

Volkswagen vs. Porsche. A Power-Index Analysis.

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Abstract

The supervisory board of Porsche SE, after a successful takeover of Volkswagen AG, was supposed to consist of three groups: The Porsche shareholders would have been endowed with 6 seats, while the 324,000 Volkswagen employees and the 12,000 Porsche employees would have been 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, the Porsche and VW employee representatives will have identical power regardless of the actual distribution of seats on the employees' side. This analysis sustains the judgment issued by a German labor court which rejected the request of the Volkswagen works council for more seats than the Porsche employees in the supervisory board of Porsche SE. The request for a more adequate representation can only be granted if a "randomized decision rule" is introduced.

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1 Introduction

The owners of the German car manufacturer “Dr. Ing. h.c. F. Porsche AG” created the “Porsche Automobil Holding SE” (henceforth: Porsche SE) in 2007. Porsche SE owns 100 percent of Porsche AG and has, of late 2008, taken over the majority of Volkswagen AG (VW). The complete takeover of the much bigger VW AG, however, has been canceled in May 2009 due to a heavy debt burden in Porsche’s balance sheet¹ that the owner families apparently try to alleviate by selling a part of Porsche SE to investors from Qatar.² This paper analyzes the composition of the supervisory board (Aufsichtsrat) of Porsche SE as it was intended for the time after a successful takeover.³ The board should have consisted of six representatives of the shareholders and the employees, respectively. After a takeover, both the current 324,000 VW employees and the 12,000 Porsche employees would have been represented by three supervisory board members each.

A *societas europeae* (SE) has to negotiate the conditions of workers’ co-determination with the workers involved.⁴ These negotiations do not necessarily include the composition of the supervisory board, as this has to be determined in the “terms of foundation” set up by the owners⁵ On the other hand, it is not prohibited to bargain over these statutes, or to bring a lawsuit, which is the way how the VW works council tried to modify the existing rule preemptively.

At the time the Porsche SE was founded, it did not dominate VW. Hence, the VW workers did not take part in negotiations. Bernd Osterloh, head of the VW works council, called the plan unacceptable and “a slap in the face”

¹See, e.g., Preuss (2009).

²See Meck (2009).

³The other basic corporate governance problem of the SE is the installation of a works council, see Keller/Werner (2008). This is, however, not in the focus of this paper. On the development of the European Company Statute, see Gold/Schwimbersky (2008).

⁴See Amann (2008).

⁵This also holds for the size of the supervisory board, see Keller/Werner (2008, 167). The number of firms that incorporated as an SE is still small, and the most prominent German example, the insurance company Allianz SE, also has chosen a two-tier model with 12 members in the supervisory board, 6 of them being employee representatives, see Gold/Schwimbersky (2008, 47).

for VW employees.⁶ The head of Porsche's works council, Uwe Hück, 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.⁷

The VW works council has, thus, 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 held only 31 percent of VW's shares and, therefore, did not dominate VW.⁸ The VW works council considered an appeal against this decision, arguing that Porsche SE already effectively did control VW.⁹ Leech (2001) has shown that 30 percent shares would be enough to have almost full power if the other 70 percent are fully dispersed (among 70 shareholders with just 1 percent each).¹⁰ After the first success in court, Porsche apparently made two offers to the VW workers.¹¹ 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 some abstract questions which deserve systematic answers: 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

⁶AsiaOne (2007). The works council of Porsche SE is, after the takeover, clearly dominated by VW employees; see Amann (2008), with Osterloh as the elected chairman.

⁷Manager Magazin (2007).

⁸Arbeitsgericht 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.

⁹See GlobalInsight (2008).

¹⁰VW is, however, not a case of dispersed ownership, as the federal state Lower-Saxony controls 20 percent. Kirstein/Koné have analyzed to which extent Leech's results are valid if an incumbent blockholder exists, and if investors face a voting cap.

¹¹See WAZ (2008), citing the German news magazine Focus. However, according to the same source, the VW works council claimed to have not received such an offer.

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 individual member of a constituency with equal influence (or power), then this principle appears useless. To decide whether individuals enjoy equal or different power, a quantitative operationalization is required that can be achieved by the concept of power indices. Following the insights of power index analysis, a blind request for “equal votes per capita” is not justified.

