Structuring Residual Income and Decision Rights Under Internal Governance: Results from the Hungarian Trucking Industry

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The paper offers a property rights and monitoring cost explanation for the allocation of residual income and decision rights between the carriers and truck drivers under internal governance. First, by applying the property rights theory, we argue that the structure of residual income rights depends on the importance of noncontractible (intangible) assets of the truck driver to generate residual surplus. The more important the truck driver's intangible knowledge assets, the more residual income rights should be transferred to him. Second, we controlled for the monitoring costs as an additional explanatory variable of the allocation of residual income rights. According to agency theory, the variable proportion of the driver's income should be higher where monitoring costs are higher. Third, we investigate the relationship between residual income and residual decision rights under internal governance. If the contractual relation is governed by an employment contract, residual decision and residual income rights may be substitutes because, under fiat, a certain incentive effect of the governance structure may result either from the allocation of high-powered incentives or the transfer of residual decision rights to the driver. These hypotheses were tested by using data from the Hungarian trucking industry. The data provide partial support for the hypotheses. Copyright © 2005 John Wiley & Sons, Ltd.

INTRODUCTION

In the past few years a large number of researchers in organizational economics examined the governance structure between carriers and drivers in the trucking industry (Hubbard, 1999; Fernández *et al.*, 2000; Lafontaine and Masten, 2001; Nickerson and Silverman, 1998, 2003; Baker and Hubbard, 2003, 2004; Arrunada *et al.*, 2004). They tried to answer the question of whether the truck driver should be an independent owner–operator (market governance) or a company driver (internal governance). On the other hand, they do not investigate the allocation of residual rights under a given governance structure. Starting from this gap in the literature, the objective of our paper is first to develop a property rights and monitoring cost explanation of the allocation of residual income and decision rights between the carrier and the truck driver under the employment relationship. In addition, we investigate the relationship between residual decision and residual income rights under internal governance.

According to the property rights theory (Hart and Moore, 1990; Barzel, 1997, 2000; Hart, 1995), noncontractible (intangible) assets influence the allocation of residual rights of control. Applying this view to the trucking industry, the allocation of residual income and decision rights in the contractual relation between the truck driver and the

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carrier depends on the importance of driver's intangible assets to generate residual surplus. The driver's intangible assets refer to his specific knowledge concerning loading, unloading and handling the goods as well as his knowledge of the routes and the customer characteristics that have an important noncontractible component. The carrier faces the problem of maximizing the residual income when it is at least partly dependent on noncontractible assets of the driver. If the assets of the truck driver represent proprietary knowledge that cannot be easily specified in contracts, residual rights of control must be allocated. We develop the hypothesis that the driver's fraction of residual income and decision rights depends on the importance of his knowledge assets to generate the ex post surplus.

In addition, we present a monitoring costs explanation of the allocation of residual income and decision rights. By applying the agency-theoretical view (Tirole, 1988; Lyons, 1996; Brickley et al., 2001, 2002), the variable proportion of the driver's income and the tendency towards decentralization of decision rights should be higher, the higher the monitoring costs are. Finally, we investigate the relationship between residual income and residual decision rights under internal governance. If the contractual relation is governed by an employment contract, residual decision and residual income rights may be substitutes because, under fiat, a certain incentive effect of the governance structure may result either from the allocation of high-powered incentives or the transfer of residual decision rights to the driver. In this case, the more residual income rights are assigned to the driver, the less residual decision rights must be allocated to him. These hypotheses were tested by using data from the Hungarian trucking industry.

The article is organized as follows: the next section reviews the recent literature concerning the allocation of ownership rights in the trucking industry. In the following section, we develop the property rights and monitoring cost explanations for the structure of residual income and decision rights in contractual relations. Finally, we test the hypotheses that the structure of residual income rights depends on the importance of the driver's intangible assets and the extent of monitoring costs; in addition, we test the hypothesis that residual income and decision rights are substitutes under internal governance.

