OTTO-VON-GUERICKE-UNIVERSITY MAGDEBURG
FACULTY OF ECONOMICS AND MANAGEMENT

Volkswagen vs. Porsche. A Power-Index Analysis

Roland Kirstein

FEMM Working Paper No. 07, March 2009

F E M M

Faculty of Economics and Management Magdeburg

Working Paper Series

Otto-von-Guericke-University Magdeburg
Faculty of Economics and Management
P.O. Box 4120
39016 Magdeburg, Germany
http://www.ww.uni-magdeburg.de/

Volkswagen vs. Porsche. A Power-Index Analysis.

Roland Kirstein*

March 11, 2009

Abstract

After Porsche SE took over Volkswagen AG, its supervisory board consists of three groups: The Porsche shareholders hold 6 seats, while the 324,000 Volkswagen employees and the 12,000 Porsche employees will be represented by 3 delegates each. This paper perceives each of these three groups as unitary players and presents a power-index analysis of this supervisory board. It shows that, unless the Porsche employees are made completely powerless, Porsche and VW employees will have identical power regardless of the actual distribution of seats on the employees' side. This analysis demonstrates that the request of the Volkswagen employees (for more seats than the Porsche employees in the future supervisory board) is unfounded.

JEL classification: C71, D72, K22, M21
Keywords: Banzhaf power-index, supervisory board, societas europeae

---

*Economics of Business and Law, Faculty of Economics and Management, Otto-von-Guericke-University, Bldg. 22/D-003, PO Box 1402, 39016 Magdeburg, Germany. Email: `rol@rolandkirstein.de`. I'm indebted to Maher Dwik, Sidi Koné and Eva Schliephake for useful comments; the usual disclaimer applies.

1 Introduction

The owners of the German car manufacturer "Dr. Ing. h.c. F. Porsche AG" have created the "Porsche Automobil Holding SE" (henceforth: Porsche SE) in 2007. Porsche SE owns 100 percent of Porsche AG and has, in late 2008, taken over the majority of the much bigger Volkswagen AG (VW). The supervisory board (Aufsichtsrat) of Porsche SE consists of six representatives of the shareholders and the employees, respectively. After the takeover, both the current 324,000 VW employees and the 12,000 Porsche employees will be represented by three supervisory board members each. A *societas europeae* (SE) has to negotiate the conditions of workers' co-determination with the workers involved.[1] At the time the SE was founded, Porsche did not dominate VW yet. Hence, the VW workers did not take part in these negotiations. Bernd Osterloh, head of the VW workers' council, has called the plan unacceptable and "a slap in the face" for VW employees.[2] The head of Porsche's workers' council, Uwe Hück, has rejected Osterloh's request. He considered it an expression of equality that each of the two employee groups will be represented by the same number of delegates in the supervisory board.[3]

The VW workers' council has brought legal action against this plan, demanding an increased number of VW representatives. In April 2008, a German labor court rejected this claim because, at the time of the court decision, Porsche SE has held only 31 percent of VW's shares and, therefore, did not dominate VW.[4] Before the takeover was completed, the VW workers' council has brought an appeal against this decision to the state labor court in Stuttgart in which it planned to establish that Porsche SE already effectively controls VW.[5] Leech (2001) argued that 30 percent shares would be enough to have almost full power if the other 70 percent are fully dispersed

[1]See Amann (2008).

[2]AsiaOne (2007. The workers' council of Porsche SE is, after the takeover, clearly dominated by VW employees; see Amann (2008), with Osterloh as the elected chairman.

[3]Manager Magazin (2007).

[4]Arbeitsgericht Stuttgart, AZ 12 BV 109/07. The court based his decision mainly on this fact and did not decide whether the existing agreement on co-determination had to be modified after a takeover.

[5]See GlobalInsight (2008).

(among 70 shareholders with just 1 percent each).[6]

After the first success in court, Porsche apparently made two offers to the VW workers.[7] First of all, the representatives of VW employees may receive a veto right in the supervisory board of the Porsche SE. Moreover, decisions regarding the erection and reallocation of production sites may require a 2/3 majority.

