four: Estimate the value of production of fishing (direct estimate)

Statistics Poland provides information on the value of sea fishing. We allocate the whole value to Pomerania, the only region with sea access. The production of inland fisheries is included in animal production (see Step Two above). The data on sea fishing started in 1930. For earlier years we extrapolate assuming the constant ratio between 11 major crop production and sea fishing in Pomerania.

[34] Statistics Poland, *Statystyka cen, 1937.*

Step Five: Intermediate consumption (direct estimate)

Our estimate of the intermediate consumption in agriculture is based on annual reports published by the State Scientific Institute of Agriculture in Puławy. The Institute surveyed approx. 1,000 farms annually, which provided their detailed budgets, including both revenues and spending. The sample was intended to be representative of different farm sizes and different regions of the country. Annual reports provide information on spending in tens of categories per hectare of farm.

State Scientific Institute of Agriculture in Puławy published reports covering the years 1927 – 1936. For the years 1930 – 1936, we have separate estimates of intermediate consumption per hectare in each region. For the years 1927 – 1929, we have only national estimates. Therefore, we need to assume that the intermediate consumption in each region changed at the same rate as on the national level. We do not have data on the intermediate consumption in the years 1924 – 26; 1937 – 38. We assume that the intermediate consumption changed at the same rate as the price index of the 5 major crops mentioned above.

To obtain regional estimates of the value of intermediate consumption we multiply the intermediate consumption per hectare by the total farm area reported for 11 major crops (this includes meadows used for cattle grazing.

Step Six: Estimate the value added

To estimate value added we first sum up the production values estimated in Steps One – Four (11 major crops, animal production, fishing, forestry). Then we subtract, the value of intermediate consumption. That's our initial estimate of the value added. To obtain the final estimate we need to apply corrections for fruits and vegetables, and less important crops.

As there are dozens of fruits and vegetables, Statistics Poland did not report the area used for the cultivation, and yields. Information on prices is also limited. Therefore, we once again refer to Ponikowski who estimates that the production of fruits and vegetables was worth 6.87% of the production of eleven major crops. As we do not have information on the cultivation area, we cannot estimate the intermediate consumption in this subsector. To account for this subsector we add 6.87% to the value added in each year.

Statistics Poland reported annual data on the cultivated area, yields, and prices of the 11 major crops (see above). However, they were not the only crops cultivated in Poland. The 11 major crops occupied approx. 85% of the total cultivated land (crops, excluding orchards) in

the country. The share of the area occupied by 11 crops varied across regions (from 76% in Pomerania to 90% in Wołyń) and exhibited small variation over time (lowest 82% in 1938, highest 87% in 1935). To obtain a comprehensive estimate of the value added we need to account also for remaining, less important crops. The soil used for other crops was of worse quality than in the case of major crops. Therefore, we increase our estimate of the value added by half of the remaining area – e.g. in Nowogródek in 1935 11 major crops occupied 86% of the total cultivated area, so we increase our estimate of the value added by 7%.

4. Production factors in agriculture: cultivation area, yields, prices, and intermediate consumption

We begin our study with a brief description of the change in the cultivation area during the investigation period. Overall, the interwar years were a period of expanding field area. The land used for the cultivation of 11 major crops (here, we have high-quality annual data) increased by 14%, from 12.7 million hectares in 1924 to 14.5 million hectares in 1938. Although analysis on the regional level is slightly complicated by the border changes in 1937, and 1938, it is clear that the fields expanded to a larger extent in eastern regions of the country, especially south-eastern provinces. The cultivated area expanded by 32% in Wołyń, 24% in Lwów, and 20% in Tarnopol region. In the northeastern regions of Wilno, Nowogródek, and Polesie field expansion rate was higher than the national average. Before World War One land fallowing was widely used in these regions. In the interwar years, farmers moved to more modern methods of agricultural production, which allowed for a significant increase in the cultivated land area. Among central regions, Lublin exhibits a strong, over 20% increase in cultivated area. The distribution of cultivated land between crops did not change significantly in the investigated period. Between 1924, and 1937 the share of land used for the cultivation of potatoes increased by 1.6 percentage points, the share of land used for the cultivation of wheat increased by 1.4 percentage points, while the share of land used for the cultivation of rye decreased by 2.2 percentage points. However, rye still occupied the largest area. The distribution of cultivated area across crops is presented in Table 1.

Table 1. The distribution of land between crops: 1924

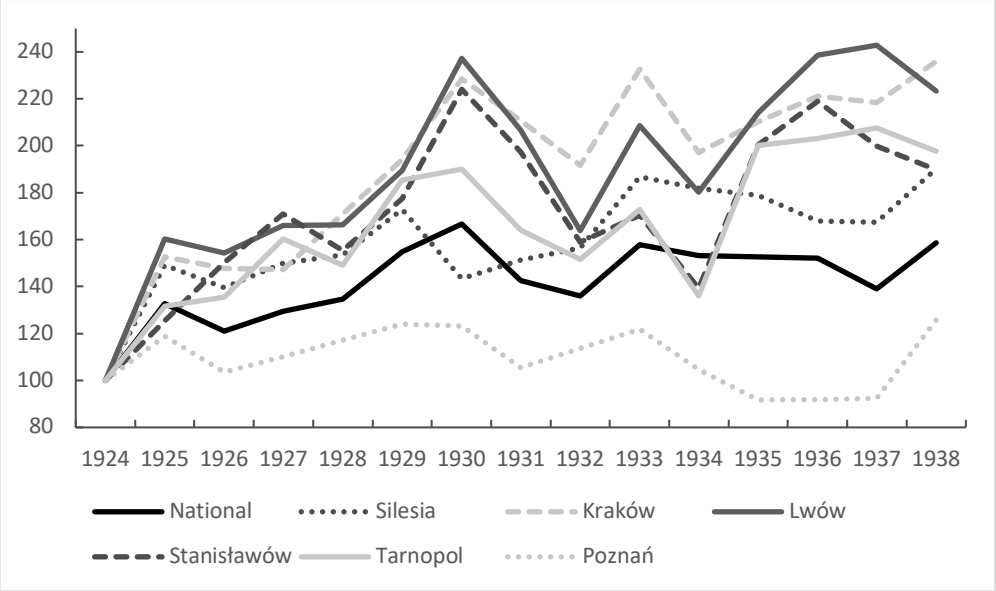
	1924	1928	1932	1937

Wheat	10.06%	9.74%	12.04%	11.47%
Rye	40.93%	40.32%	39.37%	38.72%
Barley	8.64%	8.73%	8.42%	8.48%
Oat	15.38%	15.39%	15.48%	15.53%
Potato	18.55%	18.91%	18.93%	20.17%
Remaining major crops	6.44%	6.92%	5.76%	5.63%

Source: own estimation.

Between 1924 and 1938 yields increased significantly although four cereals (wheat, rye, barley, oat) and potatoes differed both in magnitude and dynamics. Therefore, we analyze them separately. On a national level, yields of four cereals increased by 59%, while the yields of potatoes increased by 53%. The dynamic on a national level, and in the outstanding regions is presented in Figures 2 and 3. The growth of yields was highest in four southeastern regions of the country: Kraków, Lwów, Stanisławów, and Tarnopol. Interestingly, industrial Silesia also exhibits a high increase in total yields. It's probable that after Poland regained independence in 1918, the region deindustrialized because the value chains with German companies were cut. Here, we must notice that yields in 1924 were negatively impacted by pests, cereal yields were 20 – 35% than in 1923.

