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Subsidies and Employment: Exploring the experience of Russian farm economy

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Abstract

The paper investigates whether agricultural enterprises (corporate farms) and the family farm sector respond differently to agricultural subsidies in respect of agricultural employment. It uses the Russia as a case study since there these two sectors are the most distinctive. Two separate models are estimated one for agricultural enterprises and one for the family sector based on the assumption that they have different objective functions. The empirical models are characterised by endogeneity and their identification strategy follows Lewbel (1997). Results show that investment subsidies work in a conventional capital/labour substitution framework reducing employment in the sector to which they are applied but indirectly increase employment in the alternative agricultural sector. Production subsidies increase employment in the family sector characterised by low labour elasticity, but reduce it in the more labour elastic enterprises sector. The remaining covariates have opposing signs in the two models, indicating a qualitative difference between the agricultural enterprises and the family sector.

Keywords: *Subsidies, agricultural enterprises, family sector, employment, Russia*

JEL Classifications: *C23, C26, E24, Q18*

1 Introduction

The objective of this paper is to evaluate the potential employment effects of agricultural subsidies on agricultural enterprises (corporate farms) and the family sector. This issue is considered in the light of distinctiveness of these sectors in Russian agriculture. It is expected that the employment effects of agricultural support policies differ amongst these heterogeneous modes of production organisation.

The paper adds to the previous research in two aspects. First, differently to most of the previous studies, the core of the empirical analysis is focused on model identification. Two econometric issues are dealt with - endogeneity and heterogeneity due to the panel nature of the dataset. The strategy in the paper follows the approach suggested by Lewbel (1997). Second, the effect is analysed according to agricultural sectors, which are defined in this paper as agricultural enterprises (corporate farms) and the family sector comprising of family farms and household plots. The paper models separately agricultural enterprises and the family sector since it assumes a difference in their objective function - profit maximisation in agricultural enterprises and household utility maximisation in the family sector - which may result in qualitatively different policy responses.

The effect of three types of subsidies is analysed, investment, production and other. Results show that investment subsidies trigger a capital/labour substitution effect which reduces employment in the sector where they are directly applied but increases it in the alternative sector (indirect effect). Production subsidies, on the other hand, have different effects on the enterprises and family sector by restricting employment in the enterprise sector and increasing it in the family sector. Other subsidies act as infrastructure improvement increasing employment in agricultural enterprises but decreasing it in the family sector. One of the interesting results is that the other covariates have opposing signs in the two models supporting the assumption of a qualitative difference between the agricultural enterprises and the family sector.

The structure of the paper is as follows. The next section includes some brief lessons from previous studies and the following two sections provide the necessary background of agricultural subsidies in Russia and agricultural employment. Section 5 presents the theoretical model and section 6 the empirical considerations. Section 7 presents the data used and section 8 deals with the econometric issues. Section 9 discusses the results and section 10 concludes.

2 Short literature background

There is an extensive debate in the economic literature on the effect of agricultural subsidies on farm employment, with the bulk of studies focusing on the European Union (EU) Common Agricultural Policy (CAP) and often within a regionalised framework (e.g. Garrone *et al.*, 2019; European

Parliament, 2016; Dupraz and Latruffe, 2015; Olper *et al.*, 2014; Petrick and Zier, 2011, 2012). Vigani *et al.* (2019) summarised the studies on the impact of agricultural policy on agricultural and rural jobs in the EU published in the last three decades. Their conclusions, similarly to the conclusions from the studies referred above, is that there is not a clear-cut answer. The effect can be positive or negative depending on the type of policy measure and the way it is implemented at national or regional level. However, all these studies focused on countries with a more homogenous farm structure dominated by family farms. This overlooked the effect on distinctly different agricultural sectors[1]. Still, there are important conclusions of the previous studies, informing this paper, e.g. that the way the support policies are implemented may affect the employment outcomes.

