

Rostov Region in Wartime: Some Quarterly Evidence for the Impact of the Ukrainian War, 2015-2025

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Abstract

Using town and district quarterly data, the Ukrainian wartime economy of Rostov region in Russia is analyzed for the first time. From 2015 through the second quarter of 2025, housing construction is resilient to the war with higher construction of living space and little change in the distribution of construction across towns/districts. Cattle and poultry sales also increase with little change in their distribution too. Milk production increases while egg production is stable but both exhibit beta and sigma convergence. Registered unemployed and within the registered group those who found work also exhibit both beta and sigma convergence across localities. Finding a job and a place to live is likely to have never been easier in Rostov region during the transition era.

1. Introduction

While many studies examine the Russian economy at the macroeconomic level and on an annual basis, this paper adds to the understudied microeconomic performance of the Russian economy at the district/city level. Subregional analysis is particularly important to understand how the wartime Russian economy is actually performing in general and near the Ukrainian front in particular. Quarterly performance of the Russian economy was also understudied even before the Ukrainian incursion in 2014 (Kuboniwa, 2011) and can help now to understand wartime performance. Though quarterly analysis is only possible with a limited number of quarterly statistical series that are consistently reported, the immense interest in how well the Russian economy is actually doing along with disinformation campaigns, the paper takes the view that while limited economic modelling is possible given the dearth of district/town quarterly data, such analysis is now more important than it ever was. We denote a given year/quarter as “2022.Q1” for example.

Convergence models have been in the literature for decades and are well suited to these data so we examine both beta and sigma convergence in addition to descriptive statistics. Economic convergence suggests sample units are becoming more alike and is important for nations wanting to strengthen their federal structure by not having outlier poor areas. Recent applications of the convergence model have been used to examine Russian regional incomes 2002-2023 (Kurilova, 2026) and European macroeconomic performance 2004-2022 (Šiljak, 2026). The paper also represents a continuation of analysis of a single region (Rostov Oblast) near the Ukrainian war (see Brock, 2019, 2023 and 2024) that is more likely to be directly impacted than many others. Why Rostov Oblast is unique and details of the administrative divisions across 43 districts (*rayoni*) and twelve towns are outlined in prior work, but we believe this paper is the first to examine a Russian region embedded in a wartime economy using these data. Towards this, we divide the sample period into four different periods. First, we separate the sample into before the full-scale invasion 2015-2021 and label this period “incursion” as Ukraine was being attacked already. We label the rest of the sample period 2022.Q1 through 2025.Q2 as “wartime” though 2022.Q1 only includes just over a month of the full-scale invasion period. We also separate the incursion period into early (2015-2018) and late (2019-2021) as the latter period also includes the onset of the COVID pandemic in early 2020. The data do not permit separating the simultaneous impact of the Ukrainian incursion/invasion and the pandemic. When the full-scale invasion in late February 2022 began, Rosstat was still publishing monthly COVID specific mortality data but stopped in July 2022 (see Brock, 2025 for details) suggesting pandemic mortality was at least officially not significant by that summer.

Section two describes the data and includes the small literature on Rostov region’s economic performance. Section three outlines convergence modelling. Section four discusses the convergence results and section five concludes.

2. Descriptive Statistics and Rostov Region literature

As the English language literature on Rostov region's economic performance is summarized in some recent work (Brock, 2019 and 2024), we do not provide a separate literature review section. Further, Russian language analysis of Rostov has been found to be only descriptive and none could be found covering the economy after the full-scale invasion in 2022 with even the region's statistical data web site becoming inaccessible outside Russia in 2025. Statistical data are constrained to what is consistently available on at least a quarterly basis across towns and districts in Rostov Oblast from 2014 through July 2025. We focus here on physical indicators with ruble valued data such as local budgets interesting but beyond the scope of this study. Quarterly data are often reported accumulatively, so we separate out each quarter individually by subtracting a prior period's performance from the accumulative total. Housing, agriculture and labor markets are core to the Rostov region's economy (Rosstat-Rostov 2021), so we use data in these sectors. Changes in Rostov Oblast sectoral employment and wages are also important but are addressed in another paper (Brock 2023) covering through 2022. Like many studies of resilience at the local level (e.g. Sensier and Artis 2016), housing and unemployment data are included though they are not available at the detail found in other countries.

Agriculture is especially important in the Rostov economy (World Bank, 2006; Gorochnaya and Mikhaylov 2020) so several indicators of agricultural performance are included. Housing and the lack of it is a chronic problem in Russia and Rostov in particular (World Bank, 2006). Overall floor area construction and just the area constructed that is designated for single family use are analyzed. The labor market is examined with two data series. First those registered at the local unemployment office as looking for work. We will label this series "unemployed" though it does not include those looking for work who are not registered as unemployed. Second, those within this group that have been "matched" or found a job. Both of the labor series have two important shocks during the sample period besides the 2015 incursion into Ukraine which are discussed below.

Therefore, we examine seven variables covering agriculture, labor and housing (Table 1) which have been examined only by Brock (2024) but that study stops in 2022. All of these data are compiled by the Rostov Oblast branch of the federal statistical service (Rosstat). Much of the data can be found in an appendix (Приложение) covering district/towns published monthly on their website (<https://rostov.gks.ru>, accessed Jan-March, 2025). The first three agricultural variables are: (1) sold for slaughter cattle and poultry live weight in metric tons, (2) milk in metric tons, and (3) eggs in thousands. Though outlying areas of cities have agriculture production almost all is produced in the forty-three districts so we focus on the districts only sample when examining agriculture. Though anecdotal output performance information such as the fact that milk production fell 13% in 2025 relative to 2024 due to bad weather, higher dairy cattle feed costs and instability in buyer markets both domestic and foreign (Infox.ru, 2026) can be found in the news media, we know of no sub-regional analysis of such performance within a single Russian region during wartime.