RELATED LITERATURE

Recent literature on the allocation of residual rights in the trucking industry focuses on the explanation of company drivers versus independent owner–operators by applying transaction cost, strategic positioning and property rights reasoning. Nickerson and Silverman (1998, 2003) integrate in their studies Porters' competitive framework (Porter, 1980, 1985, 1996) of strategic positioning and Williamsons' transaction cost economics (Williamson, 1985, 2002) in order to explain the existence of different organizational forms—in particular, different types of employment relations in the trucking industry. According to Nickerson and Silverman (1998), a firm's strategic positioning choice has far-reaching implications for the profile of assets it needs to assemble and the hazards to which these assets are exposed. The asset profile forms the basis of a firm's ability to attract and serve particular types of customers. Under a certain asset profile, carriers choose organizational structures—in particular the use of company drivers or independent owner–operators—to economize on transaction costs. Nickerson and Silverman (2003) argue that asset specificity (temporal specificity and investments in reputation capital) favour the use of company drivers over owner–operators. Hence, carriers rely on owner–operators for haul in which the potential for hold-up and the maladaption costs are small. Although the data confirm the asset specifity theory, we have some doubts that haul length and haul weight are valid indicators for specific investments in tractor configurations.

In addition, Fernández et al. (2000) argue that drivers accumulate knowledge about routes, specific characteristics of customers, the vehicles, the services offered by the contracting firm and the communication system used. They predict that a carrier is more likely to employ company drivers, as opposed to independent owner operators, as the degree of carrier-specific knowledge increases. This reasoning is consistent with the property rights view which explains the governance structure through intangible assets that generate the residual surplus. The use of company drivers is more likely, the more the drivers accumulate carrier-specific knowledge assets. Furthermore, based on Hart and Moore's approach, Hubbard (1999) and Baker and Hubbard (2003) argue that the ownership patterns in trucking result from the

noncontractibility of specific assets. Owner–operators are residual claimants who invest more in specific assets to generate residual surplus through the use of their trucks. Thus, owner–operators are used for hauls where noncontractible decisions that affect the ex post surplus are important. In addition, in the late 1980s the adoption of on-board-computers improved the contractibility of decisions and thus led to less independent contracting and larger firms in the trucking industry (Baker and Hubbard, 2004). Compared to Fernández, Arrunada and González, Baker and Hubbard investigate the importance of the driver's intangible assets to explain the existence of owner–operators. Consequently, their views are complementary.

More recently, Lafontaine and Masten (2001) argue that vehicle ownership, which defines a driver's status as an owner operator or company driver, varies mostly with driver characteristics. Driver ownership of trucks does appear to be a function of driver wealth and experience (the years driving trucks), marital status, and nondriving family income. They find that truck ownership is not related to vehicle types (as trucks are proto-typical nonspecific assets) but, rather, depends on individual driver characteristics such as experience and access to other incomes. Consequently, contrary to the transaction cost results (Nickerson and Silverman, 2003; Arrunada et al., 2004), they argue that asset specificity (physical asset specificity) is not an important determinant of asset ownership. Although the physical assets used for hauling freight are relatively mobile, as Lafontaine and Masten argue, human asset specificity of the driver may result in driver ownership. This would explain Lafontaine and Masten's findings that driver ownership is a function of experience as indicator of noncontractible specific human assets. Therefore, we criticize Lafontaine and Masten's argument that specific investments cannot account for variations in organizational arrangements, because they do not differentiate between contractible and noncontractible specific investments. Similarly, Whinston (2001, 2003) and Woodruff (2002) argue that asset specificity theory (Klein et al., 1978; Williamson, 1985) has to differentiate between the various types of specifity that matter for integration—especially between contractible and noncontractible assets. Applying this reasoning to Lafontaine and Masten's analysis, noncontractible specific investments in human assets (driver's

experience) may explain the tendency towards owner–operators, but more contractible physical assets (vehicles' characteristics) may less likely explain the tendency towards company drivers. This argument is closely related to the resource-based or organizational capability view (Barney, 1991; Connor and Prahalad, 1996; Teece et al., 1997; Barney et al., 2001) of the organization structure. By using owner operators, the carrier may exploit the driver's capabilities (as intangible assets) to realize a higher rent.