Figure 2. The dynamics of total yields: 4 cereals (1924 = 100)

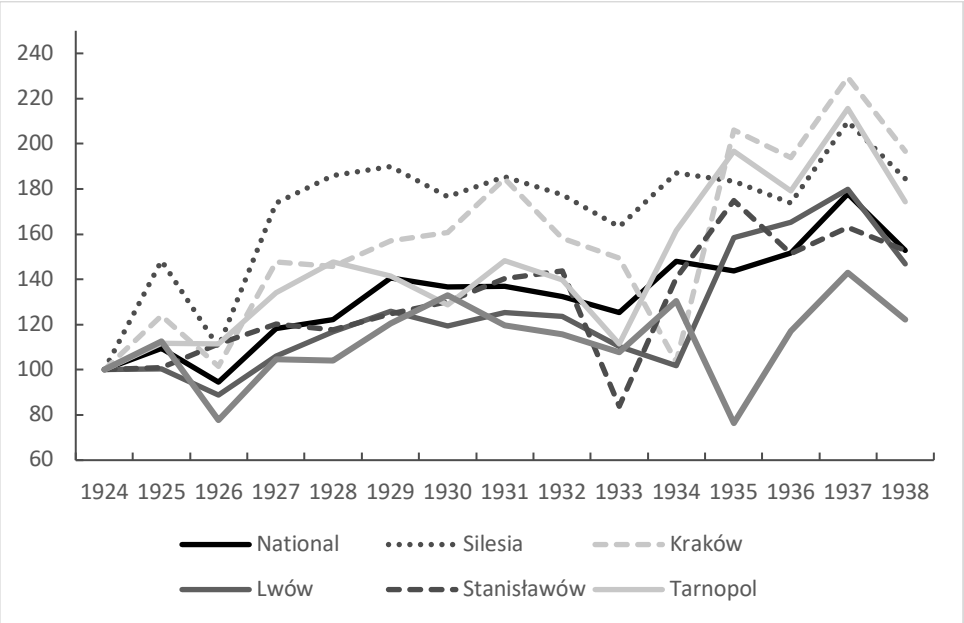


Source: own estimation.

The increase in total yields resulted from two factors. Firstly, as discussed above, the total cultivated area increased significantly in the investigated period. Secondly, yields per

hectare also increased. Here, we focus on rye yields per hectare (most important cereal), and potato yields per hectare. Yield per hectare depends of course not only on the cultivation methods but also on weather conditions in a given year. To limit the impact of changing weather conditions, we report three-year averages.

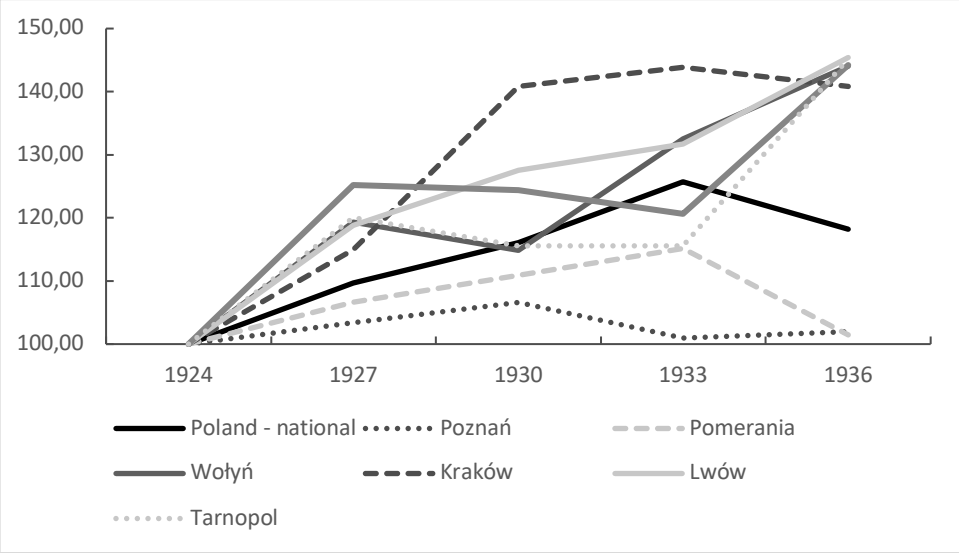
Figure 3. The dynamics of total yields: potatoes (1924 = 100)



Source: own estimation.

Yields per hectare increased significantly in the interwar period. In the case of rye, yields per hectare in the years 1936-8 (11.03 quintile per hectare) were 18% higher than in the years 1924-6 (9.33 quintile per hectare). In the case of potatoes, an increase is even higher at 28%. In the case of rye, an increase in yield per hectare was particularly strong in the southeastern part of the country, which previously lagged. In Kraków, Wołyń, Lwów, Stanisławów, and Tarnopol yields per hectare increased by 40-45%. However, in Poznan and Pomerania, which before WW I were breadbaskets of Germany, yields increased by only 2%. Between 1924 and 1938 Poznan lost the leadership to Śląsk. The yields per hectare in the four regions mentioned above with the best performance increased from 53-56% of Poznan's level in 1924 – 26 to 76-87% of Poznan's level at the end of the period. Even if we account for a change in the leader, yields per hectares in Kraków, Wołyń, Lwów, and Stanisławów still increased to 72-82% of the new leader's (Silesia). On average, due to better performance than national (increase of yields by 26%) the yields per hectare in worst-performing regions increased from 44% to 51% of the leader's level. We present an index of yields per hectare on a national level and in the outlier regions in Figure 3.

Figure 3. The dynamics of yields per hectare: rye (1924-26= 100)



Source: own estimation.

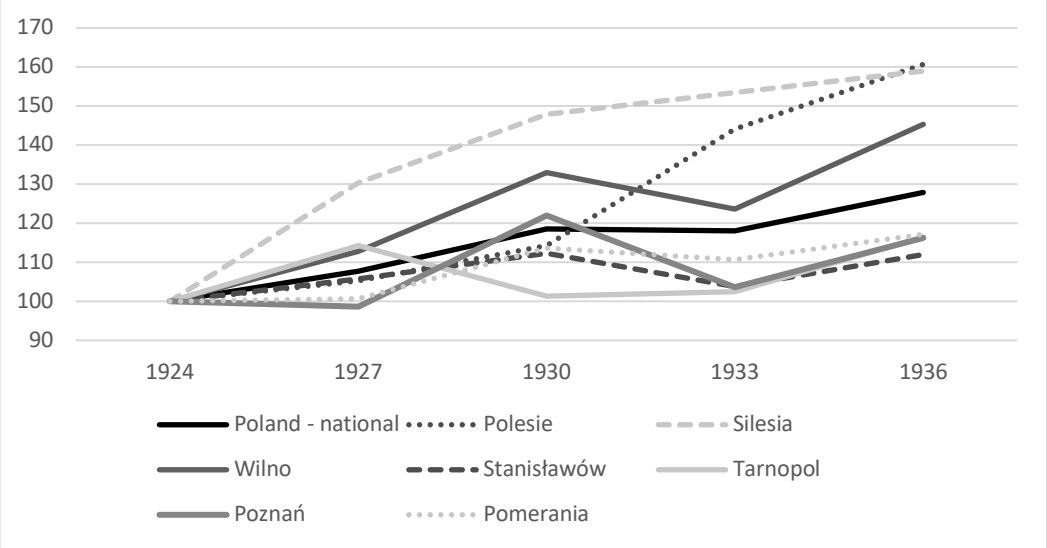
In the case of potatoes, an increase in yields per hectare was even higher. In the years 1936-8 yields per hectare (122 quintiles) were 28% higher than in the years 1924-26 (96 quintiles). Once again, we observe an important regional diversification. Poznan, Pomerania, and Stanisławów experienced the slowest increase in yields per hectare (12-16%). The increase was strongest in the north-eastern provinces of Polesie and Wilno (61%, 45%), and in Silesia (59%). Similarly, as in the case of the rye, we observe the convergence between worst and best performers. In both 1924-6, and 1936-8 yields per hectare were lowest in Wilno, however, the ratio between yields in this region and the leader's (Poznan's) yields increased from 56% to 71%. We present an index of potato yields per hectare on a national level and in the outlier provinces in Figure 4