The next section gives an overview of the power index literature. Section 3 presents an abstract analysis of the 3-player voting game. The results are used in Section 4, which evaluates the numerical examples relevant for the VW case. Section 5 evaluates three modifications of the basic analysis. These modifications are relevant for the VW-Porsche case under scrutiny. Section 5.1 analyzes the power situation if a 2/3 majority is required. In 5.2., the impact of a veto right assigned to the VW workers’ representatives in the supervisory board of Porsche SE is analyzed. In 5.3, the realistic idea of a tie-breaking vote for the shareholders’ side is taken into consideration as well. 5.4 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 5.5 combines the analysis of tie-breaking vote and maverick. Section 6 presents the idea of stochastic decision rule:¹² If the the number of votes required for a social decision (quota) is not fixed, but chosen from a set of quotas using a pre-determined probability distribution, it is possible to endow the VW employee representatives with 27 times the expected power of the Porsche employee representatives. In Section 6, one example of such a probability distribution is derived. Section 7 draws conclusions.

2 Power index analysis in the literature

A non-trivial problem of the design of statutes for representative voting bodies is the question how to ensure equal influence (or power) per represented

¹²See Holler(1982), Holler (1985), Berg/Holler (1986).

person. As the number of votes held by the member of a voting body is only occasionally a good proxy for the power or influence of this person,¹³ the problem cannot be solved by simply assigning votes to the delegates that are proportional to the size of the respective constituency. Penrose (1946) has argued that equal votes per capita would endow larger groups of voters with an over-proportional amount of voting power. In his model, the voting power of a group is proportional to the square of the number of votes it controls. If a body consists of several 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 and 1968) also demonstrated that players' power in a voting body is not necessarily proportional to their votes. A very simple example can highlight this point: If two shareholder both own 50 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 proved helpful in a lawsuit, his power index analysis demonstrated the unfairness of proportional votes in the supervisory board of Nassau County (NY). 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.

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.¹⁴ As a result of Banzhaf's

¹³See, e.g., Banzhaf (1965), Banzhaf (1968), Holler (1985), Felsenthal/Machover (2004).

¹⁴See 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

legal action, the composition of the Nassau supervisory board was changed several times.¹⁵

Drawing on the theory of voting power, this paper argues that the claim of the VW works council is 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. 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: The first player consists of the representatives of the Porsche shareholders (with 50 percent of the votes), the second player consists of the Porsche, the third of the VW workers' representatives (with the other 50 percent distributed among them). The analysis will demonstrate that Porsche and VW workers' power is identical, regardless of the actual distribution of voting rights. Only in extreme cases, if 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 indices 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 choice is identical to the social choice. A member is more powerful, the higher this probability. The power indices of Banzhaf (1965) and Penrose (1946) come to identical results.¹⁶ 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 is greater than or equal to the threshold ("quota") required for a collective decision.¹⁷ A member of a winning coalition is critical if his withdrawal from

due to the cooperation of one of the smaller districts.

¹⁵In 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).

¹⁶Penrose's index measures the probability of carrying the social decision minus 0.5; this is equal to the non-normalized Banzhaf index, see Felsenthal/Machover (2004, 5).

¹⁷"Coalition" is used in an informal or spontaneous sense, it requires no contract between

the coalition would turn it into a losing coalition (i.e., the remaining number of votes is smaller than the quota). 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.

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 Steunenbergh/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 in games with a small number of players.

3 Banzhaf power in a 3-player voting game

Consider a voting body that consists of three players $i \in \{1; 2; 3\}$ who have to make a binary decision (i.e., “yes” or “no”). The players are endowed

its members.

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 reach at least a threshold value, the quota Q , which is fixed ex-ante with $1/2 < Q < 1$. E.g., under the absolute majority rule, a proposal becomes social decision if the number of votes cast in favor of it amounts at least to $0.5 \sum_{i=1}^3 R_i + 1$ if this sum is even (if it is odd, then the number of votes has to reach at least $0.5[\sum_{i=1}^3 R_i + 1]$). For simplicity, denote the absolute majority as $Q = 1/2 + e$ with $e > 0$ representing just one vote.

If the members of a subset $I \subseteq \{1; 2; 3\}$ vote for a proposal, and

$$\sum_{i \in I} W_i \geq Q.$$

then this proposal becomes the collective decision of the voting body, and the (informal) 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 1: *Consider a voting game with three players $i \in \{1; 2; 3\}$ holding voting weights W_i with $1 \geq W_1 \geq W_2 \geq W_3 \geq 0$ and $\sum_{i=1}^3 W_i = 1$. A quota Q with $1/2 < Q < 1$ 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 $(0.33, 0.33, 0.33)$.¹⁸

Proof:

The prevailing power profile depends on the relative size of the quota 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 $(0.33, 0.33, 0.33)$.¹⁹
2. If $W_1 + W_2 \geq Q > W_1 + W_3$, then we have two winning coalitions: $\{1; 2; 3\}$ and $\{1; 2\}$. Player 3 is never critical, while 1 and 2 each are critical in both winning coalitions. Hence, the power index profile is $(0.5, 0.5, 0)$.
3. If $W_1 + W_3 \geq Q > \max\{R_1; W_2 + W_3\}$ then three winning coalitions exist: $\{1; 2; 3\}$, $\{1; 2\}$, and $\{1; 3\}$. While player 1 is critical in all of them, player 2 is critical only in $\{1; 2\}$, and player 3 is critical only in $\{1; 3\}$. The total Banzhaf power amounts to 5, and the resulting power index profile is $(0.6, 0.2, 0.2)$.
4. If $W_1 \geq Q > W_2 + W_3$, then we have a fourth winning coalition (besides those three mentioned in the previous case), namely $\{1\}$. Therefore, only player 1 is critical in all of the four winning coalitions, and the resulting power profile, thus, is $(1, 0, 0)$.
5. If $W_1 < Q \geq W_2 + W_3$, then the fourth winning coalition is $\{2; 3\}$. 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 Proposition 1.

¹⁸The similar claim has been made in Berg/Holler (1986, 424), but without proof.

¹⁹To better distinguish power indexes B_i from voting weights W_i , I write the former as decimal figures (defining $0.33 = 1/3$) and the latter as fractions.

4 Application to the VW vs. Porsche case

In the VW-Porsche-case, the biggest player is always formed by the shareholders' representatives. Denote this group as S ; its voting weight is $W_S = 1/2$. Even though this figure has not been contested by the VW works 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 . 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

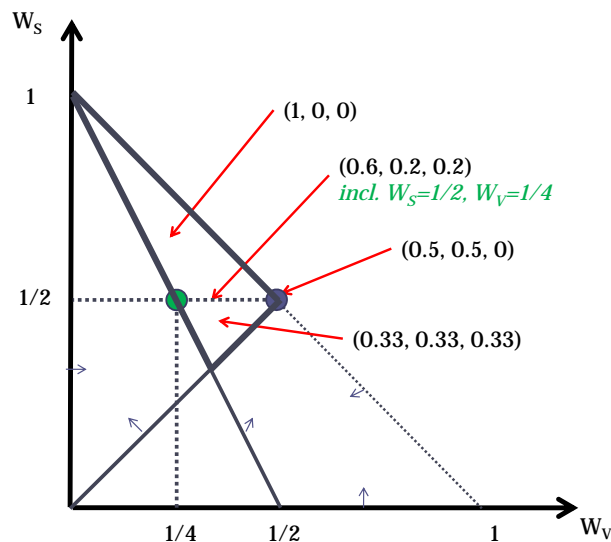
$$W_S \geq 1 - 2W_V. \tag{1}$$

The bold triangle in Figure 1 shows all the possible combinations of W_S and W_V .²⁰ First of all, these combinations have to be on or above the main diagonal (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 quota $Q = 1/2 + e$. 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 Proposition 1.

²⁰The bold triangle is equivalent to the subset ABC in the ordered simplex presented by Berg/Holler (1986, 425).

Figure 1: Power profiles if quota $Q = 1/2 + e$



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 Proposition 1. 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 Proposition 1. 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 Proposition 1.

5 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' representa-

tives 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.

5.1 2/3 majority

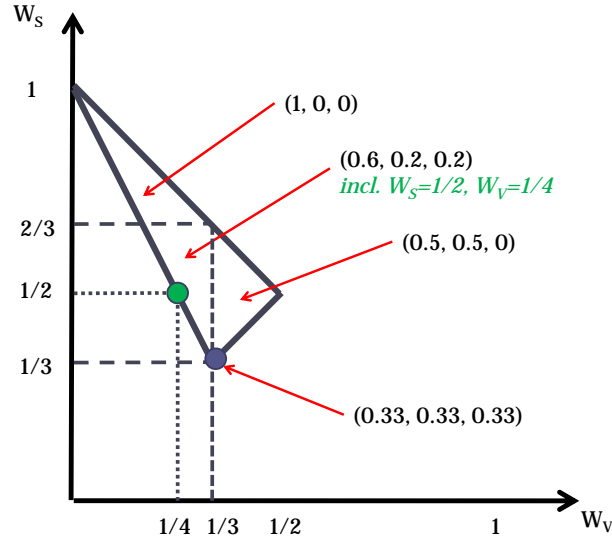
Figure 2 demonstrates the analysis of $Q = 2/3$. The bold triangle contains all possible combinations of voting weights W_S and W_V , just as in Figure 1. The current situation is symbolized by the point $W_S = 1/2$ and $W_V = 1/4$, which implies $W_P = 1/4$.