Even though the concrete VW vs. Porsche case seems to have been settled, it raises an abstract question which deserves an answer based on economic theory: Is a larger group (of employees) entitled to a larger number of seats in the supervisory boards? Under which circumstances is the number of seats relevant for the influence of this group? This question is not only relevant for the composition of supervisory boards, but also for the composition of decision bodies in federal systems, such as the EU council. Should the larger member states have a greater number of votes, proportional to their population? The principle "one man, one vote", a very basic idea of democracy, seems to imply a proportional representation at least at first glance.

If, however, it is the aim of the institutional design to endow each member of the constituency with equal influence (or power), then this principle appears useless. "Equal power" requires a quantitative operationalization of power. This is provided by the economic theory of power index analysis. This theory would decline a blind request for "equal votes per capita". Penrose (1946) has argued that equal votes per capita would endow larger groups of voters with an overproportional, more precisely: quadratic, amount of power. If a body consists of many groups, two of which control the same number of votes, then their power index is identical. If one of these groups is endowed with twice the number of votes, its power then is not just two times the power of the reference group, but four times.

The contributions of Banzhaf (1965, 1968) have demonstrated that players' power in a voting body is not necessarily proportional to their votes. A very simple example may highlight this point: If two shareholder both own 50

[6] VW is, however, not a case of dispersed ownership, as the federal state Lower-Saxony controls 20 percent.

[7] See WAZ (2008), citing the German news magazine Focus. However, according to the same source, the VW workers council claimed to have not received such an offer.

percent of their firm and decide with absolute majority, then both have equal power. With 51 vs. 49 percent however, player 1 has total power (power index 1), while 2 is powerless (power index 0). Even though the ratio of the two players' shares (or votes) is almost identical in the two scenarios, the ratio of the two players' power indices differ dramatically. In Banzhaf's canonical example, which won him a lawsuit, his power index analysis demonstrated the unfairness of proportional votes in the supervisory board of Nassau County (NY).[8] Banzhaf argued that there exists no situation in which the votes of one of three smallest members would have any impact on the outcome. In other words, the whole power is equally distributed among the three largest members, rendering the three smaller ones powerless.[9] As a result of Banzhaf's legal action, the composition of the Nassau supervisory board was changed several times. [10]

Drawing on the economic theory of power, this paper argues that the claim of the VW workers' council was unfounded. What really counts is not the number of seats or voting rights in a supervisory board, but the influence or power a group or player can exert. Economic theory operationalizes "influence" by using power indexes. The analysis in this paper shows that the influence of VW representatives in the supervisory board of the Porsche SE cannot be adapted to the different number of employees they represent. The analysis perceives the situation in the future supervisory board of Porsche SE as a 3-player game: First the Porsche shareholders (with 50 percent of the votes), then the Porsche and the VW workers' representatives (with the other 50 percent distributed among them). It demonstrates that Porsche and VW workers' power is identical, regardless of the actual distribution of

[8]In 1965, this board consisted of representatives from six districts. The two largest districts held 31 seats each, the next two held 28 and 21 seats respectively, and the smallest districts were endowed with two seats each. For a collective decision, an absolute majority was required, hence 58 votes.

[9]See Hodge/Klima (2005, 124f.). This result can be derived without computing a formal power index: Whenever two of the three larger members agree, this coalition controls an absolute majority of yes- or no-votes. Hence, no absolute majority coalition is formed only due to the cooperation of one of the smaller districts.

[10]In 1994, the votes were 30, 38, 22, 15, 7, 6. The largest district enjoys a normalized Banzhaf power of 0.25, while the smallest district holds 0.0192, see Hodge/Klima (2005, 141).

voting rights. Only in extreme cases, when Porsche representatives are made powerless, the VW workers' representatives can be endowed with more power than their counterparts. Hence, it is not possible to adapt the situation so as to endow both groups on the workers' side with "equal power per represented capita".

