

Non-Recourse Problem in the Automotive Sector: Evidence from Detailed Collection of Company Data

LEJLA MÜNCH, DAVID HAMPEL

Faculty of Business and Economics, Department of Statistics and Operation Analysis,
Mendel University in Brno,
Zemědělská 1, 613 00 Brno,
CZECH REPUBLIC

Abstract: In the automotive industry, it is common for suppliers to agree with car manufacturers to limit liability or warranty for components supplied to reduce their financial risk in the event of poor-quality delivery. This may be, for example, a maximum amount or percentage of the contract value that the supplier agrees to pay to the car manufacturer in the case of claims by end customers. Currently, there is a phenomenon of non-recourse, where the supplier refuses to share warranty costs even though there is an agreement to this effect. Our research is based on data from a major car manufacturer, where 5451 transactions remained after data cleaning. Among other things, the transaction category, the status of the supplier contract fulfillment process, and the financial year of the transaction were tracked. It is possible to observe an increase in the number of transactions over time, which is mainly due to the progressive digitization of processes and their registration on the car manufacturer's side. Statistically significant differences in the rate of non-recourse across years have been demonstrated, with the COVID-19 pandemic period being characterized by a statistically significantly higher rate of supplier compliance. Based on the results, the non-recourse behavior of suppliers needs to be another parameter by which car manufacturers judge their suppliers.

Key-Words: - Automotive industry, data collection, non-recourse risk, warranty costs, warranty risk, warranty cost sharing.

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1 Introduction

Technological advances in digitization have brought unprecedented opportunities for collecting and processing vast amounts of new and extensive data, which were previously unattainable. An example from the manufacturing enterprise environment is the paper [1] involving the application of neural networks to Big Data generated by the company. The concept of Industry 4.0 often captures the benefits of digitalization and automation, [2].

The automotive industry, one of the key manufacturing sectors, is under severe pressure. There is a substantial amount of regulation towards reducing emissions, high competition, and new technologies are emerging in electromobility and autonomous driving. A current threat is the likely imposition of high duties in the US; automakers in the European region face, among other things, intense wage growth demands, [3]. A significant share of automated production is characteristic of automotive manufacturers, and digitalization can help increase efficiency and sustainability, as seen in [4]. A detailed summary of the concrete benefits

of digitalization for car manufacturers is provided by a case study [5] dealing with the car manufacturer Audi.

Innovative technologies facilitate the collection of vast amounts of data and bring new opportunities, specifically in warranty data collection and recourse transaction management. The systematic collection, careful cleaning, comprehensive analysis, and accurate classification of collateral data have attracted considerable interest in academic research, [6], [7]. Warranty data not only enhances the quality of consumer products (such as vehicles in our context) but also plays a crucial role in financial management.

2 Non-Recourse Problem

End consumers expect that all purchased products generally have high quality and reliability, [8]. The product price is not the only relevant criterion influencing the purchasing decision, flexibility, delivery speed, delivery ability, delivery loyalty, and, in particular, quality are also important. In [9],

we can read, “Warranty and price [of the single unit] play an important role in determining total sales, and the implication of reliability on warranty cost is of great importance to manufacturers.” The factors mentioned above constitute the foundation for the contemporary success of manufacturers (respectively OEM, which stands for Original Equipment Manufacturer) or suppliers.

At least to a certain extent, manufacturers are dependent on their suppliers, as seen in [10] and [11], in terms of delivery and, consequently, the quality of the delivered product. Of course, the cost of production is also essential, where ‘should cost calculation’ plays a crucial role, allowing easier negotiation between car producer and supplier, [12]. Should the products unexpectedly cease to function correctly, evidence suggesting that the product is inherently deficient due to the emergence of defects allows end consumers to invoke the warranty for resolution.

A warranty is a guarantee, in the form of a “written assurance,” for “the quality and reliability of a product in terms of correcting any legitimate problems with the product at no additional cost, for some expressed or implied period or use”, [13]. But this already implies the main practical problem confronting us: every warranty is limited.

