Incentive provision to farm workers in post-socialist settings: evidence from East Germany and North Kazakhstan

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RESEARCH ARTICLE

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Abstract

This article explores the current practice of motivating agricultural workers in post-socialist settings. In addition, it attempts to evaluate the different wage systems observed in reality and better understand under which conditions they are reformed. It does so by contrasting the experience of two extreme cases representing fast and slow reform advance, East Germany and North Kazakhstan. The primary data for the analysis comes from cross-sectional farm surveys conducted by various researchers in both countries. East German farmers quickly replaced the inherited Soviet-style piece rate payment system by simple time rate schemes, augmented by wage premia for certain performance parameters, especially in livestock. To the contrary, the piece rate approach persists in many farms in North Kazakhstan. Moreover, the latter rarely use non-wage incentives to motivate their workers. In Kazakhstan, farms using either mixed systems or pure piece rates were more productive than the reference group using pure time rates. Labour cost per worker were lowest for pure time rate systems in both countries, followed by mixed bonus systems, whereas pure piece rate systems implied the highest cost in Kazakhstan. Kazakhstani managers tend to move away from the Soviet piece rate system if external investors become engaged in farming operations.

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1. Introduction

The organisation of agriculture in the former socialist countries of Central and Eastern Europe and the Soviet Union was driven by the Marxist ideal that agriculture, like other industrial sectors, should be organised in factory-style collective enterprises and run by a hierarchically structured labour force (Pryor, 1992). While socialist ideology disappeared with the collapse of the political regime, large-scale farming structures survived in many successor countries, and with them the need to organise agricultural labour based on hired workers. Human resource management (HRM) under the conditions of a market economy became a key challenge for business administrators in agriculture.

In the following, an attempt is made to shed light on the current practice of motivating workers in post-socialist settings and to make some advance in evaluating the different systems observed in reality. How do large-farm managers provide incentives to their workers? Which are the effects of different pay systems on the productivity and profitability of farms? How can possible variation in observed practices be explained?

Despite the origin in a common tradition, the pace of economic reforms across the region varied greatly in scope and intensity. The literature has clustered countries according to their agricultural reform progress, where the most 'advanced' countries were found among the Central European states which in the meantime acceded to the European Union (EU). They are followed by the Southeast European and Transcaucasian countries, whereas Russia, Belarus, Ukraine and the Central Asian republics (with the exception of Kyrgyzstan) are typically considered as 'slow' reformers (Lerman, 2009; Swinnen *et al.,* 2005). Even where large farms were preserved, these fundamental differences likely left their mark on how such farms are run today.

The article exploits this heterogeneity by comparing unique farm-level data from two extreme cases of reform that nevertheless left the large farm structure intact: East Germany and North Kazakhstan. East Germany entered the EU on the day of re-unification with West Germany in October 1990 and completed the transition process by the mid-1990s, when labour productivity had reached the West German level and the legal and institutional environment of farming was widely harmonised (Petrick and Zier, 2012). North Kazakhstan represents the 'slow' reform path, characterised by incompletely restructured state farms desperately in need of capital infusion and management upgrading. It was only in the end of the 1990s that a new type of farm organisation emerged, called agroholdings (Petrick *et al.,* 2013).

Based on the canonical models by Holmstrom and Milgrom (1987) and Lazear (2000), the article sets out with a conceptual framework for the study of work incentives, which is used to derive hypotheses concerning the main questions of the article. Moreover, the historical context of pay systems in the former socialist countries is presented. As one of the first empirical explorations of this sort, the article evaluates the current management response to incentive problems in agricultural labour, using unique farm level data from East Germany and North Kazakhstan. Regression models are estimated to analyse the productivity and cost effects of different pay systems and the determinants of change. Confirming key insights of the economics literature on labour incentives, it is shown that piece rates increase productivity, but at the cost of higher wage expenses. East German farmers quickly replaced the inherited Soviet-style piece rate payment system by simple time rate schemes, augmented by wage premia for certain performance parameters, especially in livestock. To the contrary, the piece rate approach persists in many farms in North Kazakhstan. Given the historical legacy of narrow job designs, it is argued that the importance of piece rates declines as the overall economy evolves toward a Western market economy with its higher emphasis on worker autonomy and individualism. Moreover, managers tend to move away from the Soviet piece rate system if external investors become engaged in farming operations.

2. Incentive provision to workers

Two key propositions of economic agency theory are that workers provide more effort if monetary incentives are stronger, but that they may reject participation in the job if they have to bear too much of the risk (Holmstrom and Milgrom, 1987). As a consequence, payment based on output will lead to higher worker productivity than a time rate. However, in environments characterised by high uncertainty, contracts will typically include a payment component that is independent of output. The literature provides empirical support for both implications, for example using data from car windshield installers (Lazear, 2000), tree planters (Shearer, 2004) and crop harvest workers (Kandilov and Vukina, 2016). But none of these studies has investigated agricultural pay systems in contexts where tasks were more complex than manual planting or harvesting, and none has looked at former socialist countries. In the following, the implications of agency theory are thus examined in their relation to broader job designs and the specific requirements of agriculture. The historical legacy of socialist work relations in agriculture is discussed in Section 3. To clarify terms, some formal notation is introduced first.

A model of monetary pay systems

Consider a worker supplying effort e to the production process of a farm. The farm's revenue q accrues to the owner and is a function of e. However, because effort is difficult to measure and profit may depend also on other factors than effort, the owner cannot directly contract the effort of the worker. For example, revenue may depend on effort and a random variable ε reflecting chance events such as weather or market fluctuations: $q = f(e) + \varepsilon$. To elicit effort from the worker even if it is not contractible, the owner offers her a linear wage schedule w consisting of a fixed rate r and a share α in revenue:

$$w = r + \alpha q, \text{ with } 0 \leq \alpha \leq 1 \tag{1}$$

The following parameter values characterise different contractual models:
   (a) $r = 0$ and $0 < \alpha < 1$ define a pure piece rate contract
   (b) $r > 0$ and $\alpha = 0$ define a fixed wage contract
   (c) $r > 0$ and $0 < \alpha < 1$ define a mixed or sharing contract
   (d) $r < 0$ and $\alpha = 1$ define a fixed rent or tenancy contract

The owner has to determine which values of r and α, hence which contractual option maximise his profit. As the literature on principal-agent relationships has shown, he faces a trade-off between risk bearing and incentive provision (Holmstrom and Milgrom, 1987: 823). A fixed wage contract leaves all the risk with the owner but does not provide any financial incentive to the employee to work harder. A pure piece rate contract provides incentives to the worker, but at the cost of more risk bearing, thus jeopardising the participation of the worker in the first place. An extreme form of risk bearing and incentive provision is implied by the fixed rent contract, which turns the worker into an independent tenant and thus a residual claimant to revenue.