Overall, yields per hectare of all crops converged significantly in the studied period. Regions with previously lower yields per hectare caught up with the most advanced regions. Agriculture in Poznan, and Pomerania, which before WW I employed modern cultivation methods stagnated in the interwar years. Landowners, who previously supplied Germany lost their export markets. The stagnation of agriculture in western regions of the country was noticed by contemporary economists[35]. Eastern parts of the country, which were lagging before WW I and in the first post-war years successfully employed at least some modern production methods. In

[35] Landau and Tomaszewski., *Gospodarka Polski Międzywojennej 1918-1939*, vol. 4.

the investigated period regional variation in yields per hectare (measured by the coefficient of variation) declined by 27% in the case of rye, and 37% in the case of potatoes.

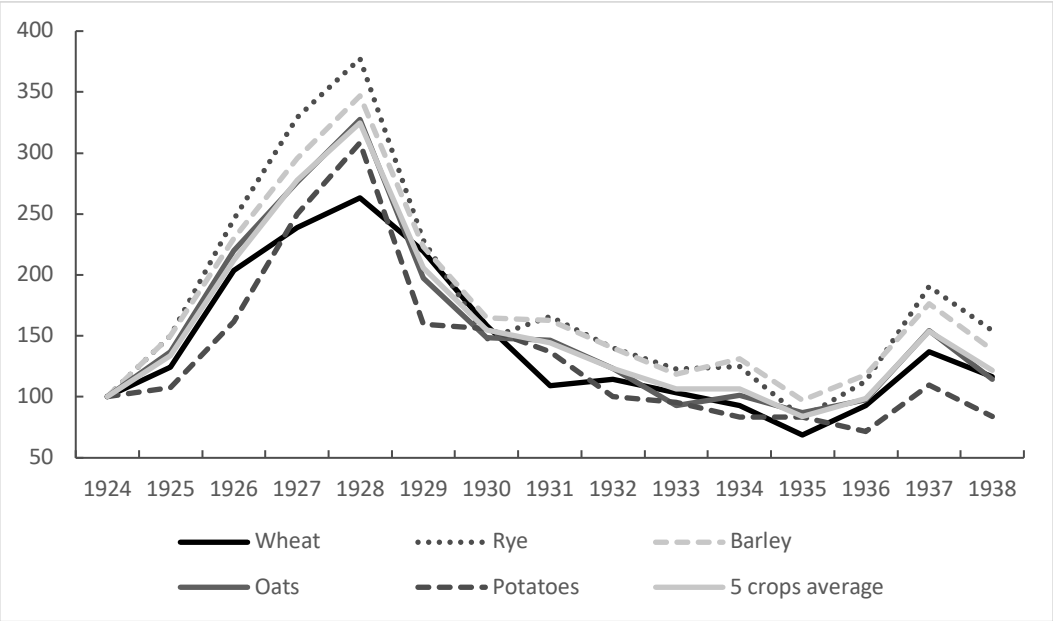
Figure 4. The dynamics of yields per hectare: potatoes (1924-26= 100)



Source: own estimation.

Price is a crucial factor determining the value of production. Even if yields are increasing, the total value of production may decline due to decreasing prices. Unfortunately, that's the case of interwar Poland during the Great Depression. In the years 1924 – 28 average price index for 5 major crops (4 cereals + potatoes+ increased by 225%. Then, prices declined sharply until 1935, when the index reached 25% of its value in 1928. In 1936, and 1937 started to increase again, but in 1938 the value of the index declined. At the end of the investigated period, prices were only slightly higher than in 1924. Overall, the prices of different crops evolved similarly with rye and barley experiencing a slightly higher increase. We present the price index in Figure 5.

Figure 5. Price index: 5 crops (1924=100)



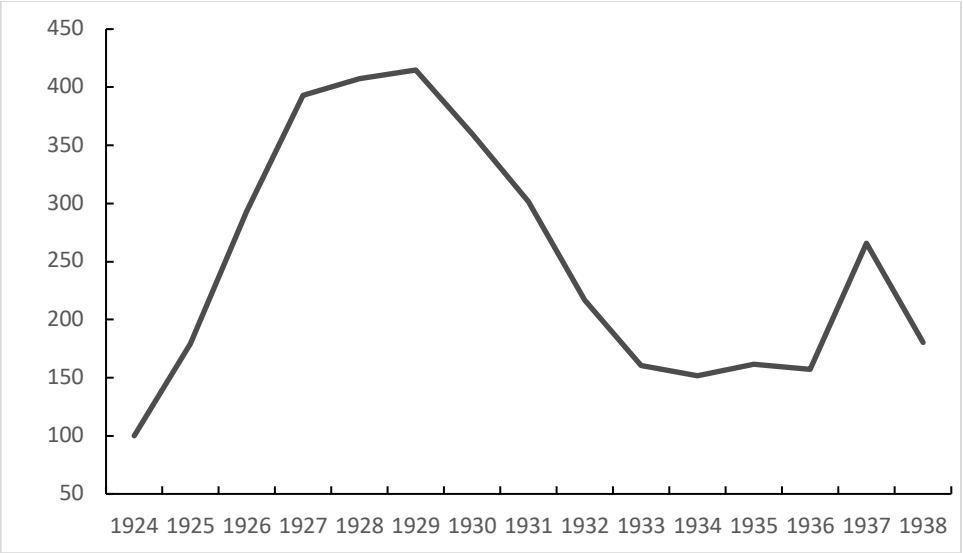
Source: own estimation.

The value added depends not only on the value of the production but also on the value of intermediate consumption. Intermediate consumption was closely related to the price level. Farmers increased their intermediate consumption when agriculture prices increased, but reduced when they declined. This issue was widely commented on in the 1930s. For example, during the Great Depression, the spending on fertilizers declined by over 50%. The correlation between an index of intermediate consumption and an index of agricultural prices (5 crops) is 0.85. Of course, this is partially caused by the correlation between the prices of different sectors. However, the decline in industrial prices during the Great Depression was significantly weaker than the decline in the prices of agricultural products.

An index of intermediate consumption (spending per hectare) increased from 100 in 1924 to 415 in 1929. Then it declined steeply to 161 in 1933 at stagnated at the level of 150-160 until 1936 In 1937 the value of the index increased significantly to 266, but declined again to 180 in 1938. The level of intermediate consumption varied strongly across the country. In more advanced western regions, it was significantly higher than the national average. In 1924 intermediate consumption per hectare in Poznan (48 zł) was 40% higher than the national average (34 zł). In industrial Silesia, it was 104% higher than the national average. On the other end of the spectrum, in northeastern regions intermediate consumption was only 25-40% of the

national average, and in south-eastern regions, the ratio was 80-90%. Here, once again we observe important regional convergence in the investigated period. The regional variation (measured using the coefficient of variation) declined by 17% between 1924 and 1938. An index of intermediate consumption is presented in Figure 6.