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 Proposition 1, 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 $Q = 1/2 + e$ and $Q = 2/3$ if player S maintains 50 percent of the votes.

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

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



5.2 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 ($Q = 1/2 + e$), 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.

5.3 Tie-breaking vote

Corporate laws usually assign a tie-breaking vote to the chairperson of the supervisory board, who usually is determined by the shareholder side.²¹ With $W_S = 1/2$ and $Q = 1/2 + e$, 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 .

5.4 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.²² 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 $S =$

²¹E.g., A §§96-107 Aktiengesetz or §§27-29 Mitbestimmungsgesetz demand that the chairperson be elected among the members of the supervisory board and, if an election fails, the shareholders alone vote in the second round. Moreover, in case of a tie the chairperson has an additional vote if the supervisory board votes again on the same topic. The statutes of Porsche SE (as of January 30, 2009) are more precise with regard to this: According to §§10-11 the chairperson has to be elected from among the shareholders' representatives, whose vote is decisive in case of a tie.

²²This is less strict than the definition of "quarreling members", see Felsenthal/Machover (1998, 237), which always disagree. The maverick may sometimes vote with the other shareholders.

$A \cup \{M\}$ 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 for the employees.²³ 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 V (for different values of the quota Q).

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

Votes		$Q = 1/2 + e$		$Q = 2/3$		$Q = 3/4$	
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

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 are

- $Q = 1/2 + e$ and V holds 5 votes;

²³See Spiegel online (2008). Piëch is also a member of the supervisory board of Porsche AG and Porsche SE. After the attempted take-over of VW was canceled the owner-families considered selling a substantial share of Porsche SE to an investor from Qatar, whose representative in the supervisory board could also be seen as an independent player on the shareholders' side.

- $Q = 3/4$ and V 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.

5.5 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. This scenario is the one that most closely reflects the actual statutes of the Porsche SE and, hence, appears to be the most realistic one for the analysis of the VW-Porsche case.

We now have to distinguish two possibilities: 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 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 $\{A; M; V; P\}$ and $\{M; V; P\}$). The other

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

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

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.

6 Random quota

6.1 The concept

Holler (1982) has introduced the notion of a random decision rule.²⁴ With fixed voting weights, a decision rule is fully characterized by the quota. Usually, one single quota is fixed ex ante in the statutes of the voting body. Each quota then implements a power profile, in other words: endows each player with one Banzhaf index. Another quote may lead to the same Banzhaf power for a specific player, or it may grant this player another amount of power.

With a finite set of decision rules, the number of possible power profiles is also finite (as it was shown in Section 2, see Proposition 1). Other power allocations can be reached by randomization between decision rules. For

²⁴See also Holler (1985), Berg/Holler (1986).

example, if a player enjoys a Banzhaf index of 0.2 under one decision rule, and 0.8 under another quota, then any expected Banzhaf power between 0.2 and 0.8 can be assigned to this player if the statutes of the voting body require to apply the two quotas at random. If the statutes demand that the one quote be applied with probability d and the other with $1 - d$, then the expected power of this player would amount to

$$0.2d + 0.8(1 - d) = 0.8 - 0.6d.$$

Any desired expected power in the interval $[0.2, 0.8]$ can thus be reached by choosing d appropriately. E.g., let the desired expected power be 0.44:

$$0.8 - 0.6d \stackrel{!}{=} 0.44 \Leftrightarrow d = 0.36/0.6 = 0.6.$$

If the rule that grants the player under scrutiny a power of 0.2 is used with probability $d = 0.6$ and the other with $1 - d = 0.4$, then the expected power of this player is a linear combination of 0.2 and 0.8, in this case 0.44.

6.2 Random quota without maverick

To apply this idea to the Porsche-VW case, table 3 displays the power of players V and P under several quotas for three different composition of seats in the Porsche SE supervisory board (in the three players game, without a Maverick, and without a tie-breaking vote of the chairperson).

Table 3: Power of V and P under different quotas.