Under plausible assumptions about risk aversion and opportunity costs of the worker, a mixed contract is the most likely outcome (Holmstrom and Milgrom, 1987). The owner may make the payment of a share in output conditional on a certain minimum output level achieved by the worker. Under such a condition, a shift from pure time rate to a pure piece rate or mixed system will unambiguously increase average effort and thus output (Lazear, 2000).

Alternative job designs and non-monetary incentives

This model is limited in that it does not take into account non-pecuniary incentives. In fact, management concepts differ in how much emphasis they place on the financial elements of workers' compensation (Lazear and Gibbs, 2015). At one extreme, workers are assumed to be highly drudgery averse and naturally inclined to shirk, thus requiring strong monetary incentives at the margin. Frederick Taylor's 'Principles of

Scientific Management' (Taylor, 1911) exemplarily represent this view. External experts break down the production process into narrow tasks which they optimise ex-ante in the form of detailed instructions and work norms. Workers are closely monitored and strictly paid according to their contribution to total output, typically in the form of piece rates. Historically, this approach of 'narrow' job design led to massive gains from specialisation (Lazear and Gibbs, 2015: 167), and it is not necessarily outdated.

Following modern views of 'enriched' job design, workers are supposed to identify with their firm's objectives and provide effort out of an intrinsic motivation. Such employees need little monetary incentive at the margin to perform their job well and they typically receive a considerable share of their salary as a time rate. Employers expect them to continuously and autonomously improve production outcomes and their work environment involves a high degree of multitasking and decentralised decision making (Lazear and Gibbs, 2015: 167). According to this second view, workers should be assigned to jobs with which they identify, and firms should invest in such attachments. Following the model above, this strategy will be cost effective to the firm if production uncertainty is high and contracting of effort very costly or impossible, and if workers are particularly risk averse (Akerlof and Kranton, 2010: 39-43).

Another reason why piece-rate systems and incentive pay are disfavoured by employers is that implementing them faces a number of practical difficulties (Akerlof and Kranton, 2010; Freeman and Kleiner, 2005). If actual performance measures are imperfectly correlated with effort, workers have an incentive to 'game' the system. For example, if job design involves multitasking and tasks differ in how well they can be monitored and rewarded, the unrewarded tasks will be undersupplied. Piece rates induce pilfering of complementary inputs, thus they require firms to spend more on supervision and quality control. They may make workers reluctant to introduce or share productivity increasing practices, as workers fear that firm-wide work norms will be increased. Moreover, workers may take greater risks, thus increasing injuries. The introduction of new technologies or product lines causes extra costs, as piece rates need to be adjusted, which in turn may induce acrimony among workers. Finally, 'demoralised' (i.e. non-adjusted) piece rates may lead to a disparity between actual pay and the opportunity costs of workers. If the degree of piece rate adjustment differs across departments, the workers' ability to beat the normal rate within the same firm will highly vary. While they may stimulate worker productivity, piece rate systems will often involve higher labour and input costs than time rate systems. A major American shoe manufacturer thus abandoned them recently (Freeman and Kleiner, 2005).

Incentive provision to workers in agriculture

Agriculture has traditionally been regarded as a sector where gains from ex-ante optimisation and Taylorist approaches to industrial mass production are minimal (Allen and Lueck, 1998). The sequential and spatial nature of crop production inhibits gains from specialisation and makes supervision particularly costly. Throughout the growing season, workers must repeatedly shift from one task to another. As production is highly exposed to the natural environment, the work pace cannot be controlled and assigning individual responsibility for harvest failures is difficult. Some authors considered these arguments to be the root cause for the inefficiency of industrialised agriculture in the Soviet Union (Bradley and Clark, 1972).

However, these factors seem to be less relevant in some forms of livestock production. If production takes place under the controlled conditions of buildings and closed production cycles, such as in large poultry breeding and hog fattening operations, payment linked to output, industry-type organisational principles and standardised job designs are observed more often (Allen and Lueck, 1998; Von Davier, 2007). Moreover, falling communication costs due to new information technology solutions may allow better ex-ante optimisation and centralised control. This applies, for example, to precision livestock farming based on the monitoring of individual animal performance and health that also allows workforce supervision and analytics. It may imply a 'Taylorism run by computers', leaving little discretion to the local managers or workers (Lazear and Gibbs, 2015: 190).

3. The evolution of pay systems in (post-) socialist agriculture

The legacy of the Soviet piece rate system

Early in the 20th century, Taylorist methods of labour management sparked the interest of the Soviet revolutionaries who were keen on emulating the successes of Western industrialisation. In the 1920s, Vladimir Lenin endorsed the widespread adoption of Taylor's principles, which seemed to harmonise well with the Soviet idea of central planning. The emerging Stakhanovite (heroes of labour) movement is sometimes regarded as the socialist variant of Taylorism. However, Soviet practice increasingly became a caricature of initial intentions (Van Atta, 1986). The overarching goal of plan fulfilment led to labour hoarding. Managers diluted the piece rates and equalised wage differences between workers in a usually informal and ad-hoc manner. Low real wages and a lack of consumer goods in the shops provided little incentive to workers. At least from the 1970s onwards, there was no longer a threat of unemployment. In general, systemic inefficiencies arose from widespread coordination failures of the central planning system.

The industrialisation of agriculture began in the 1930s through a process of forced collectivisation, along with the adoption of a first set of agricultural work norms. The following decades saw an ongoing experimentation with agricultural payment systems and the permanent revision of work norms (Wädekin, 1989). In all socialist countries with a collectivised agricultural sector, pay systems representing a Soviet variant of Taylorism prevailed until the late 1980s. Farm workers were paid according to their material contribution to plan fulfilment, which implied the widespread use of piece rates and bonuses based on hectares ploughed, cows milked or tractors repaired.