Figure 6. Intermediate consumption index: national (1924=100)



Source: own estimation.

5. Regional price convergence

The integration of the markets of the three former partitions was an important challenge of the interwar period. Price convergence is an integral part of market integration. The following section tests the price convergence for five crops (Wheat, Rye, Barley, Oats, and Potatoes) amongst 16 Voivodships in the years 1924-1938. It particularly explores the presence of the law of one price on these markets, as, in principle, arbitrage should lead to convergence of crop prices.

The concept of stationarity is one of the tools in literature to verify price convergence. In our case, the constant mean, implied by stationarity, signifies that the relation between prices in two cities remains the same. Thus, it converged. In the strong form of LOP, the difference between the prices would converge to 0; in the weak form applied here (proposed in Garcia-

Hiernaux, A., Guerrero, D.E., 2021[36]), it would converge to a deterministic term (here θ). This term stands for non-converging aspects of prices: transportation costs, labor costs, etc.

Long-run convergence can be formally defined as:

$$\lim_{(n\to\infty)} E(P_i)(t+n) - P_j(t+n)|Information\ at\ time\ t) = \theta_{ij},\ \ \theta_{ij} \neq 0 \quad (1)$$

Which can be satisfied by the stationarity of the difference between the prices.

Each of the prices can be expressed in terms of a simple equation:

$$P_{it} = \alpha_i + \beta_i \cdot t + \epsilon_i \quad (2)$$

Then, the logarithmic ratio of two of such equations would be defined as:

$$Log\left(\frac{P_{it}}{P_{jt}}\right) = Log(P_{it}) - Log(P_{jt}) = (\alpha_{it} - \alpha_{jt}) + (\beta_{it} - \beta_{jt}) \times t + (\varepsilon_i + \varepsilon_j) \quad (3)$$

Which, when stationary, states the long-run convergence as defined in the first equation.

We apply the tests for the stationarity of relative prices in two Voivodeships. Each of the pairs was tested separately. The two tests were adopted to verify stationarity – augmented Dickey-Fuller and Philip-Perron tests. In both cases, H0 states the presence of unit root, and the alternative favors stationarity. For both tests results are mostly the same but, in some cases, the non-stationarity in only one test was considered here enough to be marked as non-stationary. 1200 tests were conducted. The tests were executed with 0.05 significance but results for 0,1 were also reported. There are 16 Voivodships, 120 pairs for each crop and 5 prices, Subsequently, the standard deviations were analyzed in non-stationary pairs to assess whether the relation is converging or diverging. The final decision was based on a mean for the growth of standard deviation. Table 2 shows the number of non-stationary pairs for each crop, and whether they were converging rather than diverging over the period.

In each case, the table shows the number of non-stationary pairs out of 120 total for each crop. It indicates that markets for Wheat, Rye and Barley converged in the sense of weak law of one price – the relationship between the prices in different Voivodships remained the same. We can state that they converged at the beginning of the period and stayed as such for the whole

[36] Garcia-Hiernaux and Guerrero, *Price Convergence: Representation and Testing.*

time frame of the II RP. In the case of these crops, even for the least converged Wheat, 90% of pairs are converged. This proportion drops significantly to 75% in the case of Oats and Potatoes.

Most of the non-stationary pairs for the first three crops were those in which the Voivodeships were in different empires before the First World War. For the latter two, those pairs still account for over half of the total number of pairs.

Table 2. Number of non-stationary pairs, 120 pairs for each crop 1924-1938

Crop	0,05	0,1	0,05 Converging	0,05 Diverging	0,05 - cross partitions pairs
Wheat	12	1	5	7	10
Rye	4	2	2	2	2
Barley	9	1	3	6	6
Oat	21	14	13	8	12
Potato	30	20	15	15	17

Source: own estimation.

An important aspect of this analysis is the concept of the difference in parameters theta, to which the regions converged. To assess its values, we applied descriptive statistics for the difference in prices between the regions (mean and standard deviations). Because of the difference theta, the stationarity can be interpreted here twofold. On one hand, the western and central Voivodships (apart from Silesia) converged to similar levels. It is indicated by the high ratio of stationary pairs, fairly low standard deviations, and mean differences in prices for the pairs in those regions. On the other hand, high transportation costs prevented further convergence for the eastern Voivodships, which resulted in convergence in the sense of weak law of one price with pretty big, but stable, discrepancies of prices with the rest of the country. Those eastern Voivoidships, such as Nowogródek, Tarnopol, Wołyń, appear least frequently in non-stationary pairs and at the same time have one of the highest mean discrepancies in prices with the rest of the country. From that picture, there are two exceptions. Firstly, in the case of

Wilno, the eastern Voivodeship with the strongest differences in prices with other regions, had one of the biggest numbers of non-stationary pairs (14). The dynamics of its discrepancies in prices with other regions points neither conclusively in the direction of convergence or convergence. The other exception is Silesia, which is a western Voivodeship that is characterized by similar standard deviations and mean differences of prices as eastern Voivodeships and also a big number of non-stationary pairs (15). That non-stationarity is driven mostly by a divergence in prices of Wheat (in 7 pairs with Śląsk). Thus, we can state that Śląsk diverged in case of Wheat and for other crops was converged with a parameter theta similar to those of eastern Voivodeships. Also, potatoes have significantly different dynamics from other crops, even those around 30% of price pairs are non-stationary, the only region that has significant differences in prices is Silesia.

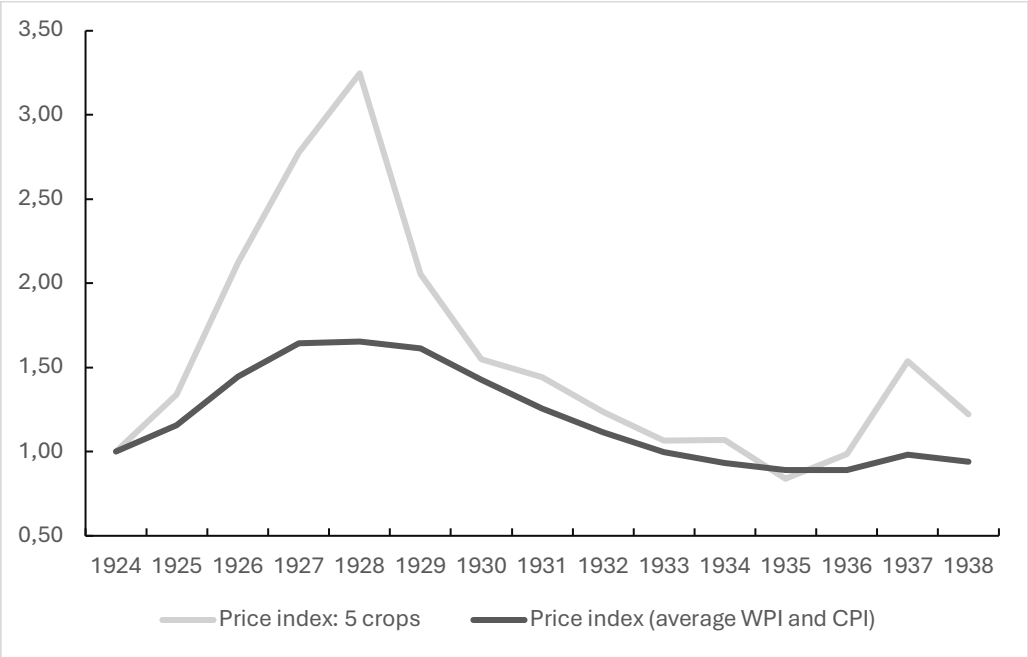
6. Evolution of Value added in agriculture.