In sum, these studies develop and test different hypotheses to explain the ownership structure between the carriers and the drivers (as independent owner–operator or company driver). On the other hand, they do not investigate the allocation of residual income and decision rights under a given governance structure. Starting from this gap, we answer the question of how the residual income and decision rights are allocated between the carrier and the driver under internal governance. The contribution of our study is twofold: First, it provides an explanation for the allocation of residual rights under internal governance drawing on property rights and agency theory. In addition, it shows that under employment relations residual income and decision rights are substitutes. Second, it utilizes primary data from the Hungarian trucking industry that enables the estimation of factors the theories consider to affect the structure of residual decision and income rights between the driver and carrier.

THEORY DEVELOPMENT

Allocation of Residual Income Rights

(a) Property rights view: According to the property rights theory, the asset characteristics relevant for the determination of residual income rights in contractual relations are the degree of intangibility (Hart and Moore, 1990; Brynjolfsson, 1994; Hart, 1995). Applied to the trucking industry, our property rights view focuses on the explanation of the allocation of residual income rights between the carrier and the truck driver under internal governance by emphasizing the role of the driver's intangible assets as determinant of the variable proportion of the driver's income. What are the intangible assets of the drivers in the trucking

industry? The driver's intangible assets refer to his 'knowledge of the particular circumstances in time and place' (Hayek, 1945, p. 524) concerning loading, unloading and handling the goods, as well as to his knowledge of the routes and the customer characteristics that have an important non-contractible (tacit) component (Fernández et al., 2000; Lazaric and Marengo, 2000; Teece, 2000). How are the residual income rights allocated between the carrier and the driver? The distribution of residual income rights depends on the importance of intangible assets to create residual surplus. If the driver's intangible assets are high, he should have a relatively high variable fraction of his total income; and if the driver's intangible knowledge assets are low, he should have a relatively large fixed fraction of his total income. Therefore, given the intangible assets of the driver, the carrier transfers a fraction of residual income rights to the truck driver to increase the driver's incentive to efficiently use his specific knowledge. Hence the carrier's residual income rights are diluted by the payment of a mix of fixed and variable component of income, and the driver's residual income rights are strengthened by the variable component of his total income. The property rights view of the allocation of residual income rights between the driver and the carrier can be stated by the following proposition: The more important the driver's intangible assets to generate the residual surplus, the more residual income rights should be transferred to him.

(b) Monitoring cost view: According to agency theory (Jensen and Meckling, 1976; Tirole, 1988; Eisenhardt, 1989; Lyons, 1996), asymmetric information and opportunism result in high agency costs. The carrier has two possibilities to reduce the agency costs: On the one hand, to reduce the residual loss by increasing the monitoring activities and, on the other hand, by allocating a higher fraction of residual income to the driver. The higher the monitoring costs of the carrier due to environmental and behavioural uncertainty, the more residual income rights should be transferred to the driver, and the higher the variable fraction of the driver's income is. This proposition is consistent with research results in the franchise literature (Brickley and Dark, 1987; Norton, 1988; Lafontaine, 1992). The following testable hypotheses can be derived from the property rights and monitoring cost view:

H1a: The driver's proportion of residual income rights is positively related to the importance of his intangible assets to generate residual surplus.

H1b: The driver's proportion of residual income rights is positively related to the extent of monitoring costs.

Allocation of Residual Decision Rights

(a) Property rights view: The driver's residual decision rights refer to all noncontractible decisions concerning the composition and handling of the truck load, the route, the extent and time of maintenance and the schedule of breaktime. The knowledge characteristics relevant for the allocation of residual decision rights are the intangible knowledge assets. If the driver's intangible assets (capabilities) are important in order to generate a large portion of residual surplus, residual decision rights must be transferred to him. Conversely, residual decision rights tend to be centralized when the carrier can easily acquire the relevant knowledge concerning loading, unloading, transportation and handling of the freight (Jensen and Meckling, 1992). Therefore, the more important the driver's intangible knowledge assets to generate the residual surplus, the more residual decision rights should be transferred to him.