3 Overview of agricultural subsidies in Russia

Russia has a long-standing record of spending large amounts on subsidies to agriculture maintaining the revenue of agricultural producers higher than what it would have been in the case without public policy support (Liefert and Liefert, 2007). Despite this generous support, neither the output growth nor technical change were closer to those in industrialised economies (Lerman *et al*,. 2001). According to social cost benefit ratio (see e.g. Masters and Winter-Nelson, 1995) Russia had a comparative disadvantage in agriculture in comparison to agricultural inputs (fertilisers and energy) (Liefert, 2002). It was not until 2006 when agriculture was included in the priorities for country development that the funding for the sector started increasing (Liefert and Liefert, 2012). Since then the support to producers has fluctuated substantially but since 2014 it has stabilised between 9 and 13 per cent of gross farm receipts (OECD, 2020).

Policy implementation procedures vary regionally since agricultural support programmes are defined at a regional level but in principle they are co-financed by the federal budget. Co-financing allocation procedure is complex (Kvartiuk and Herzfeld, 2021) and the level of co-financing is open to lobbying with a particular lobbying power exercised by the richer regions.

Large part of the budgetary support to agricultural producers has taken the form of variable input and output subsidies. Such subsidies have been repeatedly criticised due to their market distorting character (World Bank, 2006; OECD, 2011, 2020). The output subsidies have been implemented as per tonne payments on marketed output and they have been used primarily for livestock products. The eligibility requirements for output subsidies included either a minimum output sold or an obligation to increase the sold quantities. If these requirements were not satisfied, producers had to return the subsidy. The bulk of the support has been absorbed by agricultural enterprises which almost automatically fulfil the eligibility requirement.

[1] In this paper, the reference to agricultural sectors means agricultural enterprises and the family sector.

The second typical form of support, often claimed as a more successful one (Serova *et al.*, 2004; World Bank, 2006), have been loan subsidies, initially introduced for working capital for seasonal crop production and later extended to short-term and investment loans to agriculture and agricultural processing companies. In fact the so-called investment subsidies in Russian agricultural have been interest subsidies given to borrowers on long-term investment loans, defined in Russian policy as loans for a period between 1 and 8 years[2]. In order to be eligible for interest subsidies, the beneficiaries have to follow a prescribed use of the loan, e.g. purchase of agricultural machinery and equipment, conversion to gas, construction and modernisation of specialised agricultural buildings and processing facilities. The Government does not stipulate a limit to the number of beneficiaries and in the past, if necessary, the government either allocated additional funds or redistributed funds from other forms of agricultural support. In such a case, producers may have considered investment subsidies as almost certain transfer which would affect their production decisions.

4 Short overview of agricultural employment in Russia

Employment in agriculture in Russia includes those employed/self-employed in agricultural enterprises, family farms and household plots. Agricultural employment has exhibited a downwards trend similar to the one typical for developed countries. During the study period 2006-2010 and 2012-2015, employment in agriculture decreased by 29 per cent (2 million people), while the number of employed in the economy as a whole increased (in relative terms agriculture decreased from 9.9 per cent of the total employment to 6.7 per cent). In rural areas, although the largest employer is the public sector, agriculture created the largest number of jobs in the private sector.

Concerning the two sectors – enterprises, and family farms along with household plots - the number of employees decreased at the highest rate in agricultural enterprises – by 47 per cent in the period 2006-2016 (Table 1), which was due to the higher rates of labour productivity growth in comparison to the other sector (Uzun & Shagaida, 2019). The decline in the family farms was 32 per cent, whilst in household plots it was only 9 per cent. Employment in household plots has declined the least, despite the lowest profitability and labour productivity, since due to the scarce opportunities for alternative employment in rural areas some of the employees released by agricultural enterprises moved to household plots.

Table 1 around here

[2] This was the implementation of investment subsidies in the period analysed in this paper. After 2017, support was disbursed under the form of reduced interest rates fixed by the government, combined with a financial compensation to lending banks (OECD, 2020).

These developments have implications for the analytical approach adopted in this paper. First, the comparison of the employment changes across different sectors confirms that while agricultural enterprises are business oriented and correspondingly implement productivity enhancements, household plots are largely absorbing labour with low opportunity costs and their employment remained much more stable, thus, reduced as well but not to a similar extent. Family farms appear to be somewhere in-between the above two extremes since they may share characteristics of both business enterprises and household plots. Given the fact that household plots have much larger numbers and a larger relative share of employment in comparison to family farms, it could be expected that the behaviour and the response of the family sector used in the analysis, which comprises of both household plots and family farms, will mimic that of the household plots.