If we measure the value added using current prices the interwar period is composed of three subperiods. Firstly, the booming years of 1924-1929, when the value added in agriculture increased by 301% from 4.7 billion zł to 18.7 billion zł in 1928. Then, the Great Depression, when value-added declined steeply by 67% to 6.1 billion zł in 1933. Later, the value added stagnated at the level of 6-7 billion until 1936. The last three years of the investigated period were bumpy. In 1935 the value added declined to 5.5 billion in 1937 surged to 10.6 billion and finally in 1938 stabilized at 8.3 billion.

As discussed above yields increased significantly during the entire period, including the 1930s. Therefore, a decline in value-added after 1929 was caused by the declining prices. The variation in price level over this period is a reason why economists prefer production indices at constant prices. Although, in this paper, we focus on agriculture, here we propose two versions of constant price indices. The first is an index deflated by the price index of 5 major crops. The strength of this index is its direct relation to the investigated sector. However, it has also a main shortcoming – it ignores the rest of the economy. Therefore, we also estimate an alternative – an index deflated by the weighted average of the whole and consumer price index. Both indices were estimated by Statistics Poland to track the change in prices in the market economy. Therefore it may not be fully adequate in tracking the living cost of the farmers. The perspective of farmers differs because they produce a lot of the food that they consume. This limits their exposure to change in the food prices and increases their exposure to change in the rest of the prices. During the Great Depression, food prices declined faster than prices of industrial goods. Thus, the living cost of farmers (who mainly purchased industrial goods because they raised

their foodstuffs) declined slower than suggested by the price index. The correlation of both indices equals 0.89. Price indices diverged mainly in the years 1924 – 30, when agricultural prices first rose faster than price index, and then (after the Great Depression began) declined faster than prince index. Both indices are displayed in Figure 7.

Figure 7. Five major crops price index vs. CPI (1924 = 1)



Source: own estimation.

The value added calculated using current prices and in constant prices using two indices introduced above is displayed in Figure 8. The index of value added calculated using the same three methods is displayed in Figure 9. For ease of interpretation, we provide the relative change of the value added in four subperiods: 1924-28 (boom years), 1928-33 (Great Depression, peak to through), 1933 – 38 (slow revival), and 1924 – 1938 in Table 3.

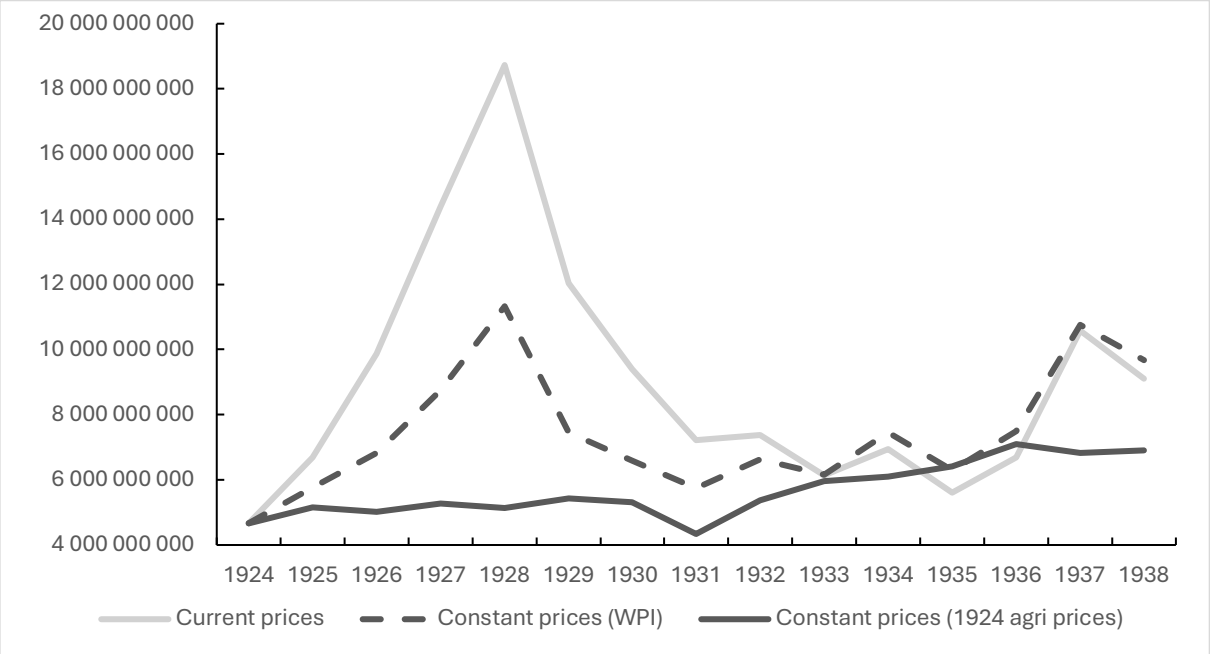
All three series peaked in 1928. In the 1930s they diverge. The decline during the Great Depression was highest if value added was estimated using current prices, smaller but still high if it was estimated using constant prices with price deflator, and non-existent if measured using constant crop prices. Overall, all three methods show that value-added in agriculture increased significantly in the years 1924 – 38. The annual rate of increase was 4.89% in current prices, 5.35% in constant prices measured WPI deflator, and 2.84% in constant 1924 crop prices. In the interwar period taken as a whole (or at least proxied by the years 1924 – 1938 as in our case), the value added in agriculture increased rapidly. However, the complete assessment of the performance requires of course the comparison of VA increase with the population growth.

Table 3. The change of value added.

Concept	1928/24	1933/28	1938/33	1938/24	1938/24 Annual increase
Current prices	301%	-67%	36%	48%	4.89%
Constant prices (WPI)	143%	-46%	38%	57%	5.35%
Constant prices (1924 agri prices)	10%	16%	16%	16%	2.84%

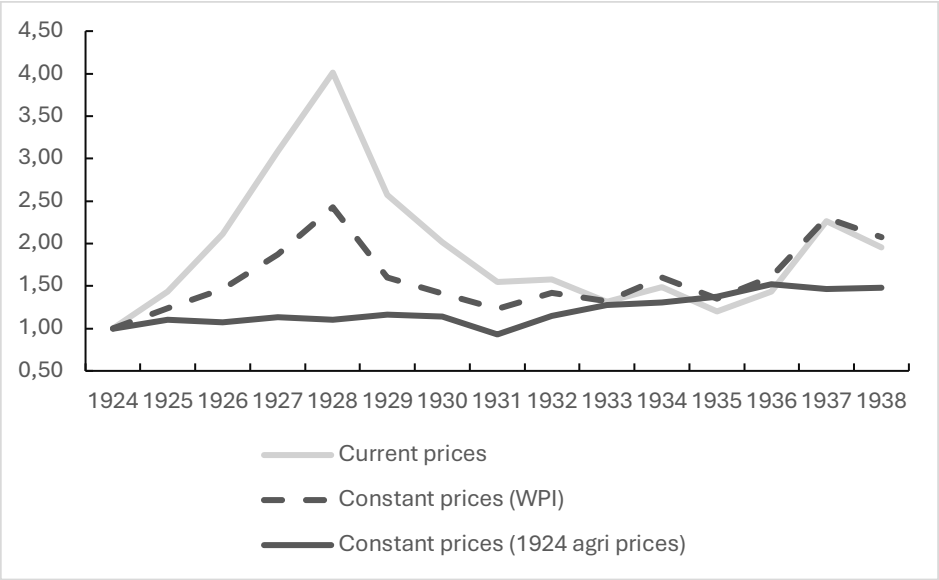
Source: own estimation.