Warranty in the automotive industry assures the end consumer that “[...] the purchased vehicle is free from defects in materials and workmanship that could cause the vehicle to fail to perform as intended”, [13]. Warranty is “[...] an integral of nearly all commercial and many government transactions that involve product purchases”, [9].

Furthermore, offering a warranty persists, which could impact the manufacturer's profit and reputation, [14]. Reputation risk, among other corporate risks, is crucial because it affects the organization's financial performance.

The importance of a warranty and the subsequent costs led to warranty expenses of several billion dollars per year. As a financial consequence, they inevitably minimized profit margins, forcing companies to invest in creating warranty modeling, [15]. The reason for this lies in the statement that offering a warranty motivates end consumers to purchase the products (respectively vehicles; [9]) despite the not-to-be-underestimated existing competition, [7].

Offering a warranty and taking responsibility for delivered defective products is an obligation per law, no matter whether “the seller is unaware of defects in the product, the risk should still be borne nonetheless, with the seller typically being in a better position to bear the cost,” as we can read in

[16]. To ensure that the end consumer receives a fully functional and secure product, for example, in Germany, the Product Safety Law applies, valid for vehicles produced by the manufacturer. On the other hand, the warranty “introduces various risks that may directly impact the profitability and reputation of the manufacturer”, [6].

Derived from the standard definition of the cost of risk, warranty risk would be a “quantitative measurement of the costs” if the event of a warranty case occurs, [17]. In [9], we can read, “Whenever an item is returned under warranty, the manufacturer incurs various costs (handling, material, labor, facilities, etc.) [, which] [...] are random (unpredictable) quantities”. The following definition of warranty risk applies: “The probability of warranty risk, defined as the likelihood of the occurrence of a hazardous event during the warranty period, may be employed in the prediction of hazard losses, either by experts or by comparison with similar events in the past”, [16].

Furthermore, warranty cost and the manufacturer's reputation have been recognized as significant factors influencing warranty risk, [6]. Therefore, manufacturers can leverage warranties to signify the quality of their products and effectively contend with competition, providing a direct metric for assessing product quality. Given that defective components necessitate vehicle replacement, they cannot be regarded as products of superior quality, [7].

It is imperative to proactively address [6] and mitigate warranty risk [18] to preclude unforeseen warranty expenses. To thoroughly evaluate risk, it is essential to consider the initial description of the risk event and the subsequent extent of damage incurred. It is typically presumed that each occurrence results in a distinct instance of damage.

Warranty cost and risk are determined by “the reliability of the product as well as the product usage mode and the maintenance and care exercised by the buyer”, [9]. However, the product's reliability is determined in advance by “the design and manufacturing of the product”, [9]. Therefore, warranty costs and the associated risk “can be reduced through better design and greater control during manufacturing,” which causes “higher unit manufacturing cost”, [9]. It appears to be a prevalent issue, prompting companies, particularly suppliers, to diligently manage and minimize their warranty expenses by imposing warranty limitations.

Warranty risk is moreover influenced by the offered warranty time. Consequently, the warranty period in North America is notably extended, encompassing either four years or 48,000 miles.

This prolonged duration results in a significantly higher incidence of warranty-covered failures compared to Europe and other regions, where the warranty period is limited to two years without any mileage consideration, [19].

Even if a warranty can be extended, as seen in [9], or offered for a lifetime, as in [20], risk avoidance and limitations are effective instruments for controlling warranty risk. Warranty could “be used as a defensive tool [...] to limit liability”, [9]. Warranty limitations, in particular, mean that reimbursements for warranty costs are limited to a defined period or a specific highest amount, even if the actual warranty costs are much higher.