5 Conceptual framework

In order to perform an empirical investigation of the employment effects of agricultural subsidies, there are two separate issues to consider. The first one relates to the driving forces of agricultural employment in general, while the other one concerns the effects of the subsidies. We deal with these two in turn. The first issue relates to what determines employment in general and agricultural employment in particular. In simple terms it means what measures we need to condition the effect of subsidies on. To do this we use a simplified job search model (for brevity the detailed explanation of the model is not included here; it is available from the authors). This is an auxiliary model, the main purpose of which is to derive a list of background variables for the empirical specification.

We conceptualise the effects of agricultural support separately. In order to do so we employ a micro-economic logic, relying upon the concept of a 'representative' farm and model its behaviour with regard to the economic stimuli provided by subsidies. The main point of interest is the effect of investment subsidies, which are predominant in Russia. The farm output can be viewed as a function of equipment, labour, and real estate the latter containing land and structure capital. In such a representation we distinguish agricultural machinery (i.e. equipment) from e.g. buildings and storage facilities which are part of the structure capital. Furthermore, We assume a homogeneous (of degree 1) Cobb-Douglas type of production technology, which allows for easy decomposition of the underlying effects.

Hence the output can be represented as:

$$Q = AR^{\alpha}M^{\beta}L^{1-\alpha-\beta}, \quad (1)$$

where Q is the output, R is the real estate (combination of land and structure), M is equipment/machinery, while L is labour. The real estate values themselves are also assumed to combine structures and land via a Cobb-Douglas technology i.e. $R = BS^{\gamma}N^{1-\gamma}$, where N is land and S is the structure

variable (immovable capital assets), A and B in the equations above refer to other effects on production.

By setting $C = AB^{\alpha}$ and rearranging the terms we can combine the above two into:

$$Q = CS^{\alpha\gamma} M^{\beta} L^{1-\alpha-\beta} N^{\alpha(1-\gamma)} \quad (2)$$

Therefore, the capital contributions (consisting of structure and machinery) is $S^{\alpha\gamma} M^{\beta}$ while that of labour is $L^{1-\alpha-\beta}$. Note that due to the Cobb-Douglas functional assumption the parameters $\alpha\gamma$ and β can be interpreted as the corresponding elasticities of structures and machinery use (i.e. capital elasticities). $1-\alpha-\beta$ on the other hand is the elasticity of labour.

Let us now consider an investment subsidy. The exact way in which such investment subsidy is applied will have implication for the model structure. We assume that it takes the form of low-interest finance (i.e. subsidised loan interest rate) as in the case of Russian agriculture during the period analysed. Note that other finance support such as capital grants and loan guarantees can be subsumed in the same structure.

In order to express the optimal behaviour of a profit-maximising farm we need the underlying prices for the production factors. Let us denote the prevailing wage rate (price of labour) as *w*, the price of machinery/equipment as *q*, the price of structure construction as *r*, and the price of (agricultural) land as *v,* while μ is the investment subsidy (in relative/percentage terms). This investment subsidy will affect the price of machinery and structure but also of land, since structure is attached to land.

Let us now consider a typical profit-maximizing farm. It will adjust its mix (quantities) of production factors in such a way that the ratio of their corresponding marginal products equates to their price ratios. This means that if we take some target level of output (i.e. conditional on the output), after normalising the price of output to one and setting $D = \frac{1}{C\alpha^{\alpha}} \left(\frac{r}{\gamma}\right)^{\alpha\gamma} \left(\frac{v}{1-\gamma}\right)^{\alpha(1-\gamma)} \left(\frac{v}{\beta}\right)^{\beta} \left(\frac{w}{1-\alpha-\beta}\right)^{1-\alpha-\beta}$ then expressing the marginal products as equal to price ratios and applying some arithmetical manipulation, the optimal value labout can be written in the following compact form:

$$L = \frac{\alpha(1-\mu)DQ}{v(1-\mu)^{1-\alpha+\beta}} \quad (3)$$

The amount of labour for a given output is decreasing in investment subsidies (i.e. μ) and capital elasticities (both $\alpha\gamma$ and β,since $\gamma > 0$). Alternatively, we can say that the amount of labour is in-

creasing in its elasticity (i.e. $1-\alpha-\beta$) and decreasing in investment subsidies. Therefore, investment subsidies are expected to lead to a capital/labour substitution which would decrease employment in agriculture.