(b) In addition, monitoring costs influence the allocation of residual decision rights (Brickley et al., 2002). Monitoring costs result both from behavioural and environmental uncertainty. The higher the environmental uncertainty, the higher the degree of asymmetric information between the carrier and the driver, and the more difficult and expensive the central control during all stages of transportation is, and hence the higher the tendency toward decentralization of decision rights. The following testable hypotheses can be derived from this approach:

H2a: The driver's proportion of residual decision rights is positively related to the extent of his intangible assets.

H2b: The driver's proportion of residual decision rights is positively related to the extent of monitoring costs.

Relationship between Residual Decision and Residual Income Rights: Complements or Substitutes

Since the property rights structure of the employment relationship between the driver and the carrier consists of residual income and decision rights, the structure of residual decision and residual income rights must be simultaneously determined. The question is which relationship exists between residual income rights and residual decision rights. Based on James argument (James, 2000) that the incentive effect of contract provisions depends on the underlying governance structure, there are two views on the relationship between residual decision rights (real authority) and residual income rights:

(I) Under the complementarity view of the governance structure (Milgrom and Roberts, 1990; Jensen and Meckling, 1992), residual decision and residual income rights are complements. This means that the truck driver's motivation to use his intangible assets to generate residual income is increased if the residual income rights are collocated with the residual decision rights. Hence the transfer of residual income rights increases the efficiency effect of residual decision rights (Arora and Gambardella, 1990; Brickley et al., 1995; Arrunada et al., 2001). This is the case under independent ownership of the driver because in this situation residual decision rights only have a coordination function.

(II) Under the substitutability view of the governance structure, residual decision and residual income rights are substitutes. If the relationship between the driver and the carrier is governed by an employment contract, residual decision and residual income rights may be substitutes because, under fiat, a certain incentive effect of the governance structure may result either from the allocation of high-powered incentives or the transfer of residual decision rights to the driver. In this case the allocation of authority is used as an incentive device (Aghion and Tirole, 1997). Under this view, the more residual income rights are assigned to the driver as an employee, the less residual decision rights must be allocated to him to maintain a certain level of control. The substitutability view is compatible with results in industrial psychology on designing efficient reward systems (Lawler, 1971, 1994, 2000; Hackman and Oldham, 1980). A certain incentive effect can be achieved either by the transfer of residual income rights as extrinsic rewards or the allocation of authority as intrinsic rewards of the organization. Therefore, under internal governance residual decision rights have both a coordination and incentive function. We derive the following testable hypothesis:

H3: Under internal governance, the driver's proportion of residual income rights is negatively related to his fraction of residual decision rights.

EMPIRICAL ANALYSIS

Data Collection

The empirical setting for testing these hypotheses is the trucking industry in Hungary. We used a questionnaire to collect the data from a sample of 290 Hungarian truck drivers at the Austrian–Hungarian border in Sopron (Klingenbach) and Nickelsdorf (Hegyeshalom). The data sets were collected in July and September 2002 and in April 2004. The questionnaire took, on average, approximately 15 min to complete. We received 209 completed responses; 195 were from company drivers. Since many questionnaires were incompletely filled out, we could only use 126 for our regression analysis. To trace nonresponse bias, we investigated whether the results obtained from analysis are driven by differences between the group of respondents and the group of nonrespondents. Nonresponse bias was measured by comparing three groups of responders (July, September, April) (Amstrong and Overton, 1977). No significant differences emerged between the three groups of respondents.

Measurement

To test our property rights, monitoring cost and substitutability hypotheses five groups of variables are important: residual income rights, residual decision rights, intangible assets of the driver, monitoring costs, and firm size as well as the drivers experience as control variables.

Residual income of the driver: The driver's residual income (VAR) is measured by the variable proportion of his total income. The variable proportion depends on the freight bill, miles and hours. According to our data the average variable proportion of the driver's income is 60% (see Table 1).