Repair expenses are not reimbursed in certain instances, as only the cost of parts, excluding labor charges, is covered, [7]. This implies that the warranty is neither perpetual nor all-encompassing; in the automotive industry, the limits are often “mileage and time (in months or years),” which means that the warranty “expires when any of the two limits are crossed”, [15]. Ultimately, „warranties that offer anything less than the ‘full warranty’ requirements must be designated as ‘limited’”, [13]. A limited warranty means limited liability for the supplier’s early failures and defects, protecting the supplier, as seen in [20].

Therefore, it is permissible to conclude that not only is there a disparity between buyers' and manufacturers' perspectives regarding warranties (see [9]) but also a distinction between warranties and warranty limitations for manufacturers and end consumers.

The relationships between manufacturers and suppliers are significant, [21], [22], [23]. Warranty risk and its limitations represent intricate challenges that necessitate a degree of simplification for adequate elucidation. The manufacturer faces a critical decision regarding whether to develop new features in-house or procure them from external sources for its upcoming consumer products.

Warranty constitutes the supplier's liability as the producer of the individual unit/part for the product and towards the manufacturer, who produces the end consumer product. Consequently, due to this (contractual) relationship, a warranty obligation exists from the supplier to the manufacturer, even if the manufacturer is a corporate entity. Ultimately, the warranty extends from the manufacturer to the end consumer.

The warranty cost is at least “the sum of the costs associated with servicing an item that fails under warranty.” Warranty costs are addressed within the warranty cost analysis, [9]. The manufacturer initially bears the warranty costs on

behalf of the end consumer. Suppliers may decline to participate in cost-sharing, notwithstanding the stipulations of the law and the contractual agreements established between the manufacturer and the supplier. This elucidates the rationale behind the proactive establishment of financial reserves: “[...] a company needs to plan for maintaining a large cash reserve to pay for the warranty services on their products”, [15].

Since warranty costs and recourse earnings should be transparently shown in the accounting balance sheet, [24], for the manufacturer as an asset and for the supplier as a liability, [25], companies are motivated to manage these financial reserves. To enhance the management of monetary reserves and the resultant profit after the fiscal year, companies endeavor to curtail warranty obligations and, consequently, the associated warranty expenses.

Regarding specific projects, recourse is feasible only to a limited extent in terms of time, scope, and quality. In practical application, the warranty period does not commence with the supplier's production date of the individual component but rather with the vehicle's registration date by the end consumer. In such instances, the manufacturer must cover the discrepancy between the warranty limitation and the actual warranty costs incurred. This discrepancy can be characterized as the non-recourse risk borne by the manufacturer. Additionally, a pertinent inquiry is whether warranty limitations can inherently imply non-recourse risk.

As has been previously reported, “[a] new trend has started to emerge for the outsourcing of vehicle content to suppliers to reduce cost and improve the efficiency of operations”, [19]. This phenomenon is referred to as non-recourse, which has thus far been characterized as warranty cost sharing.

Manufacturers are reaching out to “the suppliers to share the warranty return cost for their returned components,” even with the support of the purchasing and legal departments. Warranty cost-sharing “is putting the supplier in a precarious position, financially, [...] when supplier margins are very thin”, [19]. Manufacturers “are asking the suppliers to share the warranty return cost for their returned components”, [19], but from the supplier’s point of view, sharing warranty cost lowers the already thin margin. An illustration of the described relationships between supplier, manufacturer, and customer is given in Figure 1.

Warranty costs represent an additional expense component. Companies proactively account for potential product defects and failures in their preliminary calculations. The willingness to assume warranty costs is conditional on the product profit

margin, “increase in sales and/or reduction in warranty servicing costs”, [20]. Therefore, companies aim to control [9] and reduce warranty costs [7].