Post-socialist restructuring paths

After the collapse of central planning in 1990/1991, the formerly socialist countries embarked on quite differing reform paths in agriculture (Figure 1) (Lerman *et al.,* 2004):
- A first group took the most radical steps of completely abandoning the collective and state farm sector and redistributing land to rural dwellers. This individualisation strategy typically implied a land reform through which former collective workers and other beneficiaries became the residual claimants of the returns to land. Family labour formed the basis of the emerging peasant farms. The former pay systems of hired workers were terminated universally. Examples include Albania, Armenia, Georgia, and Kyrgyzstan.
- In a second group of countries, collective farms were reformed more gradually, by preserving or re-creating large scale structures. Anticipating accession to the EU's common market, national governments were concerned with the competitiveness of their agricultural sectors and supported large farm restructuring with subsidies, for example in the Czech Republic, Slovakia and Hungary. East Germany became part of the EU already in October 1990. While it seems likely that farm-internal management reforms accompanied this restructuring process, little systematic insight exists on how pay systems and job designs changed.
- Russia, Ukraine and Kazakhstan represent a third group with very little initial change. Collectives turned into joint stock companies and other types of corporations, but often this was not more than changing a sign on the door. In a difficult economic environment of collapsing output markets, rising input prices and a high degree of political uncertainty, farm managers muddled through and often took personal advantage of the privatisation struggle. After the turn of the millennium, outside (though typically domestic) investors took over many of the lingering former collectives in the most fertile agrarian regions. While they frequently invested in new technology, it is widely unknown to what extent they also instigated thorough management reforms in the newly formed agroholdings.

Except where land reforms led to a complete liquidation of the former collectives, corporate farming structures survived or even thrived. Because farm restructuring started earlier and was carried out more thoroughly in the Central European countries, the prevalence of modern HRM principles and the abolishment of the
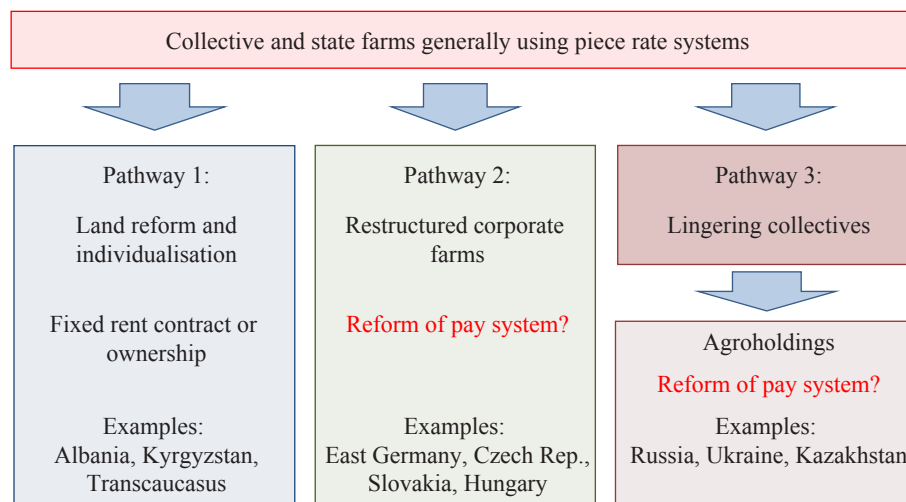
Figure 1. Simplified scheme of agricultural reform paths and pay systems in the 1990s.

traditional piece rate systems are most plausibly declining along a West-East gradient. Narrow job designs in agriculture involving pure piece rate systems are thus more likely in North Kazakhstan than in East Germany. Moreover, in the course of transition to market economic principles and more individualistic societies, narrow job designs in agriculture are likely to be replaced by enriched job designs that are also based on non-wage incentives.

Within countries, farms are expected to vary in the extent to which they keep the traditional piece rate system as well. For new entrants and farms in unpredictable environments it is more difficult to standardise work routines, they will thus lean towards enriched job designs that are not only relying on a pure piece rate system (Lazear and Gibbs, 2015: 168). Moreover, research on the barriers to adoption in other industries stresses the systemic nature of change that is required (Freeman and Kleiner, 2005; Ichniowski and Shaw, 2003). In other words, changes in pay systems are highly complementary to the reform of other management practices, for example in hiring, training, teamwork, and internal hierarchies. Enriched job designs are thus more likely on recently restructured farms and farms that are run by younger and better educated managers, or farms that were recently taken over by an outside investor.

4. Empirical approach

Hypotheses to be tested

In the following, the article investigates the empirical regularities under which different incentive systems are found in the post-socialist farming sectors of East Germany and North Kazakhstan and it studies their effects on economic outcomes. The analysis distinguishes three empirically observable systems, as introduced in Section 2 – A model of monetary pay systems:
1. Pure piece rate systems: workers are entirely paid on the basis of output.
2. Pure time rate systems: workers are entirely paid on the basis of time spent on the job.
3. Mixed bonus systems: they involve a mixture of the two previous systems, often a minimum payment independent of performance plus bonuses or premia based on output or quality of the work done.

Following the discussion in Section 2 – Alternative job designs and non-monetary incentives, piece rates are typically associated with narrow job designs, involving detailed instructions and work norms. Under pure time rates, managers will provide workers with non-wage incentives to keep them productive or rely on their intrinsic motivation. Time rates will thus more likely be associated with enriched job designs. Mixed

systems are compatible with a wide range of job designs and their effects on farm outcomes are essentially an empirical matter to be explored below.

Based on the theoretical and historical background and the conjectures presented in Sections 2 and 3, a number of hypotheses are formulated to guide the ensuing empirical analysis. The hypotheses address the incidence and evolution of pay systems, their effects on farm outcomes, and the determinants of change:

H_1: the incidence of piece rates in agriculture declines if the overall economy moves toward market economic principles.

H_2: performance pay is more prevalent in livestock operations than in crop farming.

H_3: farms using piece rate or mixed systems are more productive than those using pure time rates.

H_4: farms using piece rates incur higher labour costs than those using pure time rates.

H_5: piece rates are more likely to be abandoned if farms also undergo fundamental restructuring in other management areas.

In the sequel, the article puts these hypotheses to test using both descriptive statistics and regression analysis.

Data sources

Statistical agencies typically do not collect information about contractual relations between management and workers and the prevalence of pay systems in agriculture. Researchers therefore have to rely on their own primary data collection. The following analysis is based on two groups of sources. First, over the last twenty years, a number of researchers conducted farm surveys among corporate, individual and cooperative farms in East Germany. These surveys were typically limited in their regional scope and sometimes based on small sample sizes. But to the extent that one is willing to generalise from these samples, they provide a unique opportunity for tracing the evolution of pay systems in East German agriculture over time. The next section presents findings on the prevalence of performance pay systems among large-scale farms by Beckmann (2000), Doluschitz *et al.* (1996), Jurk (2010), Kreyßig and Pippig (1997), Schüle (1997) and Von Davier (2007). Sample sizes and regional coverage of these studies are summarised in Table 1. This data is used to explore hypotheses H_1 and H_2.