Let us now further consider the case of the two agricultural sectors. The general conclusion from the above model is that investment subsidies should reduce employment in the sector they are provided to. Through sectors interaction (competition over a common pool of agricultural labour), they should increase labour availability to the non-subsidised agricultural sector, thus, depressing its price and therefore increasing its labour use.

Considering production subsidies, their effect would be essentially to reduce the price of the output and therefore increase its quantity. If we were to capture the possible effects in a theoretical model similar to the above one, we would need to free the price of output but condition on the production technology itself. To save space and since production subsidies are not the main focus we will not elaborate this in detail, but note that conditioning on (i.e. fixing) the production technology is equivalent to using it directly. Then

$$L = \left(\frac{Q}{CS^{\alpha\gamma}M^{\beta}N^{\alpha(1-\gamma)}}\right)^{\frac{1}{1-\alpha-\beta}} \tag{4}$$

This means that labour will increase with $\frac{1}{1-\alpha-\beta}$, i.e. decrease with its elasticity $1-\alpha-\beta$. In other words, labour use will increase more for less labour elastic farms. Similarly, labour use will increase with capital elasticities. Therefore, the net effect could turn out to be negative for farms with low capital elasticities and high labour elasticity. Considering the historical changes presented in Table 1, this means that we can expect that production subsidies will lead to increase of labour use in the family sector, characterised with smaller labour elasticity, but possibly lead to negative labour effects for the enterprise sector which has higher labour elasticity and is likely to exhibit lower capital elasticity.

Finally, there is the issue of other types of subsidies. Since these are a collection of heterogeneous support measures, their combined effect may not be ascertained a priori.

6 Empirical specification

The first issue to consider in the empirical specification is that of background variables that drive employment flows derived from the conceptual model In order to derive a corresponding empirical specification, it is necessary, first, to find adequate proxies bearing in mind data availability constraints, and second, to measure them. The first driver affecting sectoral employment is the value of searches proxied by relative wages in agriculture compared to the rest of the economy. However,

since the same relative wage is used as a proxy for search values in the different agriculture sectors, it is also necessary to account for the interdependence of the agriculture sectors. The unemployment rate was chosen to account for the interdependence. First, it can be viewed as a proxy for the value of job searches in the same way as the relative wage (see e.g. Kroft and Notowidigdo, 2016). Second, the unemployment rate can be thought as part of the general labour dynamics mechanism, which allocates labour to unemployment and employment in different sectors and which is simultaneously determined with sectoral employment. This is particularly relevant to the case of Russia where a large semi-subsistence agricultural sector (namely the household plots) can effectively absorb excess labour, thus reducing the interaction between agriculture and unemployment as suggested by data presented in the overview of agricultural employment in Russia. Hence, we can use the unemployment rate not only to capture the effects of sectoral employment flows, but also to indirectly account for the trade-offs between the different agriculture sectors - enterprises, family farms and household plots.

Since we have adopted a highly simplified conceptual model, we do not specify a particular mechanism for arrivals and departures of workers in the different sectors. In the lack of such a mechanism, we opt to provide a measure of the pressures on the relative availability of labour, i.e. the regional population density. Additionally, we employ another measure of the relative importance of agricultural employment, namely labour intensity measured as the labour used to produce a unit of agricultural output (the latter expressed in 2006 real prices).

7 Data

The main unit of analysis in this paper is the region since all data is measured at regional level. The dataset covers 78 regions[3] over the period 2006-2010, 2012-2015 for which there is data availability. There is no published data for 2011 since not all the regions provided data for that year (see also Kvartiuk and Herzfeld, 2021). Data sources are the Ministry of Agriculture of the Russian Federation in respect to the data on subsidies and Rosstat for the covariates.

In Russian statistics, employment in agriculture is included in the aggregated code "agriculture, hunting and forestry, fishing, fish farming", where during the study period agriculture accounted for around 89-90 per cent of employed and 83-86 per cent of employed in agricultural enterprises only.