Using a 2007-2014 annual average as a base for agricultural output, cattle and poultry production rose through 2018, fell 2019–2020, recovered 2021–2022 and finally soared to the highest annual levels in any transition year by the end of 2024 (Table 1). However, the very high levels of output were achieved on government run farms as the percentage produced on household plots fell to a very low 34% concurrently 2022-2024. Milk production steadily increased through 2024 with the small decline in the percentage produced on household plots already evident before 2022. Egg production peaked in 2017 and fell to its lowest annual level in 2021 before leveling off at the 2020 level during wartime. Like cattle and poultry, the percentage produced on plots has fallen a lot with 2024 showing only 28% produced on the plots.

Using 2015 as a base year due to data constraints, we can also compare quarterly growth rates through 2025.Q2 (Tables 2). Average quarterly cattle and poultry output is negative before 2022 except in the fourth quarter. Separating the incursion period into two sub-periods reveals 2019-2021 Q1 and Q2 were very negative while Q3 and Q4 were negative in 2015-2018. Q1 and Q2 in wartime were similar to the early incursion period but Q3 and Q4 in wartime are positive with Q3 extremely high compared to any other period. Quarterly milk growth is negative only in Q3 in the incursion era. In wartime Q1 growth is very close to zero and negative in Q2, but continues to be positive Q3-Q4. Egg production growth is negative in all quarters in the incursion period but then flips to being uniformly positive in wartime with, like milk production, a very high Q3 growth rate (5.46) only seen in Q4 (5.17) of the 2015-2018 period.

In the labor market, the number of monthly registered unemployed workers reported by local employment centers in each city/district is much lower than an ILO defined number as it only includes those actively looking for work who register their status at a local center and are of working age. In a typical year, only 1 in 7 unemployed are eligible for unemployment benefits (Leppanen 2012). Though the ILO defined number and therefore rate is not available at the town/district level, at the regional level both the official and ILO unemployment rates are similar during a recession. Registration can provide some very low unemployment assistance and matching to registered vacancies provided by employers. However, if openings are offered and rejected by a worker, they do not remain on the books at the local center meaning the number is kept lower than it otherwise might be by purging workers out of registered status who may still be without work and looking. The unemployed number does not capture underemployment or informal employment at all. The annual unemployment number 2015-2021 is lower than the 2007-2014 period with the exception of 2020 when the value is much larger as the pandemic caused many to register as unemployed to get financial assistance. By the end of 2021 the value had returned to pre-pandemic levels but then steadily fell to much lower levels by the end of 2024 reflecting the wartime demand for workers and military recruitment. The number of registered unemployed who found a job – a successful matching – is a subset of the

unemployed group. During wartime, the value falls probably to a record low of only 24,000 at the end of 2024 as the number of jobs available increases substantially making the matching rate much higher.

In the incursion period, the number unemployed increase in the first half of the year and fell in the second half (Table 2). However, in the early incursion period the quarterly growth consistently fell throughout the year while in the later incursion period it rose substantially in the first half of the year and was close to zero in the second half. Wartime values are negative like the early incursion years, but at a much higher magnitude than any other period as unemployment drops to historic lows in the transition era. Registered unemployed who found a job like the prior indicator is also positive in every quarter of the incursion era overall and the early period, but is consistently negative in the late incursion period. In wartime when each quarterly growth value is very negative, this continued the already negative values occurring before 2022 for several years. The wartime boom in the Russian economy reduces successful matching as the need to register unemployment falls due to lots of both civilian and military job vacancies readily available. Further the ratio of city/district matching values falls below 2020 values suggesting improved matching in rural areas during wartime as well.

With housing, the commissioned square meters of new housing floor area overall and just for individual apartments has been used since the Soviet era as a crude measure of new housing. These values measure only the direct cost of housing construction performance and not housing in general which is in short supply with underserved segments that are not adequately measured statistically in Rostov region and Russia in general (World Bank, 2006). Since the 1990s even though the stock of new floor area did increase demand is never met in Rostov (Khavanskiy et al. 2014). The two series are often the same value in rural areas where all housing construction is for apartments. From 2015-2022, the value is much higher than the 2010-2014 period indicating progress in reducing the housing shortage. In 2023-2024 the value increases substantially to almost 3 billion added square meters in a year which is unprecedented for the region. Single family homes area 2015-2022 doesn't always exceed the 2010-2014 average suggesting a lower priority during the incursion period, but in wartime it also increases to exceptionally high levels.

In the incursion period, quarterly growth of overall new floor area is positive in the second and third quarters but negative in the first and fourth possible reflecting weather conditions in the region. The late incursion period pattern matches this with much higher growth in Q2 and Q3 than the overall period. Wartime quarterly growth is positive in all quarters with huge growth rates found in Q3 and Q4 that are unknown before 2022. Single family home floor area improves in all quarters except Q4 in the incursion period with a very large increase in Q2 in the late incursion period (44%) that is an outlier before wartime. Wartime quarterly growth is also very large but exceptionally Q2 is negative with an absolute value larger than any other quarterly value. Given that Q2 overall area is low but positive, one wartime impact appears to be a rotation away from single family home floor area to other types of floor area production in Q2. Such a rotation is temporary as the large positive wartime rates return in Q3 and Q4 for both floor area values. The city/district ratio of both overall and single-family floor area is well above 100 and even 200% in all quarters except Q1 during the incursion period but drops to even below 100% in Q2 in 2022 and 2023 suggesting a rotation of construction away from urban areas as one feature of the wartime economy given that overall output is growing.