Figure 8. Value added in current and constant prices (zł)



Source: own estimation.

Figure 9. Dynamics of value added (1924=100)



Source: own estimation.

The interwar period was a time of rapid population growth. Therefore measures of value added per capita should be preferred to a simple aggregate. In modern times, we can estimate value added per employee over sectors of the economy. In the case of subsistence agriculture such an estimate is difficult to obtain. Subsistence farming is a family business, all family members contribute to it, however to different degrees. Moreover, the interwar period was a time of hidden rural unemployment. For contemporary scholars of agriculture, it was clear that farms did not need all people living on them. This complicates the picture, especially during the Great Depression, when industrial employment decreased but rapid population growth generated a continued increase in the labor force adding hundreds of thousands of new adult workers to the economy. As employment opportunities in cities were limited, the outmigration declined and these people stayed on farms. The estimates of employment in agriculture provided in census data are available for only 1921, and 1931. Unfortunately, both estimates are not comparable. While the second includes only employed, the second includes all adult family members living on farms. Thus, providing a robust estimate of value added per employee is not possible in our context.

The estimate of value added per capita and its change are presented in Tables 4 and 5. Similarly as above we present estimates for the whole period and three subperiods. The interpretation of the three specified periods (boom, depression, slow revival) still holds, only

all rates of growth are weaker. The annual rate of growth of value added per capita was 2.7% based on current prices, 3.5 % based on constant prices deflated using WPI and 1.4% based on the constant 1924 agri prices. Once again rates of growth may be disappointing from the perspective of a developing economy, they should not be assessed very critically if we take into account that the investigated period includes the deepest recession in the history of modern capitalism.

Table 4. Value added per capita (zł)

	1924	1928	1933	1938
Current prices	161	610	187	263
Constant prices (WPI & CPI)	161	369	187	279
Constant prices (1924 agri prices)	161	167	182	199

Source: own estimation.

Table 5. The change of value added per capita (zł)

	1924/1928	1933/1928	1938/33	1938/24	1938/24 Annual rate of increase
Current prices	279%	-69%	27%	40%	3.56%
Constant prices (WPI & CPI)	129%	-49%	29%	49%	4.01%
Constant prices (1924 agri prices)	4%	9%	9%	10%	1.53%

Source: own estimation.

7. Regional convergence

Above, we have shown that the interwar period was a time of regional convergence of agricultural product prices. This holds also for the value added. In the years 1924 – 36 (the comparison for 1937-1938 is problematic due to changes in the borders of a few regions) eastern regions increased their share in national agriculture, while western regions experienced a relative decline. The share of Wołyń, Polesie and Tarnopol increased by respectively 1.4, 0.7

and 1.0 percentage points. The shares of Poznań, and Pomorze declined by 0.9 and 1.0 percentage points. The regional distribution of agriculture value added is presented in Table 6.

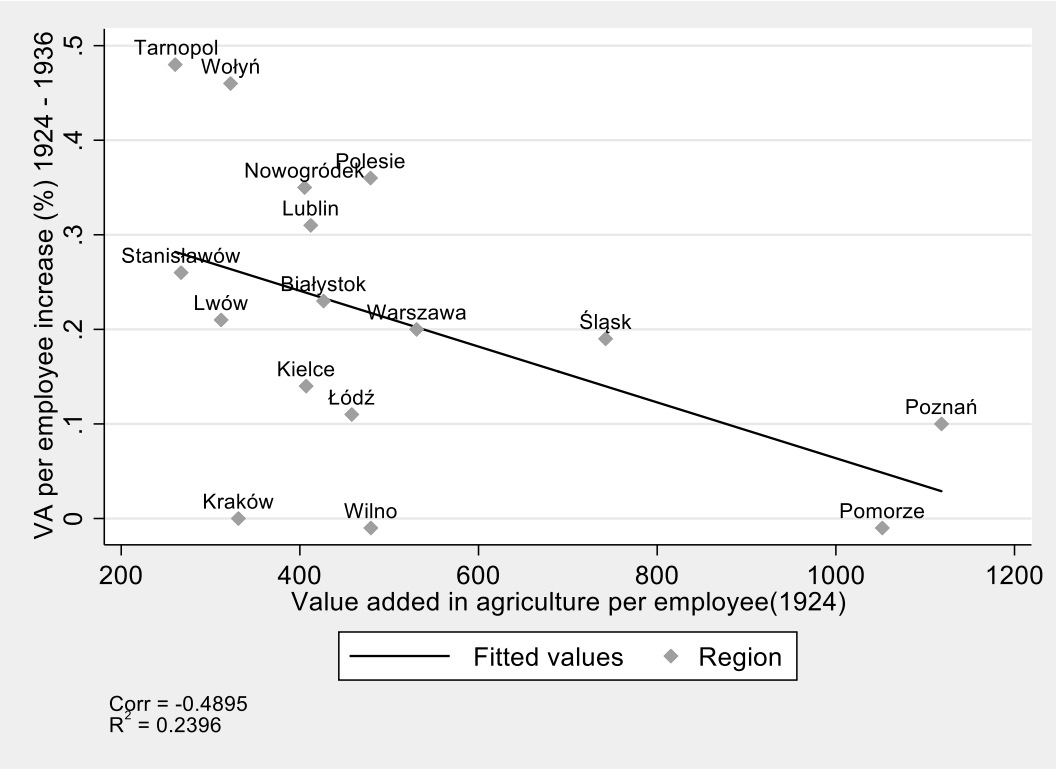
Table 6. Regional distribution of value added in agriculture

	1924	1936	Change
Warszawa	8.76%	8.78%	0.02%
Łódź	6.58%	6.07%	-0.51%
Kielce	8.00%	7.58%	-0.42%
Lublin	8.53%	9.27%	0.74%
Białystok	5.87%	6.00%	0.13%
Wilno	5.42%	4.45%	-0.96%
Nowogródek	4.32%	4.84%	0.52%
Polesie	5.38%	6.09%	0.72%
Wołyń	6.56%	7.97%	1.41%
Poznań	10.95%	10.05%	-0.90%
Pomorze	5.56%	4.56%	-1.00%
Śląsk	1.54%	1.53%	-0.01%
Kraków	5.92%	4.94%	-0.98%
Lwów	8.56%	8.65%	0.09%
Stanisławów	3.81%	4.00%	0.19%
Tarnopol	4.25%	5.22%	0.97%

Source: own estimation.

We can analyze the convergence not only with a focus on typical for Poland West-East divide but also directly investigate the link between value added in agriculture per employee. Here we estimate the size of employment in agriculture based on data from 1931 census and assume that it did not change in the investigated period. The convergence is presented in Figure 7. The value added was growing faster in the regions with lower initial value added. Although this estimate is provisory, we ckeary see that regional convergence occurred.

Figure 7. The convergence of value added in agriculture per employee



Note: own estimation.