Official statistics provides the total number of people employed in agriculture and separately those employed in agricultural enterprises. This means that the data allows to calculate employment in family farms and household plots together, but it is not possible to split them. Thus, the family sector

[3] All regions in Russia as of 2014 with the exception of federal cities (Moscow, Saint Petersburg) and autonomous districts that are part of regions.

is more heterogeneous than the enterprise one as it includes both family farms, registered as legal persons, and household plots that are not legal entities. Therefore, the analysis covers two agriculture sectors: agricultural enterprises and what we refer to as a 'family' sector, consisting of both family farms and household plots. The latter may create some conceptual difficulties, since the family farms are expected to behave in many ways similarly to agricultural enterprises, while the household plots might be largely semi-subsistent and hence may exhibit different behaviour. Consequently, the expected policy response of the family sector may aggregate contradictory underlying behaviour and will in general depend on the relative balance between family farms and household plots. But as stated previously, since household plots have much larger numbers and a larger relative share of employment in comparison to family farms, their behaviour and response are expected to affect stronger the overall response of the family sector.

Table 2 around here

The data used (variables, description and summary statistics) are presented in Table 2. In the dataset subsidies were split into investment and other. This classification ensures consistency and comparability between the different agriculture support programmes over the period under study. Investment subsidies are relatively homogeneous as required by our empirical specification. Furthermore, we have split the investment subsidies into two components directly received by the enterprises and the family sector, namely invsub and smallsub in Table 2. This was necessary to study empirically the interactions between the two sectors.

We have separated the coupled production enhancing subsidies (prodsub) due to their homogeneous nature and retained the reminder of the agricultural support as other subsidies (othersub2) not contained elsewhere.

8 Empirical model and econometric issues

Two separate models are estimated one for agricultural enterprises and one for the family sector; the logic behind this decision, as we indicated earlier, was the assumption of different objective functions. The two dependent variables are expressed as 'growth' rates, i.e. as an annual change in the rate of employment in the corresponding sector (enterprises of family). The subsidies are measured as a share of the value of the regional agricultural output[4]; the relative income is a ratio of wages in agriculture to the average regional wages in current prices, population density is expressed in thousands of persons/km^2, while the labour intensity is the number of people used to produce 1m ruble (RUB) output expressed in 2006 prices. All data is measured at regional level.

[4] Official statistics provides the regional agricultural output as a monetary value in current prices of the sum of crop and livestock output of all agricultural producers.

There are two econometric issues that have to be considered in this specifications. These refer to: i) the possible endogeneity and ii) individual or time heterogeneity due to the panel nature of the data set. These two issues are inseparable, i.e. they have to be simultaneously and concurrently examined. In practice, this means that the endogeneity implementation depends on correct specification of the corresponding panel data effects, while the tests for these subsume the endogeneity issue by using modelling specification that accounts for it.

Endogeneity may arise from the fact that employment in the enterprises and in the family sector are driven by the same underlying job allocation process that is not explicitly modelled here. The same process drives the overall unemployment. This means that a common process drives general unemployment and the two agriculture sectoral employment rates. Econometrically, this leads to simultaneous determination of the endogenous unemployment rate and the dependent variable, which is the corresponding sectoral employment. The conventional approach to dealing with endogeneity relies upon instruments. It is however difficult to find appropriate instruments that can fully identify the variation in the endogenous variable. The obvious and quite common reliance upon lagged values of the covariates did not in that instance provide a valid identification. Owing to this, the strategy in this paper follows the approach suggested by Lewbel (1997).

Lewbel (1997) showed that a subset of exogenous variables present in the endogenous regression model can be used to construct a wider set of potential instruments. These instruments are only valid if the endogenous variable has a skewed distribution. Otherwise, the same approach and justification as in conventional instrumental variables estimation apply.

Although relying on some restrictive assumptions about the endogenous variables in terms of skeweness, this method gives an opportunity to construct and test a large number of non-linear instruments and thus alleviate the issues related to the search of identification.