Several power index concepts exist. Penrose (1946) has measured voting power by the probability with which a member of a voting body "carries" the collective decision, i.e., his own preference is identical to the social preference. A member is more powerful, the more this probability exceeds 0.5. The power indices of Banzhaf (1965) and Penrose (1946) come to identical results. Banzhaf's index is based on the probability with which a member is "critical" in winning coalitions. A group of members is a winning coalition if the sum of the votes exceeds the quorum required for a collective decision.[11] A member of a winning coalition is critical if his withdrawal from the coalition would turn it into a losing coalition (i.e., the remaining number of votes is smaller than the quorum). The number of times a member is critical measures his power. Summing up all individual powers over all members yields the total power. The (normalized) Banzhaf power-index of a player is his individual power, divided by the total power.

Modifications of the Banzhaf power index have been proposed by Johnston (1978), Deegan/Packel (1978), and Holler/Packel (1983). The Johnson index gives credit to being "critical" that is inversely related to the size of the winning coalition. Deegan and Packel only count minimum winning coalitions, which in particular makes sense if the value of prevailing is a private good that has to be distributed among the members of a winning coalition. Holler and Packel perceive the value of prevailing as a public good, but also limit their view to minimum winning coalitions. A different concept to measure voting power has been proposed by Shapley/Shubik (1954). Their index looks at all possible permutations of the committee members and evaluates which member is "pivotal" (i.e., turns the coalition into a prevailing one). An individual power index is the number of constellations in which a member is pivotal, divided by the total number with which all members are pivotal.

[11] "Coalition" is used in an informal or spontaneous sense, it requires no contract between its members.

This concept is especially useful if the sequence in which coalitions are formed is relevant. However, for the analysis of a supervisory board in which the chairperson has a tie-breaking vote, this index is of little use.

All these index concepts refer to simple voting games. However, interactions between members of a committee can be more complex (e.g., if one member is allowed to set the agenda). The "strategic power index" of Steunenberg/Schmidtchen/Koboldt (1999) can be applied to such sequential games. As the subsequent analysis relates to simple voting games only, and the prize can be considered a public good, the Banzhaf index appears to be adequate. The usage of the Shapley-Shubik-Index or the Packel-Holler-Index, however, would not lead to qualitatively different results.

The next section presents an abstract analysis of the 3-player voting game. The results are used in Section 3, which evaluates the numerical examples relevant for the VW case. Section 4 evaluates three modifications of the basic analysis. These modifications are relevant for the VW-Porsche case under scrutiny. Section 4.1 analyzes the power situation if a 2/3 majority is required. In 4.2., the impact of a veto right assigned to the VW workers' representatives in the supervisory board of Porsche SE is analyzed. In 4.3, the realistic idea of a tie-breaking vote for the shareholders' side is taken into consideration as well. 4.4 discards the previously made assumption that the employers' side consists of a homogeneous bloc by introducing a maverick, i.e., an employer who votes independently from his peers. Section 4.5 combines the analysis of tie-breaking vote and maverick. Section 5 presents conclusions.

2 Banzhaf power in a 3-player voting game

Consider a voting body that consists of three players $i = 1..3$ who have to make a binary decision (i.e., yes or no). The players are endowed with voting rights $R_i \in \mathbb{N}$. For convenience we replace the notion of voting rights by voting weights $W_i \in [0, 1]$. An individual W_i is computed as

$$W_i = \frac{R_i}{\sum_{i=1}^{3} R_i}.$$

Thus, $\sum_{i=1}^{3} W_i = 1$. For a proposal ("yes") to become the collective decision, the number of voting weights cast in favor of it need to exceed a threshold value, the quorum Q, which is fixed ex-ante with $1/2 \leq Q < 1$. E.g., the absolute majority rule is expressed by $Q = 1/2$. Consider a subset $I \subseteq \{1; 2; 3\}$ the members of which vote for a proposal, with

$$\sum_{i \in I} R_i > Q.$$

Then, this proposal becomes the collective decision of the voting body, and such a coalition I is called a "winning coalition". We assume, without loss of generality, that the three members of the body can be ordered with regard to their voting weights, i.e., $1 \geq W_1 \geq W_2 \geq W_3 \geq 0$.