Second, more specific data on pay systems and the incidence of non-wage incentives is taken from primary survey data collected by Von Davier (2007) and the IAMO Kazakhstan farm survey 2012 (Petrick, 2015).

Table 1. Sources of farm survey data on performance pay in East German agriculture.

Study	Survey period	Region	Sample size	Average land endowment per farm (ha)	Average number of workers
Beckmann 2000	spring 1994	Mecklenburg-West Pomerania (Ludwigslust) and Thuringia (Wartburg)	40	~1,600	~30
Doluschitz *et al.* 1996	1995	Mecklenburg-West Pomerania	30	~1,500	unknown
Jurk 2010	fall 2009	Saxony	83	~1,900	36.9
Kreyßig and Pippig 1997	01-06/1997	Saxony	40	unknown	unknown
Schüle 1997	fall 1994	East Germany	315	1,619	40.4
Von Davier 2007	07/2005-03/2006	East Germany	188	1,322	16.8

The questionnaires used in these two surveys included identical questions on HRM and thus allow a direct comparison of pay systems in East Germany and Kazakhstan. It is used to examine hypotheses H_1, H_2, and H_4. As the data for Kazakhstan is richer in detail, it also allows examining hypotheses H_3 and H_5.

5. Comparing incentive provision to agricultural workers in East Germany and North Kazakhstan

Performance pay in East German corporate farms over time

East German corporate farms typically emerged from the former collective farms by changing their legal status to either registered cooperatives or limited liability companies, both under (West) German legislation (Forstner and Isermeyer, 2000). According to farm accountancy data provided by the Federal Ministry of Food and Agriculture (2015), the average corporate farm specialising in crop production cultivated 1,247 ha of arable land and employed 14 workers in 2013. An average corporate dairy farm kept 616 cows and had 33 workers on the payroll. The results of six farm surveys are available to study the popularity of performance pay in such entities (Figure 2). The surveyed farms were slightly bigger than the 2013 average (Table 1).

The figure takes the ideal-type socialist model of piece rate salaries as a benchmark, assuming that it was practiced on all farms in one way or the other (Gabler, 1995). Based on the stated sources, the figure then shows the share of farms that used performance pay systems in crop or livestock production in the years covered by the surveys. In the mid-1990s, about half of the farms keeping livestock used some form of performance pay in this production branch. Less than a third of the farms engaged in crop production ran performance pay schemes among their workers employed in this branch (Figure 2). While these numbers are broadly confirmed by Von Davier (2007) for 2006, Jurk (2010) suggests that the share of farms using performance pay went further down recently. Consistent with hypothesis H_2, performance pay is used much more often in livestock than in crop production.
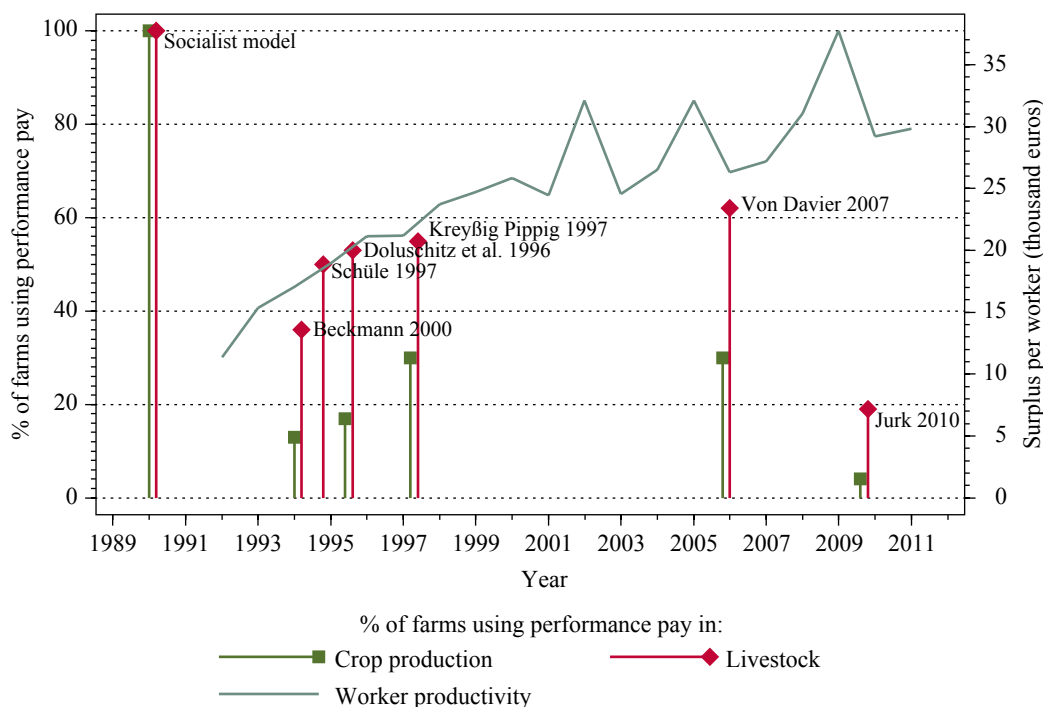

Figure 2. Share of East German farms using performance pay systems, based on farm surveys. Source given next to figure entry. Worker productivity is surplus per corporate farm worker before wage payments in 2010 prices, based on farm accountancy data.

According to these sources, practically all workers receive a monthly salary (thus a time rate) that is topped up with additional bonuses on some farms as indicated in the figure, leading to a mixed bonus system. Performance pay is commonly defined as the practice to pay employees a salary top-up (a monetary bonus) if the quality or quantity of their work fulfils certain criteria. Such criteria include but are not limited to the successful execution of a particularly demanding task, delivering a result of extraordinary quality or quantity, or the cost effective and/or careful use of machinery and equipment. The definition of performance pay excludes pay for overtime work, permanent salary increases or year-end bonuses.

None of the farms reported that it continues to use piece rates after the collapse of socialism. Commonly, farms abandoned the old payment system altogether in the early 1990s, released a significant share of workers, and introduced a new, much simplified pay system from scratch (Beckmann, 2000; Dirscherl, 1991). The new staff often consisted of only a small number of workers hand-picked from the former collective farm. Farm accountancy data published by the Federal Ministry of Food and Agriculture (2015) implies that real worker productivity on average increased over the reported period (Figure 2). However, worker productivity and the share of farms using performance pay seem to move in parallel for several years. This finding is supportive of hypothesis H_1 in the sense that most farms scrapped the rigid piece rate systems inherited from socialism. But the evidence is inconclusive on whether or not mixed bonus systems are conducive to higher productivity when compared with pure time rates (hypothesis H_3).