8. Polish agriculture in the international comparison

How does the development of Polish agriculture during the interwar years look in comparison to other countries? To provide an exploratory answer to this question, we compare wheat and potato yields per hectare in Poland, leading European economies, and regional peers. For other countries, our estimate is based on historical statistics published by Mitchell[37]. For Poland, we report our estimates and the estimate for 1909 – 1913 (here presented as 1910 – 1913) published by Statistics Poland[38]. Some scholars think that yields per hectare before the war were overestimated by GUS. Mitchell also reports data for Poland. Wheat yields estimated using data provided by him are slightly (+/-1 quintile) different than ours, in the case of potatoes yields per hectare estimated using Mitchell's data are 15-20 quintiles higher in the years 1921-

[37] Mitchell, 'International Historical Statistics'.

[38] *Mały Rocznik statystyczny*, (Statistics Poland) pp. 21

24 and 7 quintiles higher in 1930. In other years the gap is negligible. The yields per hectare are reported in Tables 8 and 9.

Table 8. The yields per hectare: Wheat

Year	Austria	Bulgaria	Czechoslovakia	France	Germany	Italy	Poland	Romania	Russia	Spain
1910-13	13.6	11.1		12.8	20.8	10.1	12.4	13.7	6.8	8.9
1921-24	11.7	9.9	14.3	14.1	17.9	10.6	10.5	8.6	7.3	8.9
1935-38	16.5	13.6	17.6	15.2	25.4	14.8	11.9	10.3	9.3	9.4
1921-24/ 1910-13	0.86	0.88		1.10	0.86	1.05	0.85	0.63	1.07	1.00
1935-38/ 1921-24	1.41	1.38	1.23	1.08	1.42	1.39	1.13	1.19	1.28	1.06
1935-38/ 1910-13	1.21	1.22		1.19	1.22	1.46	0.96	0.75	1.37	1.06
Poland in 1921-4 as %	0.89	1.06	0.73	0.75	0.59	0.99	1.00	1.22	1.44	1.18
Poland in 1935-8 as%	0.72	0.87	0.67	0.78	0.47	0.81	1.00	1.16	1.27	1.26
Change	-0.18	-0.19	-0.06	0.03	-0.12	-0.19		-0.06	-0.17	0.08

Source: own based on *International Historical Statistics* (Mitchell, 2013).

Poland does not compare well internationally. In the years 1921 – 24 wheat yields still did not recover to the pre-war level, similarly as in Austria, Bulgaria, Germany, and Romania. In the case of potatoes yields per hectare recovered successfully, similar as in the majority of countries. Although Poland experienced a significant increase in yields per hectare, the rate of growth was smaller than in other economies. Only in France and Spain wheat yields per hectare increased less than in Poland. The first country already had high yields in 1921-4, the second was devasted by the civil war. The comparison of potato yield per hectare presents slightly better results. Yields in Poland increased faster than in Czechoslovakia, Italy, Romania, and Russia.

Table 9. The yields per hectare: Potato

Year	Austria	Bulgaria	Czechoslovakia	France	Germany	Italy	Poland	Romania	Russia	Spain
1910-13	97.7	45.0		80.2	136.1	94.0	103.0	116.9	76.3	105.5
1921-24	85.4	34.5	133.9	79.2	131.5	75.8	99.3	90.7	101.1	84.2
1935-38	137.5	61.8	127.5	110.2	187.3	65.9	120.5	96.6	78.4	103.5
1921-24/ 1910-13	0.87	0.77		0.99	0.97	0.81	0.96	0.78	1.33	0.80
1935-38/ 1921-24	1.61	1.79	0.95	1.39	1.42	0.87	1.21	1.07	0.78	1.23
1935-38/ 1910-13	1.41	1.37		1.37	1.38	0.70	1.17	0.83	1.03	0.98
Poland in 1921-4 as %	1.16	2.88	0.74	1.25	0.75	1.31	1.00	1.09	0.98	1.18
Poland in 1935-8 as%	0.88	1.95	0.94	1.09	0.64	1.83	1.00	1.25	1.54	1.16
Change	-0.29	-0.93	0.20	-0.16	-0.11	0.52	0.00	0.15	0.55	-0.01

Source: own based on *International Historical Statistics* (Mitchell, 2013).

We see several reasons why Polish agriculture was falling behind other European economies and did not succeed in reaping the benefits of technical progress in the sector. Firstly, the negative impact of WW I on Polish agriculture was higher than in other countries. Moreover, during the Great Depression agricultural prices in Poland declined more and for longer than in other economies hindering the ability of farmers to invest and limiting technological progress in the sector. In 1929 the usage of artificial fertilizers was still 13% lower than before the war[39]. Later, in the 1930s it further declined. The number of tractors decreased during the interwar period, in 1938 it was lower than before the war[40]. High taxation of tractors disincentivized landowners to buy them. Markets also shrunk. Before the war, landowners in western Poland exported their products to Germany, while landowners in southern Poland sold their goods to the Austrian, and Czech provinces of Austria-Hungary. After the regained independence, these markets were lost, and thus incentives to invest in modern production methods declined. While agriculture productivity in eastern regions increased and caught up with western Poland, western regions of the country lost compared to other European economies.

[39] Landau and Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939'*, vol. 2, pp.149\
[40] Żarnowski, *Polska 1918-1939.*

In the interwar period, Poland introduced (partially successful) land reform transferring the land from large landowners to landless agricultural laborers, and peasants owning small farms. Although the reform probably increased labor input per hectare, according to contemporary critics, new owners used less technologically advanced and thus less effective production methods[41]. The impact of land reform on productivity remains to be investigated.

9. Comparisons of our estimates with the previous research and sensitivity analysis

Landau collects and describes the estimates of national income in the interwar period[42]. He identifies approx. 20 different estimates of varying quality and limited comparability, the vast majority of them published during the interwar period itself. Here we focus on estimates of value added in agriculture published by major contributors: Czesław Klarner[43], Kalecki and Landau[44], and State Scientific Institute of Agriculture in Puławy (SIA Puławy)[45]. The first two estimates were built using income and consumption data. Estimates published by SIA Puławy and us are production-based. The estimate by SIA is an estimate of the value of the production, not the value added. To make the comparisons easier we directly compare their estimates to our estimate of the value added presented in this paper. The comparison is possible for the years 1929 – 1936. The estimates of value added are presented in Table 10.

Consumption-based estimates published by Kalecki & Landau and Klarner are 10-20% higher than production-based estimates published by SIA Puławy. The difference may result from the prices used. SIA Puławy uses wholesale prices paid to producers, while Kalecki & Landau, and Klarner estimate the value of urban consumption of agricultural products using urban prices, and thus may re-allocate part of the value added by retail trade to agriculture. Moreover, SIA Puławy's estimate does not include the value of forestry. The value added in agriculture in the years 1929 – 1933 declined by 53% according to Kalecki & Landau, by 46% according to Klaner, and by 57% according to SIA Puławy. According to both sources, the economic slump continued until 1935, and the revival started in 1936. The main difference

[41] Landau and Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939*, vol. 4, s.265

[42] Landau., *National Income in Historical Research* see also: Wroński, M., *Wealth inequality in interwar Poland.*

[43] Klarner, *Dochód społeczny wsi i miast w Polsce*,

[44] Kalecki. and Landau., *Dochód społeczny w 1933 i podstawy badań periodycznych nad zmianami dochodu*.