3. Method

Economic growth theory suggests regions and countries will converge in income and GDP over time in an open economy with free trade. Kurilova (2026) suggests per capita real income across Russian regions 2002-2023 is converging but much more slowly than in an open economy with a discussion of why some relatively rich regions remain ahead of the others. She uses one model choice – the Markov chain method which we do not use here as our time periods can be quite short. Instead, we use a semi-log OLS model like Šiljak (2026) and prior analysis of Rostov region (Brock, 2024) for beta convergence because of time period constraints. Sigma convergence is done by simply examining cross-sample unit variation over time but beta convergence is a necessary but not sufficient condition for sigma convergence (Furceri, 2005) so we only examine sigma if beta is found first. The null hypothesis is that the districts will exhibit little change in convergence after 2021 if the economy is resilient to the wartime shock. Lack of change can mean that districts converging prior to 2022 continue to converge after as well. A finding of no convergence or even divergence post-2022 would be evidence of less resilience. We use a 15% level of statistical significance given the small sample size but also look at the overall goodness of fit of the equation over time using the R-squared value. Uniquely, we examine convergence for individual quarters and not annually like other studies.

Beta convergence compares a growth trend relative to an initial year (here, 2015). If relatively poorer regions grow faster than relatively richer regions over time leading to the overall group of regions becoming more alike there is beta convergence as suggested by neoclassical growth theory. Such convergence can help poorer areas adjust to the shocks without workers having to move as they catch up to relatively richer regions. For beta convergence, we fit a standard equation found in the literature in general and a few district level studies in particular (e.g. Enamorado, Lopez-Calva, and Rodriguez-Castelan 2014 and Young et al., 2008):

$$1) \quad (1/T) \log (y_{it+T} / y_{it}) = \alpha + \beta \log(y_{it}) + \gamma X_{it} + v_{it}$$

Here “y” is the indicator with subscript “i” for a given district/town and “t” for an initial quarter in the case of “y” and some control variables or, due to data availability with control variables, a year near the initial year. “X” represents control variables which when included in the regression measure conditional convergence rather than absolute convergence which ignores control variables. Convergence occurs if β is statistically significant and negative while divergence is just the opposite with a positive coefficient. Absolute convergence could be a result

with statistically significant β and all control variable coefficients insignificant. When measuring conditional convergence, several time invariant characteristics of districts/cities are used as control variables. First a dummy variable is used with non-agricultural regressions to distinguish between the twelve towns and forty-three districts with a town having a value of one and a district zero (URB). Second, the logged square kilometer area is included to control for geographical size (LSqKm). Third, a dummy variable equal to one if a district is directly adjacent to Ukraine and zero otherwise with no towns having this status (Bord). While this variable may seem somewhat arbitrary, Russian prosocial behavior and attitudes have been found to increase in areas closer to Ukraine conflict rather than closer to Moscow or a regional capital (Gurieva and Melnikov 2016) suggesting distance to the conflict matters. Ukrainian border attitudes toward neighbors have changed since 2014 (Zotova et al., 2021) and Russian regions have shown resilience during the pandemic (Li et al. 2022). Fourth, the percentage of roads that are unpaved in a given area in 2015 is used to represent the level of infrastructure development (BadRds2015). Fifth, the logged distance between a town/ district center and the regional capital Rostov-on-the-Don which is by far the largest city in the region (LDistCap). This distance variable is found in studies of Russian farms in Rostov embedded within a production function (Grazhdaninova and Brock 2004). The constant term “ α ” serves a fixed effect to capture other district/town differences that might be omitted. Sigma convergence is measured using the coefficient of variation over time with a declining coefficient representing convergence and no regression needed. Sigma convergence means the relative dispersion of the variable shrinks.

4. Convergence Results

In agriculture, we can examine each quarter’s convergence for cattle, milk and egg production. In the first two quarters we can compare the pre-war (before 2022) result with the start of the war (2022 included) and well into the war (through 2024). Due to limited data availability, we can only examine 2025 in the first two quarters of the year. Tables 3-6 show each quarter’s results with each quarter examined individually and not accumulatively. In general, we find that cattle production exhibits insignificant convergence across quarters and time with the goodness of fit for the model getting much weaker once the war begins. Milk production has statistically significant divergence and the model’s R-squared is much higher. Further, milk production divergence has none of the conditional factors statistically significant suggesting absolute divergence is the best result. Egg production has consistently weak convergence with the goodness of fit declining after 2021 in the first two quarters. However, in Q3 and Q4, the year 2022 result shows a much better model fit in part due to the border dummy and 2015 road quality becoming statistically significant. In 2022 only, districts on the Ukrainian border and with lower quality roads in 2015 exhibit higher egg production growth than others.

With cattle and poultry sold, the incursion period reveals declining sales in some quarters while the wartime period shows consistently positive sales regardless of the quarter. Milk production grows slowly in the overall incursion period except in the third quarter where production declines. However, in the wartime period there is a large decline in the second quarter that is much larger than any quarterly change in the entire sample period with the late incursion period one of consistent positive growth in all quarters. Egg production consistently declines in any quarter in the incursion period but then reverses to positive quarterly growth in the wartime period. Large quarterly declines in the early and late incursion periods suggest long term reduction in egg production that has been reversed in wartime, especially the third quarter with 5.86% growth that is the highest in any sample period quarter.

Eggs are produced in most (33 out of 42) districts entirely on household plots throughout the sample period, so we can examine quarterly growth rates of these districts in comparison with those that do not have 100% (or very close to it) egg production often due to state owned poultry farms located in them. The research question here would be whether the wartime period changed the egg production in the purely private sector (household plots) versus production where the state sector is involved as well. Quarterly growth rates are negative in all districts and in the sub-sample of 9 districts where household plot production is quite low 2015-2021. However, in the wartime period, quarterly production is always positive for all districts, but always negative for the sub-sample suggesting that private production of eggs reversed completely in household plots but not in districts where plot production was relatively unimportant. Separating the incursion period into two smaller periods, we see the quarterly growth in all 42 districts is always the opposite sign of ten district sub-sample as well, so we can’t attribute the change in production entirely to the full-scale invasion in 2022 only.