Performance pay and non-wage incentives in East Germany and Kazakhstan compared

In the following, the results of farm surveys on HRM in East Germany and Kazakhstan's northern grain region are compared. When the Soviet Union disintegrated, the situation of the farming sector in Kazakhstan's grain region was an extreme version of the typical Soviet model. In the late 1950s, in a quasi-overnight campaign, almost 500 sovkhozy (state farms) had been established in an attempt to make the 'Virgin Lands' of the Kazakh steppe amenable to grain production. Each state farm had a size of several 10,000 ha. Given this legacy, reform implementation in the 1990s led to the downsizing of former state farms, which were reorganised as agricultural enterprises. More recently and following the third pathway in Figure 1, some of the former state farms were taken over by outside investors and put under the umbrella of horizontally and vertically integrated holding structures, so-called agroholdings (Petrick *et al.,* 2013). Today, the typical agroholding encompasses several enterprises and cultivates up to 100,000 ha of cropland, occasionally even more. In addition, large individual farms based on hired labour were established. Some of the farms keep livestock, often up to several hundred animals (Petrick and Oshakbaev, 2015).

The interviewers asked farm managers from both Germany and Kazakhstan an identically worded (though translated) set of questions on the prevalence of performance pay and the use of non-wage incentives. The questions were asked separately for the crop production, livestock and administration departments of the farms. The interviews were held in East Germany in 2005 and 2006 (Von Davier, 2007) and in North Kazakhstan in 2012 (Petrick, 2015). On average, Kazakhstani farms were endowed with much more land per farm (Table 2). The average workforce was also bigger, but here the difference to Germany is smaller.

With regard to payment systems, more German than Kazakhstani farms use time rates as the only payment system, and they don't use piece rates at all (Table 2). The starkest contrasts between the two countries can be observed in crop production (Figure 3). 85% of Kazakhstani farms employ performance pay systems. More than two thirds of those or 61% of all farms use pure piece rate systems in crop production. In East Germany, 68% of farms use simple time rates in crop production. The remaining East German farms run mixed systems in crop production, consisting of a time rate and performance-related top ups.

To the contrary, with almost 40%, the share of farms using pure time rate systems in livestock production is similar in both countries. Thus in Germany, the prevalence of performance pay is higher than in crop production, whereas in Kazakhstan it is lower. However, 30% of farms in Kazakhstan work with pure piece rates also in livestock, whereas no farm follows this practice in Germany. Pure time rates are widespread

Table 2. Descriptive statistics on farms surveyed in East Germany and North Kazakhstan (adapted from Von Davier (2007) and the IAMO Kazakhstan farm survey 2012 (Petrick, 2015)).[1]

Variable	East Germany[2]	North Kazakhstan
land endowment per farm (ha)	1,322 (0; 5,010)	6,628 (10; 80,000)
number of workers (full time equivalent)	16.8 (0; 135)	21.9 (0.5; 540)
annual labour cost per farm (thousand USD)	448.2 (0; 1,986.8)	62.3 (0; 1,428.6)
% of farms keeping livestock	85	55
livestock endowment (livestock units)	765 (0; 5,790)	142 (0; 1,963)
materials input (thousand USD)	n.a.	84.1 (0; 1,517.0)
fixed capital (thousand USD)	n.a.	383.4 (0; 7,496.9)
farm revenue (thousand USD)	n.a.	391.0 (0; 7,768.7)
quasi rent (thousand USD)	n.a.	249.9 (-321.7; 5,401.4)
% of farms using only time rates	27.1	6.7
% of farms using only piece rates	0	11.3
% of farms using mixed bonus systems	72.9	82.0
years since last major restructuring of the farm	n.a.	11.4 (0; 22)
% of farms part of an agroholding	n.a.	5.3
age of the manager (years)	n.a.	47.7 (22; 73)
education of the manager (1..8)[3]	n.a.	6.7 (4; 8)
N	188	150

[1] Values are sample means (minimum; maximum).

[2] n.a. = not available.

[3] Education measured as an index based on: 1=no formal education; 2=primary school; 3=incomplete secondary school; 4=secondary general; 5=vocational school; 6=college; 7=incomplete higher education; 8=university degree.
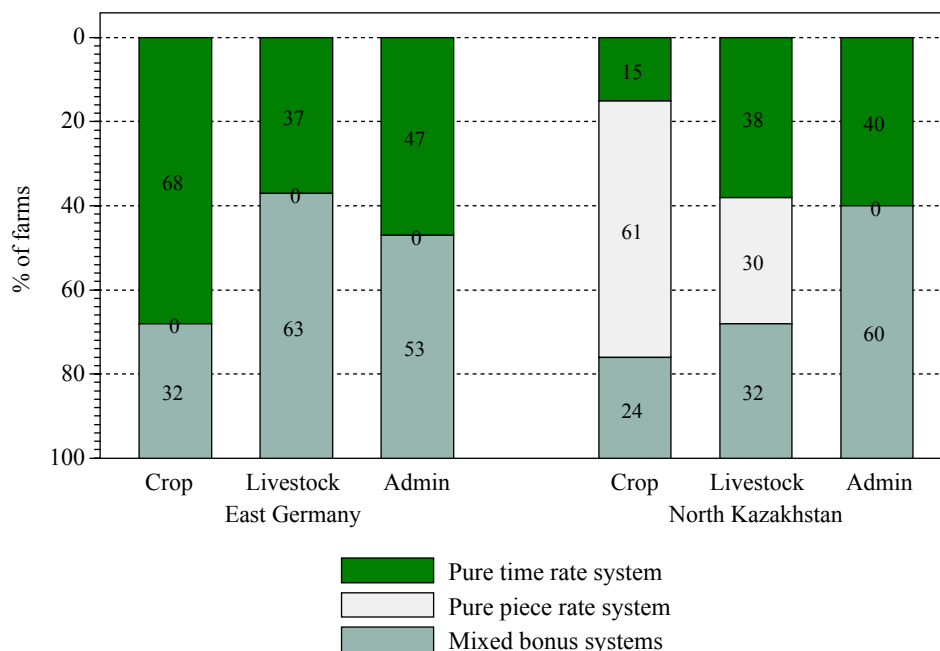

Figure 3. Share of farms using time and piece rate as well as mixed systems by production departments. Based on interviews with farm managers in East Germany and North Kazakhstan (adapted from Von Davier (2007) and IAMO Kazakhstan farm survey 2012 (Petrick, 2015)).

in administrative departments in both countries. But the majority of the farms in both countries use mixed systems in this branch.