[45] Orczyk, *Studia nad opłacalnością gospodarstw rolnych w polsce w latach 1929-1938*.

arises in the comparison of the value added in 1936 versus 1933. According to Klarner value added in agriculture in 1936 was 15% lower than in 1933, while according to SIA Puławy, it was 10% higher.

Table 10. The estimates of value added in agriculture in the interwar period: 1929 - 1936 (**current prices, bln zł**)

Year	**Kalecki & Landau**	**Klaner**	**SIA Puławy**	**Our estimate (this paper)**
1929	12.2	12.5	11.60	12.0
1930		10.4	9.90	9.4
1931		9	7.30	7.3
1932		7.7	5.81	7.4
1933	5.7	6.8	4.98	6.1
1934		6.0	4.71	7.0
1935		5.7	4.22	5.6
1936		5.8	5.23	6.7
1933/29	0.47	0.54	0.43	0.51
1936/33		0.85	1.05	1.10

Note: for Kalecki & Landau the presented numbers refer to the income of the rural population, and for Klarner the numbers presented numbers refer to the sum of the consumption of agricultural products in the cities and rural areas

Source: SIA Puławy, Knakiewicz, Z., ‘Deflacja Polska: 1930-35'

Our estimate for 1929 is very close to the one estimated by Kalecki & Landau, 4% lower than the estimate by Klarner, a 3% higher than the estimate by SIA Puławy. The estimate by SIA Puławy excludes forestry, so the fact that it’s lower is not a surprise. The depth of the crisis (measured in current prices) situates our estimates (decline by 49%) close to Klarner (decline by 46%) and below Kalecki & Landau (-53%) and (SIA Puławy (decline by 57%). However, there are some differences between our estimates and the two remaining data series. Firstly, we identify a bigger decrease in the value added in 1931. While according to Klarner, and SIA Puławy the value added in 1932 was significantly lower than in 1931, according to our estimate the value added stagnated/increased slightly. In 1932, our estimate of value added is higher than the estimate made by SIA Puławy, and closer to the estimate by Klarner. Our estimate for 1933 is between Kalecki & Landau and Klarner. We identify the temporary increase in value added

in 1934, which is non-existent in two previous data series. Our estimates for 1934 – 1936 are the highest out of the three available. The economic revival in the mid-1930s in our estimates is stronger than in the two remaining data series.

The difference between our estimates, and the estimates of SIA Puławy probably arises from the estimation method. Firstly, our estimate is an estimate of the value added (intermediated consumption is subtracted), not the value of production. Both estimates are output-based (bottom-up), however, they are based on different output data. The estimate of SIA Puławy is based on the sample of surveyed farms, our estimates are based on the aggregate statistics on the production and prices published by Statistics Poland. The sample of farms used by SIA Puławy did not include large lande estates, which may bias the value added downwards. In 1938, Statistics Poland published an estimate of the value of crop production in the years 1928 – 1938 calculated by Tumiłowiczowa[46]. Our estimates for the years 1928, 1929 and 1934 are 30 - 40% higher, in 1936 25% lower, and in the remaining years the difference is 3-15%. The difference in the estimated output probably mainly results from the difference in the prices used for the estimation. While Tumiłowiczowa uses average annual prices, we mainly use prices from August. Tumiłowczowa states that the choice of prices used in the calculation is controversial because no data on the amount of agricultural production sold over months of the year exists. Therefore, we decided to (when possible) use prices from the end of the summer, which are neither the lowest nor the highest. Unfortunately, the exact coverage of Tumiłowcza's study is not clear, so the difference may result from a difference in scope.

Estimates reported in Table 10 share one important shortcoming. In interwar Poland, only a part of agricultural production was sold on the market. A high share of subsistence farming, mainly in Eastern Regions limited the share of agricultural production sold in the market to less than 50%[47]. Landau & Tomaszewski estimate that during the Great Depression, only 30% of cereals production was sold on the market[48]. Although using market prices to valuate home production is technically correct, we should keep in mind that it overestimates the real burden of the crisis for rural households. Finally, subsistence farmers' consumption in natural units remains similar, only it is valued less. There is some evidence for an increase in food consumption in rural areas in the initial phase of the Great Depression when farmers ate a

[46] *Agricultural Statistics 1938*, (Statistics Poland,)
[47] Mieszczankowski., *Rolnictwo II Rzeczypospolitej, pp*. 205-226

[48] Landau and Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939* vol. 3, pp. 158

part of what could not be sold. However, the scale and importance of this change remain controversial. In the later phase, the rural population needed to reduce consumption due to the discrepancy between the price decrease of industrial and agricultural goods[49].

Sensitivity Analysis

As usual in the calculation of historical national accounts, our procedure relies on data of varying quality and adopts the quality of data in various subsectors. To be fully transparent, we discussed the estimation in detail above. The data quality and robustness of our estimation are highest in the case of 11 major crops, medium in the case of animal production, fishing, and forestry, and lowest in the case of fruits & vegetables. In our view, the robustness of our estimates is similar to the case of historical national accounts published for other European economies. Our calculations are vulnerable to problems discussed above, but we are not the only ones who have to deal with them.

As discussed above price of agricultural products fluctuates during the year, and the choice of exact prices has some impact on the estimate. Some also argued that regional agricultural prices of crops reported by Statistics Poland were slightly higher than prices obtained by the smallest producers, who could not easily transport their goods. Unfortunately, quantitative evidence on this issue is limited. We estimate the animal production based on the size of the livestock and the constant ratio between the prices of crops and animal products. Although both indices are highly correlated (see above), the correlation is less than one. Our estimate of the production of fruits and vegetables and less important crops is based on the ratio to major crop production.

We provide the sensitivity analysis of possible biases in Table 11. Although they have an impact on the level of value-added, they are rather stable over time and thus may have only a very limited impact on the change of value added (economic growth). In our opinion, in total our estimate of value added may be biased 10% upwards or down, but the probability of higher bias is limited.

[49] Landau and Tomaszewski, *Gospodarka Polski Międzywojennej 1918-1939,* vol. 3, pp. 159

Table 11. Sensitivity analysis

Source of bias	Size of the bias (compared to VA)
Choice of price data (period)	+/- 5%
The reported price too high for some farmers	-2 to – 5%
Estimation of animal production based on the livestock size	+/ - 5 %
The discrepancy between the prices of crops and animal products	+/- 5%
Indirect estimation of fruits and vegetables, less important crops	+/- 5%

Source: own estimates.

10. Conclusion

In this paper, we provide estimates of value added in agriculture on national, and regional levels in interwar Poland. To achieve this aim we rely on rich agricultural statistics published by Statistics Poland and other institutions in the period.

We document that cultivated area, total yields, yields per hectare, and value added increased during the interwar period. Value added per capita measured using constant prices (deflated by wholesale price index) increased by 3.5% p.a. Agricultural prices, and yields per hectare converged in the country. Less developed eastern parts of Poland partially caught up with more advanced western regions. However, on the other hand, productivity in western regions (previously exporting to the German market) stagnated. Capitalist farming in western Poland lost export markets after 1918 and thus did not face significant incentives to invest to further improve productivity. The increase in yields per hectare in Poland was slower than in most other European economies. Although some novel production methods were implemented, even in the peak years of the late 1920s, the amount of artificial fertilizers used was lower than before WW I. Mechanization was also limited, in the late 1930s, the number of tractors was lower than before the war.

In the future, we plan to extend our research and present the estimate of national income in interwar Poland. Explaining the weak performance of yields in Poland against other European economies (e.g. using formal decomposition methods), and investigation of the impact of land reform on productivity are also promising research topics.

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