$(Y - \overline{Y})(P - \overline{P})(G - \overline{G})(P - \overline{P})$ For the enterprise employment the employed 'instruments' are

1/*popul* (i.e. $popul^{-1}$)

1/*prodsub* (i.e. $prodsub^{-1}$)

1/*othsub_2* (i.e. $othsub\_2^{-1}$)

1/*labour_intensity* (i.e. $labour\_intensity^{-1}$)

$invsub^2$

The instrument set for the family sector employment is created similarly, but the last instrument is replaced by $smallsub^2$ in the theoretical model. Hence, we have four distinct instruments common to both models and one specific to each of the sectors. We can carry out a battery of specification tests, explained in the next section, so that the correct panel data modelling specification can be decided upon.

9 Results

The tests related to the panel data model specification are presented in Table 3 suggesting that the model requires time but not individual, i.e. regional effects. . We have applied a battery of LM tests, proposed by Breusch and Pagan (1980), Gourieroux *et al.* (1982), Honda (1985), and King and Wu (1997).

Table 3 around here

All tests in Table 3 indicate that while there is a need to account for panel data effects (all two-way tests are highly significant), individual effects are rejected in favour of time effects. Furthermore, the Hausman tests (which are the original version of Hausman (1978) and auxiliary-regression-based version in Wooldridge (2010, Section 10.7.3)) indicate that these time effects are correlated which means that fixed effects specification for the latter is required. The presence of only time effects can be expected since the dependent variable is constructed as a change in the corresponding employment rates. Such a change (which is essentially a first order time difference) should effectively remove any regional fixed effects if these are present in the data.

Therefore, it is necessary to account for time heterogeneity. Since such time effects are not of primary interest we omit them from further discussion. the .

Table 4 presents the estimated models together with the appropriate instruments validity tests. These are all satisfactory. The instruments do not suffer from a weak instrumentation problem, the Wu-Hausman tests indicate that they are valid as they provide significant correction in the estimated coefficient to account for the endogeneity effect, and finally they are coherent which can be seen in the Sargan test for over-identification.

Table 4 around here

The modelling specification includes interaction effects as the employment rate in the other agricultural sector is included. These interaction effects are significant and have the expected negative signs. Nevertheless, the other estimated effects are not sensitive to the inclusion of interaction. This can be verified by comparing the main specification results (in Table 4) to a specification with no interaction effects presented in Appendix 2.

The estimated effects indicate different responses to support payments in different sectors. The first point of interest is the effect of the investment subsidies. The expectation was that these would create a capital/labour trade-off in the sector where they are implemented, and hence, should have a negative effect on employment. Indeed, looking only at the signs of the estimated coefficients, this appears to be the case with negative effect of invsub on enterprises employment and similarly of smallsub on family sector employment. However, while the above effect is statistically significant for the family sector, it is not so for the enterprises. There are several possible explanations for the lack of statistical significance of this effect on employment in agricultural enterprises. One is that the production systems employed in agricultural enterprises are much more complex that those in the family sector and hence the effect of investment subsidies may take longer to materialise. Furthermore, since in general the family sector is already more labour intensive (its employment did not contract to the same extent as in the agricultural enterprises, as demonstrated in Table 1) it is easier to displace labour at the margin, while this may not be so in the agricultural enterprises. Finally, agricultural enterprises may have some non-agricultural activities, hence aggregating heterogeneous types of employment.

Furthermore the indirect effect of the two types of investment subsidies (i.e. effect of smallsub on enterprises and invsub on family employment) are both positive, which supports the conjecture of direct substitution of labour in one sector, which increases the availability of labour and hence relative employment in the other agricultural sector. Therefore, although invsub do not show a direct statistically significant effect on enterprises employment, their positive contribution to family sector employment gives some support to the argument that they inherently facilitate a capital/labour substitution in the enterprises. When we estimated a restricted specification with no sectoral interaction effect (see Appendix 2), this one and virtually all other effects did not change qualitatively. In addition to providing evidence that these findings are not sensitive (i.e. are robust) to the model specification, this provides further justification of a capital/labour trade-off, since a comparison of Table 4 with Appendix 2 demonstrates that the indirect effects of investment subsidies are not constrained to sectoral interactions only, but do derive from a more general capital induced effects.