Both housing indicators (overall and single-family floor area) exhibit poor overall fit with almost no variables including the beta coefficient ever statistically significant even at 15% level. For this reason, we do not include the housing results tables for each quarter but they are available on request. The two labor market indicators, on the other hand, have reasonable goodness of fit and consistently show beta convergence across all quarters and time periods (Tables 7-10). Before the wartime period, using either those looking for work or those successfully finding a job, town/district growth rates converge. In addition, the greater the distance a district is from the regional capital, the lower the growth rate is statistically significant as well for those looking for work but not those who found a job. When we move to a year including wartime, Q1 in 2022 (the quarter the full-scale invasion begins) shows convergence for those looking for work and getting a job, but now the latter has two statistically significant conditions – more urban and larger areas have higher matching too. In 2024.Q1, goodness of fit improves for those looking, but decreases for matching with no conditional variables statistically significant except the size of an area for those looking for work. By 2025.Q1, both indices beta converge conditional on size and urban with lower quality roads also a statistically significant condition for matching as well. For 2022.Q2, urban, size and distance from the regional capital now become significant for those looking for work, but not those who matched (the opposite of 2022.Q1). 2024.Q2 like 2024.Q1 shows significant absolute beta convergence as no conditional

variables meet the 15% cutoff. By 2025.Q2 (the last quarter with data available), urban is a condition for both indices. Size and being on the Ukrainian border impact the growth of those looking while lower quality roads negatively impact matching growth. By 2025, the beta convergence appears to be the same as prior time periods, but is becoming more conditional than before.

The labor market in the second half of the year (Q3 and Q4) results only include through 2024. In Q3, how far an area is from the district capital is significant for those looking convergence before the wartime period but not once the war begins. In 2022.Q3, only the size of an area is statistically significant for those looking for work while only being on the Ukrainian border is in 2024.Q3. Q3 is almost absolute beta convergence for all time periods. Q4 like Q3 shows distance from the regional capital significant before wartime, but not after. 2022.Q4 has the size of an area increasing the growth of those looking but not those matched. 2024.Q4 has urban and road quality significant as well for those looking for work. Like Q3, the results are close to absolute beta convergence with few conditional variables important.

As beta convergence is necessary for sigma convergence, we examine sigma convergence only for milk, eggs and the two labor market indicators that exhibited beta convergence (Table 11). Milk sigma convergence shows slow divergence throughout the sample period with further divergence after the full-scale war begins but it is not clear if the further divergence can be attributed to the war. Egg production except for an outlier in 2018.Q4 shows strong divergence 2022-2024 across quarters but then strong convergence back to pre-war variation levels in the first two quarters of 2025. Registered unemployed exhibit strong sigma divergence during the pandemic which then returns to pre-COVID levels in 2023 but then continues to converge to very low levels in 2024.Q2 and Q3 that can be attributed to the wartime labor market. Matching for unemployed with vacancies shows a clear wartime convergence with the lowest level of variation in 2025. Rapidly finding a job has never been easier in both rural and urban Rostov in 2025.

5. Conclusions

Quarterly economic performance of Rostov region adjacent to the Ukrainian war shows mixed evidence of a wartime impact on local economic activity. While agriculture and labor sectors in Rostov region exhibit convergence, the housing market does not with housing increasing output during wartime- but no changes in how the output is distributed across areas within the region except more urban relative to rural construction. Access to housing should therefore increase as the already declining population at the start of the sample period (2015) has even greater decline due to high pandemic and wartime mortality. Cattle and poultry sales neither converge nor diverge 2015-2025.Q2. Milk production diverges both in terms of beta and sigma models throughout the sample period with no clear wartime change in 2022. Beta divergence is absolute in that no exogenous factors such as road quality were statistically significant across quarters and years. Egg production converges and in 2022 only being on the Ukrainian border and lower quality roads (a proxy for economic development) are associated with higher egg production relative to other districts. Milk production falls a lot in 2022 but then recovers while egg production starts to grow in wartime arresting a long gradual decline before 2022.

The labor market 2015-2025.Q2 follows the national trends of much higher registered unemployment during the pandemic returning to pre-pandemic levels by 2023 but then falling further to historically low levels by 2025. Districts and towns are becoming more alike in terms of both registered unemployment and those finding a job. Wartime leads to more conditional convergence with urban and size of the district becoming important in terms of finding a job. In the labor market sigma convergence reinforces beta convergence in that all localities are becoming more alike in a very tight labor market.

Several further research areas are suggested by our results. One would be to examine post 2025.Q2 performance once the statistical data become available again. Second, a comparison of Rostov's results with other regions to discern any variation in wartime impact on these markets. Third, more work in general on the quarterly performance of the Russian economy both before and after the war to better understand how different quarters are from each other over time and space. Unfortunately, much of this analysis must await the end of the war as statistical information is now restricted even at the national level.