The "grand coalition" of all players is always a winning coalition. The possible coalitions, winning or not, can be ordered with regard to their size in terms of voting rights held by their members. One ranking, which is directly implied by the assumption made above, is $1 \geq W_1 + W_2 \geq W_1 + W_3$. The assumption says nothing about the relative size of W_1 and $W_2 + W_3$: either $W_1 \geq W_2 + W_3$ or $W_2 + W_3 \geq W_1$. Despite this, the assumption is sufficient to derive all the possible power profiles (B_1, B_2, B_3), where B_i denotes the Banzhaf power index of player i (the concept was verbally explained in the Introduction).

Proposition: *Consider a voting game with three players $i = 1..3$ holding voting weights W_i with $1 \geq W_1 \geq W_2 \geq W_3 \geq 0$ and $\sum_{i=1}^{3} = 1$. A quorum Q with $1/2 \leq Q < 1$ exists. This game results in only one out of the following four Banzhaf power-index profiles (B_1, B_2, B_3): either $(1, 0, 0)$, $(0.6, 0.2, 0.2)$, $(0.5, 0.5, 0)$, or $(0.33, 0.33, 0.33)$.*

Proof:

The prevailing power profile depends on the relative size of the quorum Q and the voting weights of the three players:

1. If $Q \geq W_1 + W_2$, then the only winning coalition is the grand coalition $\{1; 2; 3\}$. Each player is "critical" here, hence the resulting power index profile is $(0.33, 0.33, 0.33)$.[12]

[12]To better distinguish power indexes B_i from voting weights W_i, I write the former as

2. If $W_1 + W_2 > Q \geq W_1 + W_3$, then we have two winning coalitions: $\{A; B; C\}$ and $\{A; B\}$. Player C is never critical, while A and B each are critical in both winning coalitions. Hence, the power index profile is $(0.5, 0.5, 0)$.

3. If $W_1 + W_3 > Q \geq \max\{R_1; W_2 + W_3\}$ then three winning coalitions exist: $\{A; B; C\}$, $\{A; B\}$, and $\{A; C\}$. While player A is critical in all of them, player B is critical only in $\{A; B\}$, and player C is critical only in $\{A; C\}$. The total Banzhaf power is 5, and the resulting power index profile is $(0.6, 0.2, 0.2)$.

4. If $W_1 > Q \geq W_2 + W_3$, then we have a fourth winning coalition, namely $\{A\}$. Hence, only player A is critical in all of the four winning coalitions, and the resulting power profile is $(1, 0, 0)$.

5. If $W_1 \leq Q < W_2 + W_3$, then the fourth winning coalition is $\{B; C\}$. Now each of the three players is two times critical, respectively. This results in a power profile $(0.33, 0.33, 0.33)$.

This case distinction proves the proposition.

3 Application to the VW vs. Porsche case

The previous (and rather abstract) analysis starts with the assumption that the three members of a voting body can be sorted according to their voting weights. In the VW-Porsche-case, the biggest player is formed by the shareholders' representatives. Denote this group as S; the voting weight is $W_S = 1/2$. Even though this figure has not been contested by the VW workers' council, the subsequent analysis also allows for different values of W_S. The other two groups are the representatives of the VW employees (denoted as V) and of Porsche employees (P). Since the VW workers demand more voting rights than P, but not more than S, we can limit our view to voting weight configurations with $1 \geq W_S \geq W_V \geq W_P \geq 0$.

The result derived in the previous section implies that the power ratio is never equal to the ratio of the workers represented by players V and P.

decimal figures (defining $0.33 = 1/3$) and the latter as fractions.

If both P and V enjoy power, then the power ratio B_P/B_V equals one. A deviation from one is only possible if P is deprived of his power.

The voting weights of all players add up to one: $W_S + W_V + W_P = 1$. Hence, the analysis can be limited to discussing only the voting weights of players S and V, as the voting weight of P is implicitly given by $W_P = 1 - (W_S + W_V)$. Substituting the right hand side of this equation into the assumption $W_V \geq W_P$ yields $W_V \geq 1 - W_S - W_V$, which is equivalent to