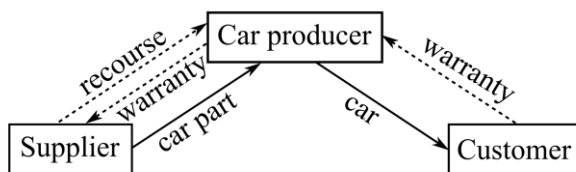


Fig. 1: Flowchart of the claim for partial coverage of costs arising from the supplier's warranty invocation
Source: Own processing

Summarizing the above knowledge, the non-recourse risk is defined as *the risk of the supplier's refusal to share warranty costs with the manufacturer*. From the manufacturer's perspective, in the absence of non-recourse, the onus would fall squarely upon the manufacturer to bear the full extent of the warranty costs, devoid of any opportunity for mitigation. As a direct consequence of this financial burden, the aggregate profit margin would invariably be compressed. It can be stated that non-recourse reduces the manufacturer's possibility of minimizing the total warranty costs and affects their total profit. This exploration highlights the problem, and therefore, the non-recourse risk can be defined as *the probability of non-repayment of the externally caused warranty costs*.

Supplier participation, resulting from negotiations between manufacturers and suppliers regarding the supplier's responsibility in specific warranty cases and long-term agreements, including warranty coverage provisions, is essential, [7]. This implies that the supplier has additional effort since such negotiations or agreements require capacity and recourses from the organization [19] and focus on non-recourse debt or non-recourse loan from a financing point of view, [25].

This paper utilizes data and empirical analysis to assess the severity of non-recourse risk in the automotive industry.

3 Materials and Methods

The following requirements and premises for warranty cost analysis apply in general cases: systematic analysis; consideration of particularities; coordination with sales; ratio to sales volume, especially affection of the profit margin;

applicability of the warranty contracts, e.g., limitations and forecast of warranty costs, [16].

Data on an automotive company's warranty costs and recourse transactions from 2013 to August 2024 is available for analysis. A recourse accounting transaction represents a formally documented instance of a warranty claim between a manufacturer and a supplier. This transaction meticulously records the warranty costs incurred and the subsequent recourse payments executed.

Each transaction is classified into a singular category, with three distinct categorizations available: serial damage, technical campaign, and yearly recourse settlement. Serial damage occurs when multiple warranty instances exhibit an identical flaw, all of which can be traced back to a common underlying cause. A technical campaign similarly constitutes a serial defect; however, it is distinguished by the legal obligation to recall the product. This process involves issuing a formal written invitation to the end customer, requesting they visit the workshop for the necessary defect remediation.

The annual recourse settlement refers to the yearly negotiation between the manufacturer and the supplier regarding warranty expenditures incurred within a single fiscal year due to various individual defects. The data on recourse transactions included transaction ID, type, accounting year, description, transaction categorization, supplier ID, supplier, part category, processing status, processing status set on (date), warranty costs, compensation for defective part analysis, corrections on compensation for defective part analysis, recourse amount, corrections on recourse amount, and remaining recourse forecast.

In total, 6,239 transactions have been collected. Five hundred sixty-nine transactions had zero or negative warranty costs and were therefore excluded. Additionally, 192 transactions have not been processed and must be excluded. Therefore, 5,478 transactions remain. Recourse transactions are monitored according to the following processing status: new case, in research/data preparation, case reported to supplier, agreement reached/follow-up settlement, and final settlement.

Recourse transactions with processing status agreements reached/follow-up settlements instead of final settlements are used because they are partial payments that can be settled over several accounting years in the future.

First, a descriptive data analysis will be provided regarding the categorization of recourse transactions, processing status, and accounting year. Next, the dependence of the successful and

unsuccessful recourse quotas on individual years was analyzed using contingency table tests. The conversion of the recourse quota into a categorical variable mitigates the impact of potential outliers within the recourse quota data. This transformation facilitates an alternative examination of dependencies within a contingency table by applying the chi-squared dependency test. The null hypothesis means the independency of the proportion of successful recourse quotas in particular years.