Overall, this evidence supports hypothesis H_1 in that systems on many Kazakh farms still resemble the Soviet piece rate system, whereas it was completely abandoned in East Germany. Even so, consistent with hypothesis H_2, the majority of farms in both countries use some sort of performance pay in livestock production.

Farmers were also asked about their use of non-wage incentives (Figure 4). Again, there is a sharp difference between the two countries. Whereas the majority of German farms pursue the whole range of strategies listed in the figure, only gratifications and presents play an important role in Kazakhstan. This strategy probably comes closest to an immediate material benefit for the workers. Strategies that invest in a long-term relation between the farm and the worker include access to further training, employer contributions to health and pension plans. Other strategies aim at the non-pecuniary factors of work relations, such as flexible working hours and a good working atmosphere. Both groups of strategies were routinely practiced on German farms but were rarely followed by Kazakh managers. In particular the practices to provide further training and to allow flexible working hours are indicators of enriched job designs in East German agriculture.

Productivity effects of performance pay and the choice of pay systems

The primary farm-level data available for this study also allows comparing farms that use different pay systems within the national subsamples. To this end, three (two) mutually exclusive groups of farms were defined in both subsamples. A farm is defined as using a pure time rate system if in both crop and livestock operations only time rates are paid. A farm is defined as using a pure piece rate system if in both crop and livestock operations only piece rates are paid. This set is empty in East Germany. Finally, a farm is defined as using a mixed bonus system if in either crop or livestock operations or in both some sort of performance pay is used. In Germany, such mixed systems typically involve the payment of top ups as explained in Section 5 – Performance pay in East-German corporate farms over time. In Kazakhstan, farms under mixed
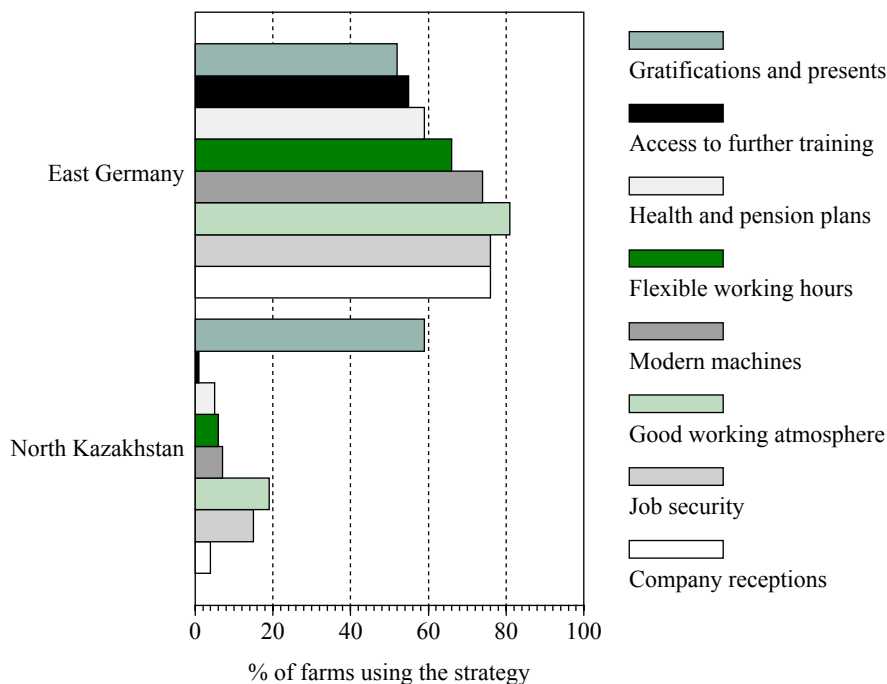

Figure 4. Share of farms using specific non-wage incentives (adapted from Von Davier (2007) and IAMO Kazakhstan farm survey 2012 (Petrick, 2015)).

systems typically paid piece rates for some tasks and time rates for others. The relative importance of the groups is shown in Table 2. In the following, this coding is used to compare the productivity, total labour costs and profitability of farms across groups. Unfortunately, only the Kazakhstan data is rich enough to allow productivity and profitability comparisons.

Inspired by Freeman and Kleiner (2005), regression analysis was used to examine the effects of different performance pay systems on farm outcomes. The following models include the three groups in a dummy variable framework, testing the effect of piece rates and mixed systems against the reference of time rates:

$$y_i = \mathbf{x}_i \beta + \delta^p t_i^p + \delta^m t_i^m + \epsilon_i \tag{2}$$

where y is farm outcome (output, labour cost or quasi rent), $\mathbf{x}$ is a vector of control variables, t^p is a dummy variable indicating the presence of a piece rate system, t^m is a dummy variable indicating the presence of a mixed bonus system, ϵ is an identically and independently distributed (i.i.d.) error term, i indicates the individual farm, and β and the δ's contain parameters to be estimated.

Model 1 in Table 3 shows the results of a simple Cobb Douglas function estimation of Equation 2 using Ordinary Least Squares (OLS). Only observations with nonzero output and non-missing data were included. Descriptive statistics of the variables are presented in Table 2. The two dummy variables test whether the presence of performance pay systems induces a linear productivity shift. In line with hypothesis H_3, both

Table 3. Regression estimates of the effect of performance pay on productivity, North Kazakhstan sample.[1,2]

Variable	Model 1: North Kazakhstan, farm output (OLS)[3]	Model 2: North Kazakhstan, farm output, endogenous mixed system (ML)[4]
Output equation		
log land input (ha)	0.199 (0.013)**	0.150 (0.037)**
log labour input (full time equivalent)	0.678 (<0.001)***	0.732 (<0.001)***
log materials input (USD)	0.173 (0.003)***	0.206 (<0.001)***
log fixed capital (USD)	0.031 (0.072)*	0.035 (0.015)**
mixed bonus system (0/1)	0.627 (0.013)**	1.898 (<0.001)***
pure piece rate system (0/1)	0.573 (0.044)**	0.358 (0.193)
Mixed bonus system equation		
land endowment (ha)	–	-0.005 (0.536)
farm is keeping livestock (0/1)	–	-1.847 (<0.001)***
farm was taken over by an agroholding (0/1)	–	3.797 (0.074)*
years since last restructuring of the farm	–	-0.029 (0.115)
age of manager (years)	–	0.010 (0.566)
education of manager (1..8)	–	-0.265 (0.009)***
ρ (Wald test $\rho=0$)	–	-0.915 (0.002)***
prob>F	<0.001	<0.001
R^2	0.74	–
N	125	125

[1] Dependent variable is log farm revenue (USD).