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Tables

Table 1. Annual Descriptive Statistics

	<u>2015</u>	<u>2016</u>	<u>2017</u>	<u>2018</u>	<u>2019</u>
1.a.Sold for slaughter cattle and poultry live weight (metric tons)	328600	360700	362500	379200	263000
1.b. % produced on household plots	47.5	43.3	43.4	41.1	55.6
2.a. Milk (metric tons)	1080500	1088100	1091600	1095900	1096600
2.b. % produced on household plots	84.5	84.3	83.2	81.2	79.3
3.a. Eggs (in thousands)	1907045	2126300	2177900	1886100	1744300
3.b. % produced on household plots	44.4	40.3	37.6	34.7	37
4. Number of Working Age Without a Job Actively Looking for Work and Registered at Local Job Placement Center	19973	18117	16698	16676	17347
5. Registered Unemployed who found a position	107152	115619	120524	126877	126587
6.a. Overall New Floor area (ths. Sq. meters)	2408721	2296928	2336321	2354524	2780936
6.b. New Floor for Single Family homes area (ths. Sq. meters)	1544312	1398975	1385089	1250305	1449303
	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024</u>
1.a.Sold for slaughter cattle and poultry live weight (metric tons)	253100	312200	381000	393700	396000
1.b. % produced on household plots	57.3	45.6	36.9	35.6	34.3
2.a. Milk (metric tons)	1096700	1098200	1102000	1104700	1104600
2.b. % produced on household plots	77.5	76.4	75.8	74.6	74.8
3.a. Eggs (in thousands)	1699600	1396600	1661200	1624700	1672800
3.b. % produced on household plots	37.7	44.3	35.5	33.5	28.1

4. Number of Working Age Without a Job Actively Looking for Work and Registered at Local Job Placement Center	107006	17320	10853	7605	5908
5. Registered Unemployed who found a position	82346	118158	64641	41984	24470
6.a. Overall New Floor area (ths. Sq. meters)	2613978	2753800	2703722	2963427	2950859
6.b. New Floor for Single Family homes area (ths. Sq. meters)	1291323	1541484	1430239	1743181	1820022

Table 2. Quarterly Regional Growth Rates 2015-Q2.2025

Quarter	Q1	Q2	Q3	Q4
1.Sold for slaughter cattle and poultry live weight (metric tons), Incursion, 2015-2021	-2.68	-0.97	-0.02	1.52
War Years 2022-2025Q2	8.00	6.89	7.65	3.28
Early Incursion, Pre-war, 2015-2018	8.90	7.74	-0.70	-1.38
Late Incursion, Pre-war, 2019-2021	-18.11	-12.59	0.89	5.38
2. Milk (metric tons), Incursion, 2015-2021	0.46	0.11	-0.05	0.70
War Years 2022-2025Q2	0.00001	-2.17	0.11	0.17
Early Incursion, Pre-war, 2015-2018	0.34	-0.08	-0.26	0.53
Late Incursion, Pre-war, 2019-2021	0.54	0.24	0.11	0.82
3. Eggs (in thousands), Incursion 2015-2021	-6.33	-5.53	-2.95	-2.90
War Years 2022-2025Q2	1.66	1.23	5.48	1.25
Early Incursion, Pre-war, 2015-2018	-17.90	-14.77	-10.89	5.17
Late Incursion, Pre-war, 2019-2021	2.35	1.40	3.01	-8.95
4. Number of Working Age Without a Job Actively Looking for Work and Registered at Local Job Placement Center, Incursion 2015-2021	8.75	2.07	-0.28	-2.65
War Years 2022-2025Q2	-42.96	-30.10	-31.35	-32.12
Early Incursion, Pre-war, 2015-2018	-3.45	-2.43	-0.81	-4.53
Late Incursion, Pre-war, 2019-2021	20.95	6.57	0.25	-0.77
5. Registered Unemployed who found a position, Incursion 2015-2021	2.61	1.67	2.83	2.16
War Years 2022-2025Q2	-43.11	-47.15	-51.55	-46.63
Early Incursion, Pre-war, 2015-2018	7.82	6.17	7.13	8.66
Late Incursion, Pre-war, 2019-2021	-2.60	-2.82	-1.46	-4.35
6.a. Overall New Floor area (ths. Sq. meters), Incursion 2015-2021	-1.38	1.72	2.94	-3.22
War Years 2022-2025Q2	11.00	1.54	59.88	67.80
Early Incursion, Pre-war, 2015-2018	2.83	-4.93	-2.93	-1.09
Late Incursion, Pre-war, 2019-2021	-6.99	10.59	10.77	-6.06
6.b. New Floor for Single Family homes area (ths. Sq. meters), Incursin 2015-2021	1.47	14.96	5.26	-1.07
War Years 2022-2025Q2	11.88	-72.44	61.23	68.21
Early Incursion, Pre-war, 2015-2018	5.55	-7.27	-1.24	-1.11
Late Incursion, Pre-war, 2019-2021	-3.96	44.61	13.93	-1.03

Table-3. Conditional Beta Convergence Results Q1 only

2015 is Initial Year (N=43 Districts)								
1. Cattle Production								
	2021		2022		2024		2025	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	***-0.572	-2.050	-0.296	-0.820	-0.136	-0.560	-0.141	-0.600
LSqKm	0.092	1.240	0.049	0.600	0.020	0.400	0.004	0.090

Bord	0.003	0.090	0.015	0.370	-0.008	-0.260	-0.023	-0.950
BadRds2015	0.001	1.330	0.001	1.080	0.001	0.950	0.0004	0.610
LDistCap	0.024	1.180	0.023	1.150	0.007	0.560	0.016	1.020
Initial2015	-0.051	-1.090	-0.038	-0.810	-0.012	-0.450	-0.0002	-0.010
R-sq	0.409		0.163		0.052		0.073	
2. Milk Production								
	2021		2022		2024		2025	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.1128	-0.95	-0.116	-0.99	-0.10393	-1	*-0.134	-1.52
LSqKm	-0.0151	-0.52	-0.016	-0.59	-0.00889	-0.35	-0.00126	-0.06
Bord	-0.0019	-0.15	-0.002	-0.18	-0.00955	-0.61	-0.01213	-0.88
BadRds2015	-0.0001	-0.27	-0.0001	-0.19	-0.00029	-0.64	-0.0004	-0.89
LDistCap	0.0113	0.9	0.011	1.04	0.008109	0.77	0.00825	0.87
Initial2015	**0.0216	1.68	***0.0221	2.08	*0.0177	1.58	0.014286	1.27
R-sq	0.1132		0.1143		0.1166		0.161	
3. Egg Production								
	2021		2022		2024		2025	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.416	-1.010	-0.036	-0.100	-0.193	-0.670	-0.170	-0.610
LSqKm	0.042	0.540	-0.017	-0.280	0.025	0.400	0.043	0.830
Bord	0.007	0.130	**0.0507	1.780	0.050	0.900	0.009	0.140
BadRds2015	-0.0002	-0.090	0.0002	0.150	0.001	0.720	0.002	1.320
LDistCap	0.051	0.930	0.024	0.540	0.012	0.240	-0.004	-0.090
Initial2015	-0.027	-0.680	-0.003	-0.120	-0.019	-0.540	-0.034	-1.060
R-sq	<u>0.293</u>		<u>0.068</u>		<u>0.134</u>		<u>0.174</u>	