Additionally, it enables the evaluation of the strength of these dependencies using Cramer's V coefficient (values close to 0 indicate a weak dependency, whereas values close to 1 indicate a strong dependency) and identifies cases that are significantly divergent through Haberman residual testing. The original dependency of the recourse quota on accounting years will be scrutinized through a one-way analysis of variance (ANOVA), succeeded by Tukey's Honest Significant Difference (HSD) pairwise comparisons. Given the borderline results of the tests of assumptions of the one-factor analysis of variance, the robustness of the results will be confirmed by the non-parametric Kruskal-Wallis test. The tests were performed at the 0.05 significance level, and the computational system MATLAB R2024a was used for the calculations.

4 Results and Discussion

Table 1 shows the distribution of transactions by category. Even considering the warranty costs, the distribution in percent did not change.

Table 1. Distribution of recourse accounting transactions by categories

Transaction category	Transactions	In %
Yearly recourse settlement	3,791	69.20
Serial damage	409	7.47
Technical campaign	1,278	23.33
Total	5,478	100

Source: Own calculation

Table 2 shows the distribution of transactions by processing status. Data on accounting years for transactions within serial damage and technical campaign categories is unavailable; it is only for transactions within yearly recourse settlement. Nevertheless, it can be estimated using the variable Processing status set on (date) also for technical campaigns and serial damages. Still, 27 recourse transactions must be excluded because no accounting year could be estimated.

Ultimately, a total of 5,451 transactions persist. Figure 2 shows the distribution of transactions by accounting year.

Table 2. Distribution of recourse transactions by processing status

Processing status	Transaction	In %
New case	706	12.89
In research/data preparation	161	2.94
The case reported to the supplier	504	9.20
Agreement reached/follow-up settlement	280	5.11
Final settlement	3,827	69.86
Total	5,478	100

Source: Own calculation

The company deployed and integrated a software solution in 2013. Over the years, the system has been augmented with new software functionalities. This enhancement highlights the subsequent increase in transaction volume observed in the years that followed. Regrettably, the frequencies observed during the 2013–2018 interval evinced markedly diminished values, necessitating the exclusion of this temporal period from further analytical inquiries.

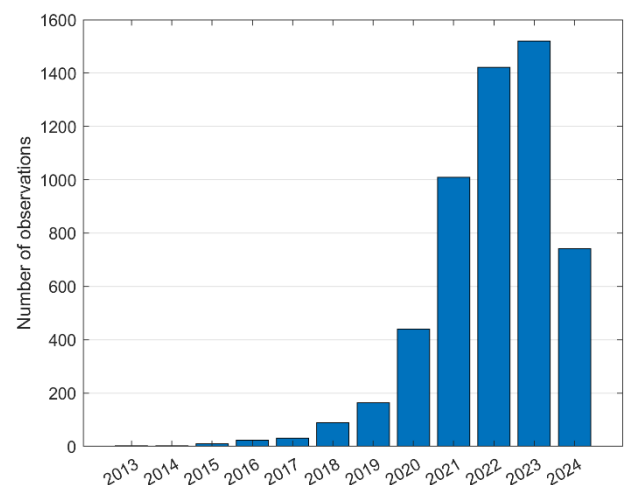


Fig. 2: Distribution of recourse transactions by accounting year

Source: Own processing

To determine the recourse quota, it is essential to compute the recourse incomes for each transaction. The recourse income is derived from the aggregate of the following variables: Compensation for defective part analysis, Corrections on Compensation for defective part analysis, Amount of accounted transaction, Corrections on amount of accounted transaction, and Remaining recourse forecast.

In the ensuing phase, the recourse and non-recourse quotas are calculated meticulously. This involves determining the ratio of the income derived from recourse agreements to the corresponding warranty costs associated with these agreements. If the resource quota falls below 25.00%, it is deemed unsuccessful; whereas a quota exceeding 25.01% is regarded as successful (this classification is provided by the company's managers and represents an established corporate practice).