$$W_S \geq 1 - 2W_V. \tag{1}$$

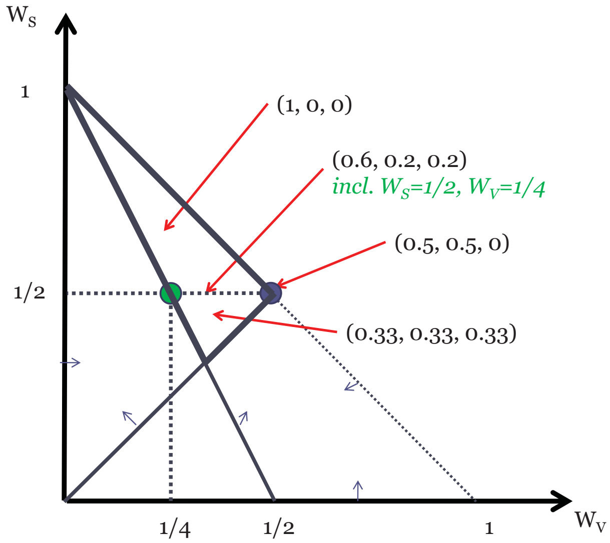
The bold triangle in Figure 1 shows all the possible combinations of W_S and W_V. First of all, these combinations have to be on or above the main diagonale (through the origin), as $W_S \geq W_V$. Second, they have to be on and below the flat diagonal line that connects $W_S = 1$ and $W_V = 1$, as no player can have more than all votes. Third, they have to be on and above the steeper diagonal line, represented by the equation $W_S = 1 - 2W_V$, due to inequality (1). Finally, all voting weights are non-negative: $W_S \geq 0$ and $W_V \geq 0$. These five constraints are symbolized in Figure 1 by tiny arrows.

The horizontal dashed line in Figure 1 represents the quorum $Q = 1/2$. Above this line and within the bold triangle, we have $W_S > Q$ and, thus, the Banzhaf power index profile $(1, 0, 0)$. This relates to case 4 of the above proposition.

On the horizontal line, but only for $W_V < 1/2$, the resulting power profile is (0.6,0.2,0.2), see case 3 of the proposition. This case also includes the initial situation with $W_P = 1/2$ and $W_V = 1/4$, implying $W_S = 1/4$, that is contested in court by the VW workers.

Now consider the voting weight combination $V_S = V_W = 1/2$, represented by the bold dot in the right corner of the large triangle. It implies $W_P = 0$, hence the parties are in case 2 of the proposition. Thus, the power profile is $(0.5, 0.5, 0)$. Below the horizontal dashed line, in the bold triangle, the power profile is $(0.33, 0.33, 0.33)$, as derived in case 5 of the proposition.

Figure 1: Power profiles if quorum $Q = 1/2$



4 Proposed modifications

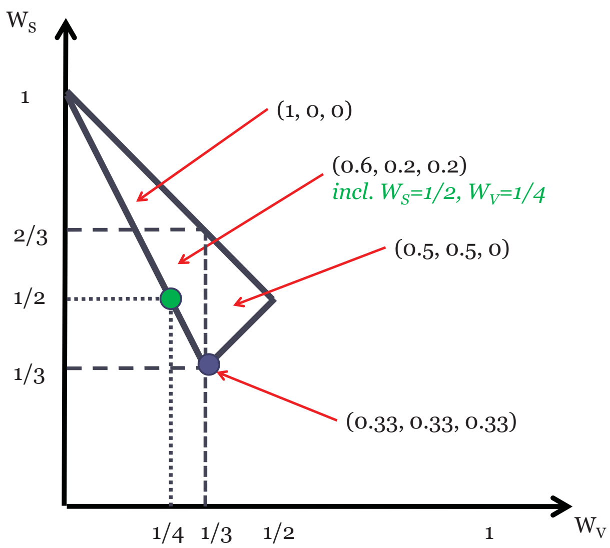
Two modifications of the current co-determination agreement for Porsche SE have been discussed, as explained in the Introduction: Important decisions may require a majority of (more than) 2/3, and the VW workers' representatives may receive a veto right. These modifications are discussed in sections 4.1 and 4.2. Section 4.3 adds the idea of a tie-breaking vote for the chairman of the supervisory board, who is elected by the shareholders' side.