Note: ****-1%, ***-5%, **-10%, *-15%

Table 4. Conditional Beta Convergence Results Q2 only

2015 is Initial Year (N=43 Districts)								
1. Cattle Production								
	2021		2022		2024		2025	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	** -0.539	-1.750	-0.101	-0.370	-0.090	-0.410	-0.252	-0.900
LSqKm	0.079	0.980	0.008	0.160	0.006	0.150	0.0004	0.010
Bord	-0.003	-0.110	0.015	0.490	-0.011	-0.420	-0.006	-0.190
BadRds2015	0.001	1.130	0.0004	0.500	0.0004	0.650	0.001	0.800
LDistCap	0.031	1.330	0.022	1.130	0.012	0.760	*0.0277	1.510
Initial2015	-0.042	-0.850	-0.012	-0.630	-0.004	-0.220	0.010	0.470
R-sq	0.388		0.080		0.043		0.114	
2. Milk Production								
	2021		2022		2024		2025	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	** -0.21	-1.850	-0.149	-1.310	*-0.169	-1.640	****-0.3	-2.700
LSqKm	-0.004	-0.170	-0.008	-0.400	-0.003	-0.140	0.022	1.020
Bord	-0.008	-0.660	-0.006	-0.470	-0.008	-0.550	-0.016	-1.120
BadRds2015	-0.0003	-0.670	-0.0001	-0.140	-0.0003	-0.890	-0.0005	-1.150
LDistCap	0.013	1.330	*0.014	1.630	*0.015	1.590	**0.012	1.670
Initial2015	*0.0197	1.620	*0.0156	1.460	0.014	1.270	0.011	0.820
R-sq	0.246		0.182		0.263		0.351	

3. Egg Production								
	2021		2022		2024		2025	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.369	-0.960	0.102	0.240	-0.231	-0.830	-0.567	-1.130
LSqKm	0.028	0.410	-0.004	-0.050	0.018	0.310	*0.115	1.460
Bord	0.035	0.600	***0.116	2.320	0.039	0.740	0.030	0.460
BadRds2015	-0.0004	-0.250	0.001	0.870	0.001	0.640	0.001	0.530
LDistCap	0.061	1.250	0.016	0.290	0.018	0.410	-0.051	-0.930
Initial2015	-0.025	-0.670	-0.033	-0.880	-0.012	-0.360	-0.025	-0.590
R-sq	<u>0.347</u>		<u>0.220</u>		<u>0.111</u>		<u>0.103</u>	

Note: ****-1%, ***-5%, **-10%, *-15%

Table 5. Conditional Beta Convergence Results Q3 only

2015 is Initial Year (N=43 Districts)						
1. Cattle Production						
	2021		2022		2024	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	***-0.604	-2.040	-0.302	-1.070	-0.101	-0.460
LSqKm	0.100	1.360	0.053	1.000	0.019	0.450
Bord	0.005	0.140	0.002	0.040	-0.022	-0.790
BadRds2015	0.002	1.360	0.001	0.590	0.0001	0.100
LDistCap	0.018	1.220	0.019	1.210	0.004	0.260
Initial2015	-0.048	-1.040	-0.030	-1.260	-0.008	-0.400
R-sq	0.328		0.151		0.038	
2. Milk Production						
	2021		2022		2024	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	***-0.237	-2.130	***-0.252	-2.510	***-0.24	-2.640
LSqKm	-0.004	-0.160	-0.002	-0.110	0.001	0.030
Bord	0.004	0.310	0.004	0.290	-0.002	-0.170
BadRds2015	-0.0003	-0.610	-0.0002	-0.650	-0.0003	-1.050
LDistCap	0.014	1.190	0.013	1.360	0.010	1.330
Initial2015	*0.023	1.550	**0.024	1.880	***0.022	2.180
R-sq	0.236		0.272		0.315	
3. Egg Production						
	2021		2022		2024	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.247	-0.650	-0.188	-0.620	-0.632	-1.110
LSqKm	-0.024	-0.310	0.029	0.450	0.062	0.670
Bord	0.038	0.810	*0.086	1.570	0.052	0.720
BadRds2015	0.001	0.690	**0.003	1.790	0.001	0.300
LDistCap	0.041	0.970	-0.002	-0.040	0.011	0.190
Initial2015	0.012	0.380	-0.025	-0.720	-0.001	-0.030
R-sq	<u>0.100</u>		<u>0.243</u>		<u>0.078</u>	