The effects of the other subsidies on the two sectors are diametrically opposite (Table 4). In particular, production subsidies reduce enterprise employment but increase family sector employment, while the other subsidies work the other way around. The result for the other subsidies fits with our interpretation that they can be mostly viewed as infrastructure improvements. Since the other subsidies are heterogeneous and have decreased over time, we focus on the effect of production subsidies. The labour increasing effect of these on the family sector is to be expected. Due to its higher reliance on labour and its lower labour elasticity, the family sector has to increase its labour use to meet the increased output requirements to be eligible for production subsidies. The effect on the agricultural

enterprises however is not so straightforward. Due their more capital-intensive nature they are expected to rely more heavily on capital to meet such requirements. Another possible reason is that the environment of relatively stable expectations of production subsidies may induce technological change which substitutes capital for labour. The theoretical pre-requisites for obtaining a net negative effect, discussed in the conceptual framework, i.e. high labour elasticity and low capital elasticities, are present in the enterprises.

The other covariates have opposing signs in the two equations demonstrating the qualitative difference between the two agricultural sectors. Relative income reduces employment in the enterprise sector but increases it in the family sector. Since this is a relative income in agriculture compared to the rest of the economy, this means that when it increases the wage bill of the agricultural enterprises will also increase and this may force managers to reduce employment in order to control the labour cost. For the family sector, the outcome is a result of an interplay of two factors. First, due to the increased relative wage households may become more competitive and face an increased demand for their output and, thus, engage more household members since they do not need to pay a market wage rate. Second, the decreasing differential between agricultural and non-agricultural incomes reduces the pressure on labour migration out of agriculture, thus, keeping employment in the family sector.

Population density which reflects population flows is assumed to follow the formal job opportunities. It increases employment in the enterprise sector and reduces it in the family one. The availability of formal job opportunities attracts labour to formal enterprises. The family sector reacts to the better employment opportunities outside the family by releasing labour. On the other hand, the general unemployment rate reduces employment in the enterprise sector but increases it in the family sector. Higher unemployment means less job opportunities particularly in the formal sector and, hence, people go back to their family farms and mainly semi-subsistence plots which flexibly absorb excess labour, a process well-documented during the reforms of Central and Eastern European countries resulting in low labour productivity and incomes.

Finally, the second measure of the pressure on the relative availability of labour, the labour intensity, increases employment in the enterprise sector but it is not significant in terms of the family sector employment.[5] This result suggests that a more labour intensive (regional) product mix increases labour requirements in agricultural enterprises. In practice, this means that the employment allocation mechanism, assumed in this paper, does vary with the difference in the labour intensity of regional agricultural activities.

10 Conclusions

[5] This is the only difference to the reduced (no interactions specification) in Appendix 2, where this effect is not significant for both agricultural enterprises and the family sector.

Whilst there are many studies on the effect of agricultural subsidies on farm employment in the EU, characterised by mainly family farms, little attention has been paid on their differential effect on the corporate and family farms. The paper evaluated the employment outcomes of agricultural subsidies in the two distinct sectors typical for Russian agriculture – agricultural enterprises and the family sector. Empirically, two separate models were estimated for the two agricultural sectors due to the assumption of profit maximising behaviour in the enterprise sector and utility maximising in the family one. The study controlled for endogeneity and time heterogeneity. Two types of subsidies were explicitly defined and analysed. The first type were investment subsidies which were defined in terms of the sector they were applicable to. The second type were production subsidies which due to the data limitations could not be split by destinations. The study also included the so-called other subsidies, a heterogeneous group acting in different directions. The effect of these other subsidies was not of primary interest in the paper.

Results indicated that investment subsidies work in a conventional capital/labour substitution framework in that they reduced employment in the sector to which they directly applied, but also indirectly increase employment in the alternative agricultural sector. Production subsidies reduced employment in the enterprise sector, but increased it in the family sector, reflecting the different reliance on labour of these two sectors and the predominance of household plots in the family sector.

One of the general conclusions of the study is that from employment point of view the family sector acted as a 'residual' sector driven by the developments in agricultural enterprises and in the wider economy. More policy-oriented research is necessary to inform policy-makers of the consequences for the family sector of public support to agricultural enterprises and other non-agricultural industries.