A fourth modification of the basic analysis is presented in section 4.4: Until then, it is assumed that the shareholders form a homogeneous player, i.e., always vote identically. This assumption is relaxed in section 4.3, where the "maverick" shareholder is introduced, as this is a relevant part of the VW-Porsche-case which has an impact on the results derived so far. Section 4.5 looks at a scenario where one of the shareholders is a maverick, and the shareholders' side holds a tie-breaking vote.

4.1 2/3 majority

Figure 2 demonstrates the analysis of $Q = 2/3$. The bold triangle contains all possible combinations of voting weights W_S and W_V, just as in Figure 1. The current situation is symbolized by the point $W_S = 1/2$ and $W_V = 1/4$, which implies $W_P = 1/4$.

Figure 2: Power profiles if quorum $Q = 2/3$



In the area above $W_S = 2/3$, the prevailing power profile is $(1, 0, 0)$. For $1/3 < W_S \leq 2/3$, different cases may occur: If $W_V \leq 1/3$, then player S can create a winning coalition with just one of the two other players (who are unable to form a winning coalition). According to the proposition, the power profile is $(0.6, 0.2, 0.2)$; this case also contains the current situation. If, on the other hand, $W_V > 1/3$, then player P is powerless even if he holds a positive voting weight as he is unable to form a winning coalition with S or V alone. The resulting power profile is $(0.5, 0.5, 0)$.

For the VW-Porsche-case, only the horizontal line at the level $W_S = 1/2$ is relevant. With identical voting weights, players V and P would enjoy an identical power of 0.2. With $W_V > 1/3$, implying $W_P < 1/6$, V's power amounts to 0.5 whereas P's power shrinks to zero. With regard to the Banzhaf power index, there is no difference between the cases $Q = 1/2$ and $Q = 2/3$ if player S maintains 50 percent of the votes.

Result: The introduction of a 2/3 quorum (instead of an absolute majority rule) does not alter the power situation of the VW workers.

4.2 Veto right for player V

A veto right for player V means that he can block a majority decision for "yes". If V exercises this right, the collective decision would be "no" even if both S and P vote for "yes" and $W_S + W_P > Q$. Hence, there is no winning coalition that excludes V and, moreover, V is always critical.

With the absolute majority rule ($Q = 1/2$), only two winning coalitions exist: $\{S; V; P\}$ and $\{S; V\}$. Both S and V are critical in both coalitions, while P is never critical. Thus, the resulting Banzhaf power-index profile is $(0.5, 0.5, 0)$.

Result: Introducing a veto right for V would have the same effect as reassigning all voting rights from P to V.

4.3 Tie-breaking vote

Corporate law often assigns a tie-breaking vote to the chairperson of the supervisory board, who usually is determined by the shareholder side. With $W_S = 1/2$ and $Q = 1/2$, the tie-breaking vote can only kick in if player S takes one position while P and V take the other. In that case, $\{S\}$ is a winning coalition due to its tie-breaking vote, which implies that neither V nor P are critical. The resulting power profile thus is $(1, 0, 0)$.

If both a veto right for V and a tie-breaking vote for S exists, situations may occur in which these two rules conflict with each other. Then, a constitutional provision is required that regulates which rule overrides the other. If the tie-breaking vote overrides the veto, we are in the same power situation as described above: $\{S\}$ is a winning coalition, and the power profile is $(1, 0, 0)$.

If, however, V's veto right overrides the tie-breaking vote of S, then $\{S\}$ is not a winning coalition. The players are in the same situation as the one described in section 4.2, and the resulting power profile is $(0.5, 0.5, 0)$.

Result: If the shareholders' side holds a tie-breaking vote, it enjoys all the power, unless it can be overridden by a veto of V.

4.4 A maverick on the shareholders' side

This section is devoted to analyzing situations in which a member of the shareholders' representatives shows a tendency to occasionally disagree with his peers. Formally, the set of shareholders S is divided into two subsets: the maverick $\{M\}$ on the one hand, and the other shareholders, who vote homogeneously, on the other hand. Denote the latter bloc as A, with $S = A \cup \{M\}$ and $M \notin A$.