[2] *P*-values in parentheses, based on robust standard errors; *,**,*** significantly different from zero at the 10, 5 and 1% level, respectively; all equations include constant terms.

[3] OLS = ordinary least squares.

[4] ML = Maximum likelihood.

mixed system and piece rate dummies display significantly positive effects relative to the reference group of pure time rates. The effect of mixed bonus systems is larger than the piece rate effect.

A potential line of criticism concerns the assumption of an i.i.d. error term, on which the OLS estimation in Model 1 is based. This assumption is violated if the explanatory variables are not truly exogenous, but, for example, depend on some unobserved factor that is not accounted for in the regression. In Kazakhstan, factor market rigidities may provide a rationale why land, labour and capital input are not easily altered by farm managers, and may thus be considered as predetermined (Petrick, 2015). But it is a reasonable concern that pay systems are actually chosen by the manager and not exogenously given. An alternative Model 2 was thus estimated which considers the existence of the mixed bonus system (and thus a departure from the Soviet-style pure piece rate system) as endogenous and due to other factors that are exogenous to the farm, at least in the short run. This endogenous dummy variable model assumes the existence of a latent choice variable that determines whether mixed bonus systems are used or not, and that the latent choice variable can be explained by a second linear equation:

$$t_i^m = \begin{cases} 1, \text{ if } \mathbf{z}_i\, \gamma + u_i > 0 \\ 0, \text{ otherwise} \end{cases} \tag{3}$$

In this equation, $\mathbf{z}$ is a vector of determinants of t^m, and γ is a parameter vector to be estimated. Moreover, the error terms of the output equation ϵ and the bonus system equation u are assumed to follow a bivariate normal distribution with mean zero and correlation ρ. The model is a standard workhorse in the econometric literature on qualitative choice (Maddala, 1983: 120). Both Equations 2 and 3 were estimated jointly using Maximum Likelihood (ML). Alternative estimates using a semi-parametric control function estimator yielded very similar results (not reported).

The specification of the mixed bonus system equation was partly motivated by hypothesis H_5 and is given in the lower part of Table 3. The results show that better educated managers were actually less likely to run a mixed system, and the age of the manager did not have a significant effect. This finding might be reconciled with reality by the insight that Soviet farm managers often had a university education, but that did not necessarily turn them into reform advocates if they continued to be farm managers after 1991. An alternative specification using a dummy variable for college degree or higher confirmed the negative sign. Consistent with hypothesis H_5, farms belonging to an agroholding used mixed systems more often than other farms. This finding supports the idea that vertical integration and the takeover by outside investors give a boost to the reform of pay systems. Land endowment and the time that has elapsed since the last restructuring did not lead to significant effects.

Other than suggested by a cursory reading of Figure 3, farms keeping livestock were significantly less likely to use mixed systems across the entire farm than pure crop farms. In fact, almost all of the less productive pure piece and time rate farms were found among livestock producers, whereas only one pure crop farm runs a pure piece rate system. From this observation follows that most Kazakhstani farms indicating that they used only piece rates in crop production in Figure 3 also kept livestock. Unfortunately, the cross sectional data available here does not allow to ultimately clarifying the causal relationship between the decision to keep livestock, the choice of pay system, and overall farm productivity.

The negative sign of ρ implies that unobserved factors increasing the likelihood of a mixed bonus system tend to reduce farm output. Such factors may include the average quality of the labour force or the rate of staff turnover, which are unobserved in the datasets used for this study. Everything else equal, managers with less able workers may be more inclined to reform the pay system in order to counteract the negative effect on output. The statistical significance of ρ indicates that the enriched regression Model 2 is warranted and should be preferred to the OLS. In the simultaneously estimated output equation, the coefficients of the production factors change little compared to Model 1, but now the hypothesis must be rejected that piece rates have a positive effect on output.

Cost and profitability effects

As posited by hypothesis H_4, the median of labour cost in USD per worker is lowest for pure time rate systems in both countries (Figure 5). Furthermore, in the North Kazakhstan sample, pure piece rate systems imply the highest cost. However, the variation in labour cost for mixed systems is the highest in this sample, as expressed by the distance between the upper whisker and the box. Note that the scale for the German sample is ten times the scale of the Kazakhstan sample in this figure, to allow an easier comparison of the differences between payment systems within countries.

The previous finding is supported for Kazakhstan by regression analysis (Table 4). Model 3 estimates the effect on total labour cost per farm of mixed and pure piece rate systems, controlling for land and livestock endowment and using the same estimator as for Model 2. To enable the log transformation, observations with zero labour cost were replaced by 1 USD. Model 3 shows that piece rates increase labour costs, whereas mixed systems have no statistically significant effect vis-à-vis the pure time rate system. This result is insensitive to using other control variables, such as output or total labour force. Results for the mixed bonus system equation included in this model were very similar to the ones presented for Model 2.

Model 4 shows a similar estimation for the East German sample, using OLS. Due to a lack of data, an endogenous bonus system equation could not be specified here. Moreover, labour cost per farm had to be calculated by referring to farm-specific hourly wages and bonuses reported by the managers, and their rough estimates of how many hours workers were employed on the farm. The fit of the model is not very good, but it indicates that there was no statistically significant effect of performance pay on total labour cost per farm in the German sample.