Successful recourse quota percentage is statistically significantly dependent on the year ($p < 0.001$). However, the dependence is relatively weak (Cramer coefficient 0.025). According to the analysis of Haberman residuals, it can be concluded that the significantly highest percentage of successful recourse quota of 62 % was achieved in 2021, where the percentage of successful recourse quota was 40 % in 2019, grew until 2021, and then decreased to 38 % in 2024.

These findings are congruent with the outcomes of the one-way analysis of variance, which identified a statistically significant disparity in recourse quota across the years ($p < 0.001$). Pairwise comparisons identified 2021 (with a mean recourse quota of 0.362) as statistically different from all other years except 2020 (mean recourse quota of 0.322) when the mean recourse quota in the other years ranged from 0.260 to 0.317. Figure 3 shows the comparison by accounting year. A robustness assessment employing the Kruskal-Wallis test as a non-parametric method corroborated the same outcome.

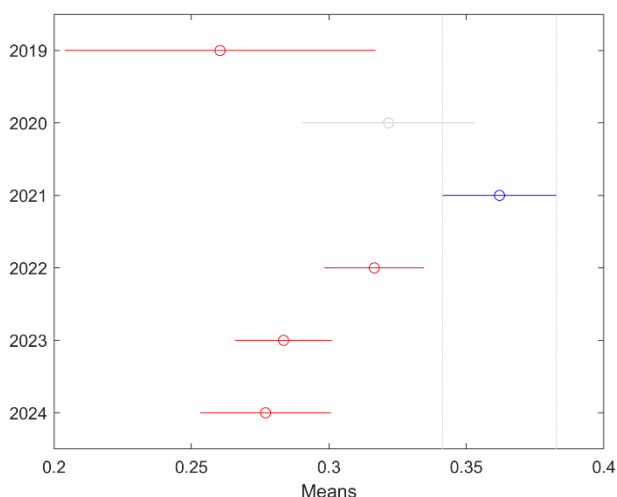


Fig. 3: Comparison by accounting year
Source: Own processing

In light of managerial reviews, potential factors contributing to the rise in cases include the impact of the COVID-19 pandemic, the necessary rework

required by the semiconductor shortage, and the enhanced data collection capabilities made possible by implementing new software.

Conversely, the decline in the recourse quota can be attributed to several key reasons: Increased pressure on the entire automotive industry, particularly the diminished profit margins experienced by suppliers due to elevated labor costs in Europe, and the global deficiencies in supply chain resilience. These findings align with the works [26] and [27], which address supplier-customer relationships during the COVID-19 pandemic. As a result, changes in strategy can be discussed, leading in particular to an orientation towards maintaining strong supplier-customer relationships and thus ensuring long-term production activity.

5 Conclusions

The issue of the non-recourse quota appears to be of substantial significance, with potential ramifications that could prove quite intriguing for both the manufacturer's and supplier's financial and accounting divisions. The manufacturer aims to minimize the non-recourse quota and desires a comprehensive warranty. At the same time, the supplier seeks to maximize the non-recourse quota and prefers a limitation on the warranty.

Although the above-presented findings, the research on non-recourse risk remains limited. The warranty-sharing process as part of financial management remains briefly addressed in the literature despite the importance of handling financial risks for the sustainability of the manufacturer and supplier.

Automobile manufacturers must carefully assess the hazards associated with non-recourse scenarios and implement effective strategies to manage these risks. The systematic collection of data can significantly enhance the company's operational functions. However, while the number of recourse transactions has steadily increased on an annual basis, the recourse quota has concurrently declined.

Our subsequent analyses should aim to identify potential dependencies between the non-recourse quota levels and the attributes of specific suppliers, using firm-level indicators as a basis. An in-depth analysis should also elucidate the reasons behind the unparalleled success observed in 2021 and investigate the underlying factors contributing to the decline in the recourse quota.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

While preparing this work, the authors used Grammarly to edit the language. After using this service, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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Conflict of Interest

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