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Table 1. Descriptive Statistics

	Mean	Standard deviation	N
EXPER—experience of the driver in years	11.57	9.46	190
DAYS—duration of the carriage in days	3.64	2.08	186
DES—number of destinations per carriage	2.22	1.50	178
DIS—length of the carriage in kilometre	2576.74	3003.43	182
Driver's specific knowledge (loading, unloading, transportation) (1–7)	4.53	1.96	186
Specific experience of the driver in handling the freight (1–7)	5.81	1.61	189
Specific capabilities of the driver (1–7)	3.93	2.01	181
SIZE—number of trucks owned by the carrier	11.97	14.82	176
VAR—variable proportion of the driver's income	0.60	0.31	180
DR—decision rights (1–7)	3.96	1.37	193

Residual decision rights of the driver: The indicator of decision rights (DR) addresses the extent to which residual decisions are made by the driver or the carrier. Hence it is a measure of decentralization of decision-making in the employment relationship. The drivers were asked to rate his influence on these decisions on a seven-point scale. The higher the indicator, the higher the driver's influence on residual decision-making. We used a six-item scale to measure the driver's intangible knowledge assets (see appendix). The six-item measure was extracted by employing factor analysis (Churchill, 1995). The reliability of this scale was assessed by Cronbach's alpha (0.803).

Intangible knowledge assets: The driver's intangible assets (INT) refer to the specific knowledge of loading, driving routes, handling, customer characteristics and time management during the transportation that cannot be easily specified in contract provisions. We used a three-item scale to measure the driver's intangible knowledge assets (see appendix). The reliability of this scale was assessed by Cronbach's alpha (0.70) which exceeds the generally agreed upon limit of 0.6 for exploratory research (Hair *et al.*, 1998).

Monitoring costs: The indicator of monitoring costs represents the difficulty of performance and behaviour monitoring of the carrier during the transportation. The monitoring costs are higher, the greater the length of the carriage (DIS), the more days (DAYS) the transportation requires, and the higher the number of different destinations (DES). The average length of the carriage is 2576.74 km, the average duration of the carriage is 3.64 days, and the average number of destinations per carriage is 2.22 (see Table 1). Similar measures are used in empirical franchise research (see Brickley *et al.*, 1991; Lafontaine and Slade, 2001).

Control variables: (1) Firm size (SIZE): We use the total number of company-owned trucks as proxy for the firm size of the carrier resulting in economies of scale of coordination and monitoring (Fernández *et al.*, 2000). The average number of company-owned trucks is 11.97. The larger the total number of trucks, the larger the coordination and monitoring capacity of the firm, the more easily the carrier can centrally control the drivers, and the lower the propensity to transfer residual decision rights to the truck drivers. (2) Driving experience (EXPER): We use the number of years of the driver in the truck-driving job as control variable. The average driving experience is 11.57 years.

Results

The hypotheses (H1, H2, and H3) are tested by using 2SLS regression. The property rights variables are residual income rights (VAR) and residual decision (DR). The choice of VAR may depend on the choice of the DR, and other factors, such as intangible assets, monitoring costs and driver's experience. The simultaneous equation model hypothesizes that (1) VAR influences DR, and (2) DR affects VAR, and (3) several antecedents affect both variables. The model includes intangible assets (INT), monitoring costs (DES, DIS, DAYS, DES*DAYS) and experience of the driver (EXPER) as antecedents of the residual income decision. Likewise, INT, DAYS, DIS, DES and company size (SIZE) are used as predictors of the decision rights structure.

Therefore, INT and DES, DIS as well as DAYS are common to both decisions. On the other hand, EXPER is unique to the residual income decision, and SIZE is unique to the DR-decision. As a result, the empirical model is characterized by the following simultaneous equation:

$$
\begin{pmatrix} \text{VAR} \\ \text{DR} \end{pmatrix} = \begin{pmatrix} 0 & \text{\ss}_1 \\ \text{\ss}_2 & 0 \end{pmatrix} \bullet \begin{pmatrix} \text{VAR} \\ \text{DR} \end{pmatrix}
$$

$$
+ \begin{pmatrix} \gamma_1 & \gamma_2 & \gamma_3 & \gamma_4 & \gamma_5 & \gamma_6 & 0 \\ \gamma_7 & \gamma_8 & \gamma_9 & \gamma_{10} & \gamma_{11} & 0 & \gamma_{12} \end{pmatrix}
$$

$$
\bullet \begin{pmatrix} \text{INT} \\ \text{DES} \\ \text{DIS} \\ \text{DAYS} \\ \text{DES*DAYS} \\ \text{EXPER} \\ \text{SIZE} \end{pmatrix} + \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix}.
$$