Note: ****-1%, ***-5%, **-10%, *-15%

Table 6. Conditional Beta Convergence Results Q4 only

2015 is Initial Year (N=43 Districts)						
1. Cattle Production						
	2021		2022		2024	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.343	-1.03	-0.087	-0.29	-0.124	-0.49
LSqKm	0.056	0.64	-0.011	-0.18	0.009	0.16
Bord	0.028	0.71	0.008	0.22	-0.010	-0.40
BadRds2015	*0.002	1.62	0.001	1.33	0.001	0.92
LDistCap	0.026	1.05	**0.039	1.68	*0.032	1.63
Initial2015	-0.043	-0.84	-0.010	-0.43	-0.018	-0.69
R-sq	0.309		0.157		0.198	
2. Milk Production						
	2021		2022		2024	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.012	-0.06	0.069	0.37	0.018	0.12
LSqKm	-0.012	-0.40	-0.020	-0.65	-0.002	-0.10
Bord	0.008	0.45	0.005	0.28	-0.008	-0.49
BadRds2015	-0.001	-0.98	-0.0002	-0.30	-0.0003	-0.65
LDistCap	*0.0195	1.53	0.019	1.37	0.010	1.05
Initial2015	0.004	0.22	0.0002	0.01	-0.004	-0.24
R-sq	0.108		0.092		0.063	
3. Egg Production						
	2021		2022		2024	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Constant	-0.484	-0.94	-0.191	-0.58	-0.343	-0.80
LSqKm	0.108	0.79	0.062	0.92	0.043	0.58
Bord	0.037	0.82	**0.089	1.82	0.028	0.39
BadRds2015	0.003	1.42	**0.0028	1.72	0.001	0.75
LDistCap	-0.038	-0.49	-0.017	-0.35	0.008	0.16
Initial2015	-0.042	-0.81	-0.046	-1.30	-0.021	-0.56
R-sq	0.178		0.315		0.074	

Note: ****-1%, ***-5%, **-10%, *-15%

Table 7. Labor Market Conditional Beta Convergence Results Q1 only

2015 is initial year, N=55 towns/districts, ****-1%, ***-5%, **-10%, *-15%						
a. Unemployed						
	2021		2022			
	Coeff	Tstat	Coeff	Tstat		
Constant	0.136	0.490	-0.002	-0.020		
Urban	0.141	1.060	0.062	1.100		
LSqKm	0.024	0.520	0.018	1.130		
Bord	-0.011	-0.340	-0.005	-0.370		
BadRds2015	0.001	0.810	0.00001	0.020		
LDistCap	-0.020	-0.620	-0.005	-1.280		
Initial2015	-0.031	-0.770	*-0.029	-1.630		
R-sq	0.331		0.135			
b. Matched						
	2021		2022			

Constant	*0.341	1.480	0.097	0.540		
Urban	0.108	0.850	***0.155	2.060		
LSqKm	0.017	0.420	**0.037	1.760		
Bord	0.023	0.760	0.004	0.150		
BadRds2015	-0.0002	-0.270	-0.0001	-0.130		
LDistCap	-0.014	-0.460	-0.008	-1.390		
Initial2015	****-0.071	-4.110	****-0.085	-5.960		
R-sq	<u>0.310</u>		<u>0.270</u>			
a. Unemployed						
	2024		2025			
Constant	-0.030	-0.200	-0.242	-1.350		
Urban	0.093	1.400	***0.161	1.960		
LSqKm	*0.031	1.580	***0.049	1.950		
Bord	-0.007	-0.420	-0.023	-1.230		
BadRds2015	-0.0005	-1.060	-0.0003	-0.610		
LDistCap	-0.003	-0.290	-0.0005	-0.030		
Initial2015	****-0.05	-2.750	***-0.04	-2.140		
R-sq	0.325		0.290			
b. Matched						
	2024		2025			
Constant	-0.201	-1.360	0.014	0.100		
Urban	0.024	0.310	***0.118	2.040		
LSqKm	0.017	0.780	***0.032	1.950		
Bord	-0.017	-0.950	0.001	0.060		
BadRds2015	-0.0002	-0.460	**0.001	-1.930		
LDistCap	0.001	0.100	-0.002	-0.520		
Initial2015	-0.004	-0.350	****-0.06	-6.330		
R-sq	<u>0.145</u>		<u>0.158</u>			

Table 8. Labor Market Conditional Beta Convergence Results Q2 only

2015 is initial year, N=55 towns/districts, ****-1%, ***-5%, **-10%, *-15%						
a. Unemployed						
	2021		2022			
	Coeff	T-stat	Coeff	T-stat		
Constant	0.046	0.23	0.026	0.21		
Urban	0.093	1.24	*0.072	1.45		
LSqKm	0.025	1.09	**0.023	1.67		
Bord	-0.001	-0.04	0.001	0.04		
BadRds2015	0.0001	0.17	-0.0003	-0.73		
LDistCap	**0.013	-1.65	****-0.007	-2.95		
Initial2015	-0.028	-0.88	****-0.038	-2.71		
R-sq	<u>0.18</u>		<u>0.22</u>			
b. Matched						
	2021		2022			
Constant	***0.335	1.98	0.212	1.29		
Urban	0.061	0.61	0.059	1.15		
LSqKm	0.008	0.24	0.011	0.65		
Bord	0.021	0.95	0.008	0.37		
BadRds2015	-0.0003	-0.47	0.0001	0.26		

LDistCap	-0.010	-0.43	-0.003	-0.79		
Initial2015	****-0.05	-3.16	****-0.06	-4.40		
R-sq	<u>0.24</u>		<u>0.38</u>			
a. Unemployed						
	2024		2025			
Constant	-0.109	-0.67	-0.176	-1.30		
Urban	0.057	0.77	*0.084	1.45		
LSqKm	0.027	1.19	*0.03	1.60		
Bord	-0.020	-1.32	*-0.02	-1.45		
BadRds2015	-0.0004	-0.86	-0.0001	-0.26		
LDistCap	0.0003	0.02	0.0005	0.04		
Initial2015	***-0.032	-2.38	***-0.027	-2.21		
R-sq	<u>0.35</u>		<u>0.29</u>			
b. Matched						
	2024		2025			
Constant	0.022	0.16	0.132	0.89		
Urban	0.086	0.92	*0.093	1.46		
LSqKm	0.025	0.84	0.022	1.07		
Bord	0.016	0.65	0.005	0.22		
BadRds2015	-0.0004	-0.76	***-0.001	-2.01		
LDistCap	-0.003	-0.12	-0.002	-0.23		
Initial2015	****-0.06	-3.44	****-0.07	-4.86		
R-sq	<u>0.37</u>		<u>0.49</u>			