One step further is taken by Model 5, which aims to estimate the effects of pay systems on farm profitability. The dependent variable is called the quasi-rent of the farm, calculated as total revenue minus labour cost minus material cost (Table 2). Observations with negative quasi-rents were eliminated from the estimation as they could not be transformed into logarithms. The regression does not show any significant effects of payment systems on quasi rents. However, if, in an attempt of data mining, the indicator for the mixed and
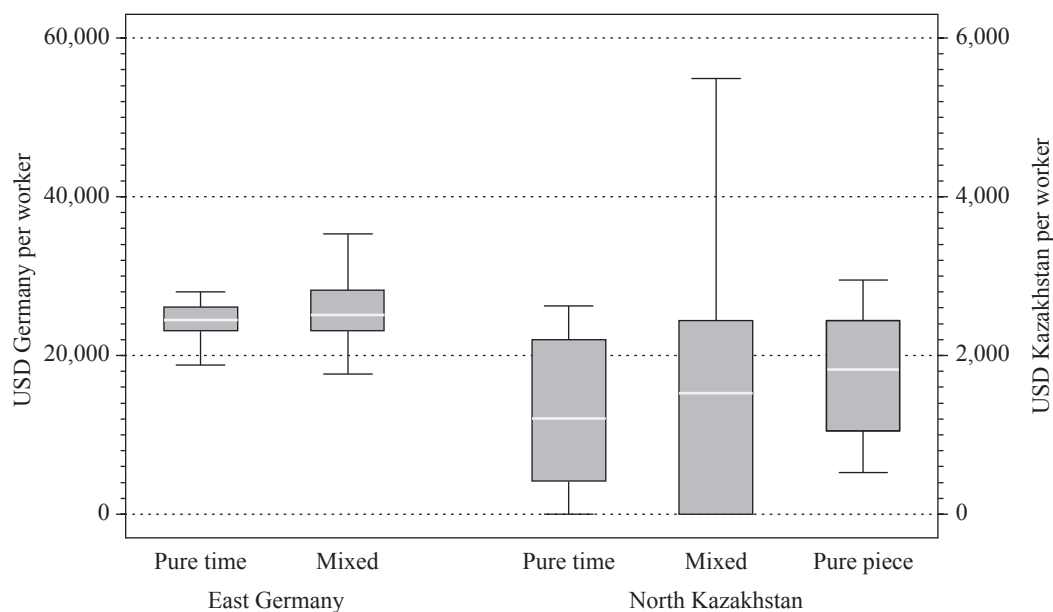

Figure 5. Boxplots of annual labour cost per worker, distribution across farms by pay system and countries (adapted from Von Davier (2007) and IAMO Kazakhstan farm survey 2012 (Petrick, 2015)).

Table 4. Regression estimates of the effect of performance pay on total labour cost and profitability, East Germany and North Kazakhstan samples.[1,2]

Variable	Model 3: N Kazakhstan total labour cost (ML)[3]	Model 4: E Germany total labour cost (OLS)[4]	Model 5: N Kazakhstan quasi rent (ML)	Model 6: N Kazakhstan quasi rent (OLS)
log land input (ha)	1.642 (<0.001)***	0.903 (0.002)***	0.772 (<0.001)***	0.798 (<0.001)***
log livestock units	-0.086 (0.160)	0.054 (0.239)	-0.059 (<0.068)*	-0.023(0.440)
mixed bonus system (0/1)	-0.481 (0.803)	-0.120 (0.846)	-0.354 (0.661)	–
pure piece rate system (0/1)	2.837 (0.003)***	–	-0.815 (0.207)	–
mixed & piece rate combined (0/1)	–	–	–	1.010 (0.065)*
R^2	–	0.04	–	0.51
Endogenous mixed system	yes	no	yes	no
prob>F	<0.001	<0.001	<0.001	<0.001
N	150	122	103	103

[1] Dependent variable is log annual labour cost per farm (USD) in Models 3 and 4, and log quasi-rent per farm (USD) in Models 5 and 6.
[2] *P*-values in parentheses, based on robust standard errors; *,**,*** significantly different from zero at the 10, 5 and 1% level, respectively; all equations include constant terms.
[3] ML = Maximum likelihood
[4] OLS = ordinary least squares.

piece rate systems is merged into one, Model 6 shows that the effect on quasi rents is significantly positive versus farms with pure time rate systems.

6. Conclusions

The principles of narrow job designs and piece rate payment heavily influenced the industrialisation of agriculture in the former socialist countries. The evidence presented in this article suggests that the influence continues today, although it tends to vanish when the overall economy becomes more liberal and individualistic. In the very first years of transition, large farm managers in East Germany replaced the Soviet system by much less complicated time rate schemes. Some managers continued to pay wage premia for certain performance parameters, leading to mixed bonus systems. To the contrary, the Soviet piece rate approach persists up to the present day in many farms in North Kazakhstan. Moreover, the latter rarely use non-wage incentives to motivate their workers. Most East German farmers stress that they invest in team building, allow flexible working hours and provide benefits such as pension plans, further training or job security. These practices indicate that more enriched job designs involving worker autonomy, multitasking and higher skills took root in East German agriculture. Even so, the majority of farms in both countries use some sort of performance pay in livestock production.

The empirical findings are consistent with the implications of established economic theories of the employment relationship. It was found that linking pay to output does increase worker productivity but also labour cost. For the Kazakhstan data, it was shown that farms using either mixed systems or pure piece rates were more productive than the reference group using pure time rates. Labour cost per worker were lowest for pure time rate systems in both countries, followed by mixed bonus systems, whereas pure piece rate systems implied the highest cost in Kazakhstan. Moreover, there is weak evidence that Kazakhstani farms using some sort of performance pay were more profitable than those using pure time rates.

The results do not suggest that there is one optimal incentive system applicable to all farms in all places. In line with theoretical expectations, farms in both countries seem to work well under mixed bonus systems

combining a time rate with a simple performance pay scheme, as it balances the trade-off between productivity and cost. Other than their Kazakhstani counterparts, East German managers pay a lot of attention to non-wage incentives. In Kazakhstan, even under mixed bonus systems, job designs appear to be still narrower and more hierarchical. Managers tend to move away from the Soviet piece rate system if external investors become engaged in farming operations and if farms specialise in crop rather than livestock production. More research is required into how exactly mixed bonus systems should be designed and how they relate to other productivity and cost affecting characteristics of farms.

This article is one of the first attempts to analyse payment systems in post-socialist agriculture in a comparative fashion. It raises the question whether managers in 'slowly' reforming countries such as Kazakhstan can learn from more 'advanced' reformers in East Germany. A careful assessment of this question should take into account that payment modes represent only one piece of a system of HRM practices that reinforce each other. Moreover, they are part of an institutional environment and a set of social habits. In a study of traditional Russian companies under the influence of Western investors, Michailova (2002) points out how Russian managers consider more autonomous job designs for workers a 'dangerous loss of power'. In addition, she argues that due to a legacy of a 'socialist collectivist-autocratic system', workers feel secured and guarded by an authoritarian boss and thus 'prefer directives instead of discussions' (Michailova, 2002: 183-184). After the collapse of socialism, the economic environment changed tremendously in East Germany, but much less in the successor states of the Soviet Union. Outside this historical window of opportunity, fundamental change is more difficult to induce.

Acknowledgements

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