Using this system of equations, we empirically investigate the interaction effect between residual income rights and residual decision rights. Support for substitutability exists if VAR and DR are negatively related. In addition, VAR increases with the driver's INT and monitoring costs (DAYS, DIS, DES, DAYS*DES). Furthermore, the experience of the driver (EXPER) may positively influence his residual income position (VAR). The second equation relates to the DR variable. DR increases with the driver's INT and the monitoring costs (DAYS, DIS, DES, DAYS*DES). In addition, we include the company size (SIZE) as an explanatory variable. SIZE has a negative impact on DR indicating that, due to coordination economies of scale, a larger size of the carrier's company increases the tendency towards central control.

Table 2 presents the correlations of the variables used in the simultaneous equation system. We do not find any colinearity indication. To estimate the system of equations, we employ the two-stage least-squares (2SLS) procedure (Greene, 2000). Table 3 reports the result of 2SLS regression analysis for the residual income and decision variables. Model fit is acceptable with F-values ranging from 3.8 to 4.12 and R^2-values varying between 0.18 and 0.186.

(a) VAR-equation: The coefficient of residual DR is highly significant and consistent with our substitutability hypothesis. An increase in residual decision rights of the driver implies a lower proportion of residual income rights. The coefficient of INT is not significant. In addition, the coefficient of the driver's experience (EXPER) is positive and significant indicating that more experience results in a higher fraction of residual income of the driver. The coefficients of DAYS support the monitoring cost view of the allocation of residual income rights. However, the interaction effect (DES*DAYS) is negative.

(b) DR-equation: The coefficient of residual income rights (VAR) is highly significant and consistent with our substitutability hypothesis. An increase in residual income rights of the driver leads to a lower proportion of residual decision rights. The coefficient of INT is significant and consistent with our property rights hypothesis. An increase in intangible assets of the driver leads to a transfer of residual decision rights to the driver. Furthermore, the coefficient of monitoring costs (DES, DAY) shows that the impact of monitoring costs upon the delegation of residual decision rights is positive and significant. However, the interaction effect is negative. In addition, the coefficient of the SIZE is negative but weakly

Table 2. Correlations

	EXPER	DAYS	DES	DIS	SIZE	INT	VAR	DR
EXPER	1000							
DAYS	0.076	1.000						
DES	0.056	0.243	1.000					
DIS	−0.080	0.433	0.071	1.000				
SIZE	0.088	0.182	0.133	−0.015	1.000			
INT	0.308	0.196	0.119	0.041	0.159	1.000		
VAR	0.108	0.078	−0.070	0.000	0.009	−0.072	1.000	
DR	−0.109	0.070	0.034	0.142	−0.120	0.217	−0.181	1.000

Table 3. 2SLS Regression Results

	Dependent variables	
Independent variables	Variable proportion of income (VAR)	Decision rights indicator (DR)
Intercept	0.0212	0.0114
	(0.86)	(0.080)
VAR (variable proportion of income)		−0.219***
		(0.079)
DR (decision rights)	−0.295***	
	(0.091)	
INT (intangible assests)	−0.087	0.214**
	(0.097)	(0.082)
DES (destinations)	0.129	0.414***
	(0.154)	(0.139)
DIS (distance)	0.044	0.083
	(0.084)	(0.077)
DAYS (duration)	0.304**	0.292**
	(0.146)	(0.129)
DES*DAYS	−0.436**	−0.598***
	(0.197)	(0.179)
SIZE (firm size)		−0.144*
		(0.084)
EXPER (experience)	0.256**	
	(0.108)	
F	3.79	4.13
R^2	0.18	0.19
	$N = 121$	$N = 126$

***$P < 0.01$; **$P < 0.05$; *$P < 0.1$. Values in parentheses are standard errors.

significant indicating that a higher coordination capacity enables the carrier to exercise control by setting-up monitoring devices. Finally, the negative coefficients for VAR and DR, respectively, support a substitute relationship between residual income rights and residual decision rights.