Table 9. Labor Market Conditional Beta Convergence Results Q3 only

2015 is initial year, N=55 towns/districts, ****-1%, ***-5%, **-10%, *-15%

a. Unemployed						
	2021		2022			
	Coeff	T-stat	Coeff	T-stat		
Constant	0.154	0.860	0.012	0.090		
Urban	0.064	1.100	0.061	1.140		
LSqKm	0.019	1.010	*0.023	1.540		
Bord	0.009	0.440	-0.001	-0.090		
BadRds2015	0.0001	0.240	-0.0001	-0.140		
LDistCap	***-0.014	-2.390	-0.006	-1.440		
Initial2015	***-0.044	-2.060	****-0.037	-2.700		
R-sq	0.25		0.25			
b. Matched						
	2021		2022			
Constant	***0.372	2.290	**0.27	1.810		
Urban	0.029	0.250	-0.003	-0.040		
LSqKm	-0.002	-0.050	-0.005	-0.220		
Bord	0.015	0.620	0.014	0.580		
BadRds2015	-0.0003	-0.530	0.0001	0.190		
LDistCap	-0.007	-0.260	-0.006	-0.440		
Initial2015	****-0.043	-2.720	****-0.04	-3.290		
R-sq	<u>0.21</u>		<u>0.25</u>			
a. Unemployed						
	2024					

Constant	-0.131	-0.880			
Urban	0.059	0.720			
LSqKm	0.029	1.130			
Bord	*-0.022	-1.500			
BadRds2015	-0.001	-1.120			
LDistCap	0.002	0.090			
Initial2015	***-0.031	-2.450			
R-sq	0.40				
b. Matched					
	2024				
Constant	0.084	0.600			
Urban	0.053	0.600			
LSqKm	0.015	0.540			
Bord	0.034	1.170			
BadRds2015	-0.0003	-0.480			
LDistCap	-0.004	-0.210			
Initial2015	****-0.049	-3.210			
<u>R-sq</u>	<u>0.32</u>				

Table 10. Labor Market Conditional Beta Convergence Results Q4 only

2015 is initial year, N=55 towns/districts, ****-1%, ***-5%, **-10%, *-15%

a. Unemployed						
	2021		2022			
	Coeff	T-stat	Coeff	T-stat		
Constant	0.0597	0.46	-0.149	-0.81		
Urban	0.0336	0.78	0.117	1.62		
LSqKm	0.0168	1.31	***0.043	2.1		
Bord	-0.0017	-0.12	-0.001	-0.05		
BadRds2015	0.00004	0.09	-0.0003	-0.53		
LDistCap	****-0.009	-3.64	-0.004	-0.7		
Initial2015	** -0.031	-1.92	***-0.041	-2.15		
R-sq	0.27		0.28			
b. Matched						
	2021		2022			
Constant	****0.392	3.08	**0.254	1.74		
Urban	0.030	0.33	-0.012	-0.17		
LSqKm	0.0002	0.01	-0.005	-0.21		
Bord	0.012	0.61	0.012	0.48		
BadRds2015	-0.0003	-0.61	0.0001	0.19		
LDistCap	-0.011	-0.5	-0.006	-0.44		
Initial2015	****-0.04	-3.28	****-0.035	-2.7		
<u>R-sq</u>	<u>0.27</u>		<u>0.23</u>			
a. Unemployed						
	2024					
Constant	-0.214	-1.38				
Urban	*0.109	1.53				
LSqKm	0.043	2.02				
Bord	-0.013	-0.65				
BadRds2015	*-0.001	-1.6				

LDistCap	0.001	0.09			
Initial2015	***-0.037	-2.08			
R-sq	0.38				
b. Matched					
	2024				
Constant	0.109	0.76			
Urban	0.037	0.41			
LSqKm	0.011	0.4			
Bord	0.031	1.17			
BadRds2015	-0.0004	-0.68			
LDistCap	-0.003	-0.13			
Initial2015	****-0.045	-2.97			
R-sq	0.34				

Table 11. Sigma Convergence

	<u>Milk</u>				<u>Eggs</u>				<u>Registered Un.</u>				<u>Matched</u>			
<u>Year</u>	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>Q4</u>	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>Q4</u>	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>Q4</u>	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>Q4</u>
2015	59	53	55	58	140	130	148	140	111	120	128	128	170	154	158	157
2016	59	53	55	60	131	119	134	131	128	128	135	130	173	158	160	168
2017	61	56	58	58	130	126	141	144	128	111	115	121	161	150	150	149
2018	61	56	57	57	151	131	136	197	118	109	107	114	153	144	154	154
2019	61	56	58	58	166	158	156	156	118	120	119	123	155	153	153	155
2020	62	58	58	59	154	154	157	128	128	226	200	215	142	140	143	148
2021	62	61	61	60	147	141	147	146	253	221	199	166	164	147	133	164
2022	64	61	62	58	169	156	173	159	141	148	142	141	132	109	123	125
2023	65	59	61	58	171	164	183	171	135	115	116	114	126	126	115	111
2024	65	59	63	64	171	180	182	176	108	97	97	104	124	129	139	128
2025	66	62	n/a	n/a	162	162	n/a	n/a	110	108	n/a	n/a	107	103	n/a	n/a