A famous example for such a maverick is the chairman of the supervisory board of Volkswagen AG, Ferdinand Piëch, who lately cast *in absentia* a sealed vote which led to a victory of the employees side.[13] If a maverick chooses to always vote in accordance with one group on the employees' side, say, V, this situation could be analyzed as a 3-player game using the results derived in section 2. If, however, the maverick prefers to vote completely independent of the three other players, then the game consists of four instead of three players. The power profiles in a four player game cannot be derived from the general analysis in section 3.

In what follows we concentrate on the scenario of the VW-Porsche case and, therefore, assume that the voting weights of the shareholders' representatives always add up to 0.5, with one member as a maverick. The aim is to evaluate whether (and to which extent) employee representative V would now benefit if voting rights are shifted from P to him (for different values of the quorum Q).

Table 1 shows the Banzhaf power index values of players V and P for different parameter settings. It is obvious that, in most cases, either $B_V = B_P$ or $P_P = 0$ holds, just as in the case without maverick. The only exceptions

[13] See Spiegel online (2008). Piëch is also a member of the supervisory board of Porsche AG and Porsche SE.

Table 1: Power of V and P if one shareholder is a maverick.

Votes		$Q = 1/2$		$Q = 2/3$		$Q = 3/4$	
V	P	B_V	B_P	B_V	B_P	B_V	B_P
3	3	0.25	0.25	0.2	0.2	0.333	0.333
4	2	0.25	0.25	0.5	0	0.375	0.125
5	1	0.333	0.167	0.5	0	0.5	0
6	0	0.6	0	0.5	0	0.5	0

are

- $Q = 1/2$ and W holds 5 votes;
- $Q = 3/4$ and W holds 4 votes.

In both scenarios, A controls 5 votes, while M has just one vote. In the first of these scenarios, a coalition prevails if it controls at least seven votes; moreover, V has 5 votes, P one. In this scenario, we have six winning coalitions: $\{V; M; P\}$ and $\{A; M; P\}$ with 7 votes; $\{A; V\}$ with 10 votes; {A;M;V} and {A;V;P} with 11 votes; and finally $\{A; M; V; P\}$ (12 votes). Players A and V are 4 times critical each, players M and P are critical in two coalitions, respectively. This implies $B_P = 1/6$ and $B_V = 1/3$.

In the second scenario, a coalition prevails if it controls at least ten votes. Thus, three winning coalitions exist: $\{A; M; V\}$ (10 votes), $\{A; V; P\}$ (11 votes), and $\{A; M; V; P\}$ (12 votes). Players A and V are critical in all of these coalitions, while players M and P are critical just once, respectively. Thus, $B_P = 1/8$ and $B_V = 3/8$.

Result: If one shareholder is a maverick, it is possible to endow V with more power than P without making the latter powerless (either absolute majority and 5 votes for V, or 3/4-majority and 4 votes for V). In both scenarios, V would enjoy three times the power of player P.

4.5 Maverick and tie-breaking vote

This section analyzes the power situation in a supervisory board if a maverick on the shareholders' side exists, and the chairperson has a tie-breaking vote. We have to distinguish two possibilities here: the chairperson can either be the maverick, or one of the other shareholders. We look at the 12-person board in which the shareholders and the employees have 6 seats each, and ask again under which circumstances a shift of voting rights from one employee group (P) to the other (V) increases the power of the latter, starting with $W_V = W_P = 1/4$.

Table 2: Power of V and P with maverick and tie breaking vote, $Q = 1/2$.

Votes		Chairperson among A		M is chairperson	
W_V	W_P	B_V	B_P	B_V	B_P
1/4	1/4	0.167	0.167	0.167	0.167
1/3	1/6	0.167	0.167	0.167	0.167
5/12	1/12	0.167	0.167	0.333	0
1/2	0	0.333	0	0.333	0

Table 2 shows the power of the employee representatives in the different constellations. If the chairperson is member of group A, this player is critical in all winning coalitions (except for AMVP and MVP). The other three players are critical two times, respectively. This gives a Banzhaf power of $B_A = 0.5$ to player A. Remarkably, the Banzhaf power of V and P is independent of the actual configuration of voting rights on the employees' side. If the maverick shareholder is also chairman, he can exert his tie-breaking vote only in two cases: He agrees with A while the employees are in opposition. The only other constellation is that V has 5 votes and agrees with the maverick, opposed by A and P. This explains why V's power increases to 0.33 already if he has 5 votes.