Discussion and Conclusion

The goal of the paper is to provide a monitoring and property rights explanation of the allocation of residual income and decision rights in contractual relations between the truck driver and the carrier under internal governance by emphasizing the driver's intangible knowledge assets and monitoring costs as explanatory variables. First, we develop the hypothesis that the driver's fraction of residual income and decision rights directly varies with the importance of his knowledge assets to generate the ex post surplus. The data from the Hungarian trucking industry confirm the hypothesis that the driver's intangible assets positively influence the tendency toward decentralization of decision rights (H2a). However, our data only weakly support the property rights hypothesis of residual income rights, if we assume that experi-

ence is closely related to the driver's capabilities (H1a).

Second, we develop the hypothesis that the variable proportion of the driver's income and the tendency toward decentralization of decision rights are positively related to the monitoring costs. The results provide partial support that the allocation of residual income and decision rights between the truck drivers and the carriers depends on the extent of monitoring costs (H1b, H2b). The duration of the carriage and the number of destinations per carriage significantly influence the allocation of residual decision rights. In addition, only the duration of the carriage significantly varies with the variable proportion of the driver's income. On the other hand, the impact of the length of the carriage as indicator of monitoring costs is not significant. Furthermore, contrary to the monitoring cost hypothesis of residual income and decision rights, the interaction effects between the number of destinations per carriage and the duration of the carriage are negative. This may be due to the fact that under a very high environmental uncertainty the tendency towards a more bureaucratic control of the carrier—with more centralized decision making

and low-powered incentives—increases (see Williamson, 1991; Zajac and Westphal, 1994).

Third, we investigate the relationship between residual income and residual decision rights of the driver. Under an employment contract, residual decision and residual income rights are substitutes because, under fiat, a certain incentive effect of the governance structure may result either from the allocation of high-powered incentives or the transfer of residual decision rights to the driver. The more residual income rights are assigned to the driver, the less residual decision rights must be allocated to him to maintain a certain level of control. The data provide strong support of the substitutability hypothesis (H3).

These findings, however, must be tempered because of several empirical issues. First, although the database in the survey sample is diverse, it remains far from a large and statistically random sample. Second, the measurement of intangible assets is arguably subject to criticism because more details on the driver's capabilities are required to operationalize the intangible asset indicator. In future research, case studies should complement quantitative studies in order to sharpen and refine the theoretical constructs (Ragin and Becker, 1994). Third, while the empirical results provide support for the proposed substitutability relationship between residual decision and residual income rights under internal governance, additional empirical evidence would increase the generalizability of the results.

APPENDIX: MEASURES OF VARIABLES

Driver's residual income rights (VAR):
Proportion of the variable income to the total income of the driver

Driver's decision rights:
The indicator of decision rights addresses the extent to which decisions are made by the driver and the carrier.
DR (six item-scale)
To what extent are the following decision made by the driver? (no extent 1–7 to a very large extent; Cronbach alpha = 0.803)

1. Decision concerning the composition of the truck load (factor loading: 0.647)
2. Decision concerning the route (factor loading: 0.628)

3. Decision concerning the breaktime (factor loading: 0.682)
4. Decision concerning the schedule of working hours (factor loading: 0.728)
5. Decision concerning the time of truck maintenance (factor loading: 0.725)
6. Decision concerning the extent of the truck maintenance (factor loading: 0.714)

Monitoring costs:
DAYS = Duration of a carriage in days
DES = Number of different destinations per carriage
DIS = Length of the carriage in kilometre

Driver's intangible assets:
INT (seven item-scale).
The driver has to evaluate his specific knowledge and capabilities on a seven-point scale (1—no specific knowledge; 7—very specific knowledge; Cronbach alpha = 0.70)

1. Specific knowledge at the loading, unloading and transportation (factor loading: 0.767)
2. Specific experience with the handling of the freight (factor loading: 0.841)
3. Specific capabilities that other drivers do not have (factor loading: 0.77)

Firm size (SIZE):
Log of the total number of company-owned trucks of the carrier

Driver's experience (EXPER)
Number of years in truck driving

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