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Table 1. Structure of employment in agriculture according to types of producers (2006-2016)

Sector	2006		2016		2016/2006
	People (m)	%	People (m)	%	%
Total agriculture	6.3	100.0	4.6	100.0	73.2
Agricultural enterprises	2.6	41.3	1.4	29.9	53.0
Family farms	0.6	8.7	0.4	8.1	68.2
Household plots	3.2	50.0	2.9	62.0	90.6

***** Without employees in forestry, fishing and aquaculture enterprises to ensure comparability with the data from the agricultural census.

Source: Russian Federal State Statistics Service, Russian agricultural census (2016).

Table 2 Summary statistics

Variable	Description	Mean	Min	Max	SD
empl_ent	change in enterprises employment rate	-0.069	-0.566	0.425	0.084
empl_fam	change in family sector employment rate	0.051	-0.775	0.698	0.092
Invsub	enterprises investment subsidies rate	0.013	0.000	0.099	0.014
smallsub	family sector investment subsidies rate	0.003	0.000	0.049	0.005
prodsub	production subsidies	0.037	0.000	1.565	0.095
Othsub2	other subsidies rate	0.075	0.004	1.841	0.120
Income	relative income of agri-culture	0.598	0.170	1.131	0.170
Popul	population density	0.029	0.000	0.166	0.029
unemploym	unemployment rate	0.080	0.020	0.677	0.063
labour._intensity	number of people for unit of output	4.468	0.366	18.711	2.054

Table 3 Panel data effects tests

Test	Enterprises employment Test statistic	P Value	Family employment Test statistic	P Value
LM test - two-ways effects Gouri-eroux et al.	118.410	0.000	24.483	0.000
LM tests – Honda				
two-ways effects	6.994	0.000	3.217	0.001
individual effects	-0.990	0.839	-0.399	0.655
time effects	10.881	0.000	4.948	0.000
LM tests – Breusch-Pagan				
two-ways effects	119.390	0.000	24.643	0.000
individual effects	0.981	0.322	0.159	0.690
time effects	118.410	0.000	24.483	0.000
LM tests – King and Wu				
two-ways effects	10.053	0.000	4.587	0.000
individual effects	-0.990	0.839	-0.399	0.655
time effects	10.881	0.000	4.948	0.000
Hausman test	53.659	0.000	45.610	0.000
Regression-based Hausman test	53.485	0.000	45.068	0.000

Table 4 Estimation results

	Enterprises employment		Family employment	
	Estimate	P Value	Estimate	P Value
empl_ent			-0.859	0.000 ***
empl_fam	-0.690	0.000 ***		
invsub	-0.089	0.743	1.875	0.011 *
smallsub	4.769	0.002 **	-16.406	0.000 ***
prodsub	-0.157	0.001 ***	0.294	0.025 *
othsub_2	0.269	0.035 *	-1.113	0.002 **
income	-0.129	0.003 **	0.409	0.001 ***
popul	0.650	0.005 **	-2.291	0.000 ***
unemploym	-1.182	0.001 **	4.106	0.000 ***
labour._intensity	0.005	0.007 **	-0.008	0.103
	Statistic	P Value	Statistic	P Value
Weak Instru-ments	2.892	0.006 **	2.419	0.019 *
Wu-Hausman	28.199	0.000 ***	298.028	0.000 ***
Sargan	8.786	0.186	1.765	0.940

Appendix 1 Simplified model specification

	Enterprises employment			Family employment		
	Estimate	P Value		Estimate	P Value	
invsub	-0.584	0.274		1.779	0.049	*
smallsub	10.309	0.001	***	-19.058	0.000	***
prodsub	-0.233	0.012	*	0.356	0.026	*
othsub_2	0.678	0.006	**	-1.298	0.003	**
income	-0.260	0.002	**	0.473	0.001	**
popul	1.405	0.002	**	-2.632	0.001	***
unemploym	-2.648	0.000	***	4.849	0.000	***
labour._intensity	0.005	0.126		-0.008	0.161	
	Statistic	P Value		Statistic	P Value	
Weak Instruments	2.968	0.005	**	2.420	0.019	*
Wu-Hausman	54.773	0.000	***	132.279	0.000	***
Sargan	4.558	0.602		5.357	0.499	