Result: If the shareholders' side is characterized by a maverick and a tie-breaking vote, then the employees' representatives V and P either have identical power, or P is powerless.

5 Conclusions

Shifting votes from P to V does not increase V's power, except for two cases: V's power can be increased by making P powerless, which is not intended by the parties in the law suit under scrutiny. No shift of voting rights from P to

V can leads to a Banzhaf-power ratio B_V/B_P that is greater than one and finite. Using a 2/3 majority does not change this result (with and without a maverick). Introducing a veto right for V would make P powerless.

The only constellation in which a finite Banzhaf-power ratio greater than one can be achieved is if a maverick on the shareholders' side exists and the shareholders do not have a tie-breaking vote, see section 4.4. To implement such a situation, however, is not within the discretion of the court.

If equal power per employee is the ultimate goal, and the power analysis is based on the Banzhaf-index, then the law suit pursued by the VW workers' council is, thus, unfounded. The VW workers may have other motives, but a desire for a "more adequate" power-ratio can not be brought forward to sustain their claim.

References

Amann, M. 2008 Porsche, VW und die Juristen. In: Frankfurter Allgemeine Zeitung Nr. 223 (September 23rd) 22.

AsiaOne 2007 Porsche, VW workers square up in German takeover drama. September 25, 2007, downloaded November 15, 2008 from *http://www.asiaone.com/print/Motoring/News/Story/A1Story20070925.*

Banzhaf III., J.F. 1965 Weighted Voting Doesnt Work: A Mathematical Analysis. In: Rutgers Law Review 19(2), 317343.

Banzhaf III., J.F. 1968 One Man, 3.312 Votes. A Mathematical Analysis of the Electoral College. In: Villanova Law Review 13, 303.

Deegan, J./Packel, E.W. 1978 A new index of power for simple n-person games. In: International Journal of Game Theory 7(2), 113123.

GlobalInsight 2008 VW Workers Complaint to Establish Co-Determination with Porsche. August 15, 2008, downloaded November 15, 2008, from
http://www.globalinsight.com/SDA/SDADetail13753.htm.

Hodge, J.K./Klima, R.E. 2005 The Mathematics of VOting and Elections: A Hands-on Approach. Mathematical World, vol. 22, American Mathematical Society, Providence (RI).

Holler, M.J./Packel, E.W. 1983 Power, luck and the right index. In: Journal of Economics (Zeitschrift für Nationalökonomie) 43(1), 2129.

Johnston, R.J. 1978 On the measurement of power: Some reactions to Laver. In: Environment and Planning A 10(8), 907914.

Leech, D. 2001 Shareholder Voting Power...NordJofPolEc 27(1), 2001

Manager Magazin 2007 Porsche/Volkswagen. Offener Schlagabtausch. manager-magazin September 21, 2007, downloaded November 12, 2008 from *http://www.manager-magazin.de/unternehmen/artikel/0,2828,507138m00.html.*

Penrose, L.S. 1946 The elementary statistics of majority voting. In: Journal of the Royal Statistical Society 109(1), 5357.

Shapley, L.S./Shubik, M. 1954 A method for evaluating the distribution of power in a committee system. In: American Political Science Review 48(3), 787792.

Spiegel online 2008 VW-Arbeitnehmer zwingen Porsche zu Kampfabstimmung. Spiegel online March 6, 2008. Downloaded November 12, 2008, from *http://www.spiegel.de/wirtschaft/0,1518,druck-539931,00.html.*

Steunenberg, B./Schmidtchen, D./Koboldt, C. 1999 Strategic power in the European Union. Evaluating the distribution of power in policy games. In: Journal of Theoretical Politics 11(3), 339366.

WAZ 2008 Porsche-Streit: Veto-Recht für Arbeitnehmer? In: Westdeutsche Allgemeine Zeitung June 22, 2008, downloaded November 12, 2008, from *http://www.waz-online.de/newsroom/wirtschaft/dezentral/politik/art37.*