Votes		Decision rule			
V	P	$Q = 1/2 + e$	$Q = 2/3$	$Q = 3/4$	$Q = 1$
3	3	0.2, 0.2	0.2, 0.2	1/3, 1/3	1/3, 1/3
4	2	0.2, 0.2	0.5, 0	0.5, 0	0.5, 0
5	1	0.2, 0.2	0.5, 0	0.5, 0	1/3, 1/3
6	0	0.5, 0	0.5, 0	0.5, 0	0.5, 0

The first entry in each cell denotes V's normalized Banzhaf index, the second entry refers to player P. In the original situation (with 3 seats each), a randomization between the decision rules $Q = 2/3$ and $Q = 3/4$ would

allow to assign expected power between 0.2 and 1/3 to both players. In each case the power ratio is one, hence this would not lead to the power ratio of 1/27 desired by the VW works council.

This is different if the VW employee representatives hold four (or five) seats and the statutes require a randomization between absolute majority and $Q = 2/3$. In this scenario, a power ratio B_P/B_V equal to 1/27 can be implemented, as the next proposition claims.

Proposition 2: In the three-player game between S, V, and P without a tie-breaking vote, the expected power ratio between V and P is 1/27 if V holds 4 or 5 seats and the quota $Q = 0.51$ is applied with probability $d = 0.0877\dots$, while the quota $Q = 1/3$ is applied with probability $1 - d$.

Proof: With probability d , V's expected power amounts to $0.2d + (1 - d)/2$, while P's expected power is $0.2d$. The power ratio equals 1/27 if, and only if,

$$\frac{0.5 - 0.3d}{0.2d} = 27 \Leftrightarrow 0.5 = 5.7d \Leftrightarrow d = 0.0877\dots \quad \square$$

This result requires the abolishment of the tie-breaking vote (TBV) that is assigned to the chairperson of Porsche SE's supervisory board.²⁵ With the TBV in the hands of a shareholder, the power of the smaller players V and P is zero, unless V has a dominating veto right, see Section 4.3. The TBV only kicks in under the absolute majority rule (with higher quotas, it will never become effective). Hence, if the TBV is considered indispensable, then randomization will only lead to the desired power ratio of 1/27 if the absolute majority is circumvented, as the next proposition states:

Proposition 3: If, in the three-player game between S, V, and P, one member of S holds a tie-breaking vote, then the expected power ratio between P and V is 1/27 if V holds 4 or 5 seats and the quota $Q = 2/3$ (or $Q = 3/4$) is applied with probability $d = 0.945\dots$, while the quota $Q = 1$ is applied with probability $1 - d = 0.054\dots$

Proof: With probability d , V's expected power amounts to $d/2 + (1 - d)/3$, while P's expected power is $(1 - d)/3$. The ratio equals 27 if, and only if,

²⁵See §11(5) of the statutes of Porsche SE (as of January 30, 2009). §10(1) of the statutes demand that the chairperson has to be elected from among the shareholders' representatives.

$$\frac{(d+2)/6}{(1-d)/3} = 27 \Leftrightarrow 55d = 52 \Leftrightarrow d = 0.945\dots \square$$

Hence, two cases of randomized voting rules exist which implement an expected power ratio of $1/27$ between players P and V. In both scenarios it plays no role whether V has 4 or 5 seats (while P receives the remaining 2 or 1, respectively).

- Either the random decision rule attaches a probability of 0.0877 to the absolute majority, and 0.9122 to $Q = 2/3$;
- or it attaches 0.054 to unanimity, and 0.954 to $Q = 2/3$.

The first case would only work under abolishment of the chairperson's TBV, the second case circumvents an existing TBV (as it will never be used). In both cases, the $2/3$ -majority plays a major role. Both cases do not work as described above if V has a veto right.

6.3 With maverick and tie-breaking vote

The last application of the random quota idea refers to the analysis of the VW-Porsche case under the assumption that one of the shareholders acts as a maverick, i.e., votes independently of his peers. Hence, the game is played among four players, namely V and P (who together control six votes), A (with 5 votes), and M (holding one vote). Table 2 in section 5.5 demonstrates that, if V holds 5 votes, then the Banzhaf power of players V and P under the absolute majority rule may depend on the identity of the maverick: if he is chairperson, then $B_V = 1/3$ and $B_P = 0$; if the chairperson one of the members of A, then $B_V = 1/3 = B_P = 1/6$. In all the other cases (V holds 3,4, or 6 votes) it plays no role whether or not the maverick is the chairperson.

Under the $2/3$ majority, the tie-breaking vote of the chairperson plays no role anyway. As it was reported in table 1, with four or more seats for player V, we have $B_V = 1/2$ and $B_P = 0$ (3 seats for V implies $B_V = 1/5 = B_P$). Thus, in the case that is closest to the Porsche SE statutes (chairperson has tie-breaking vote, maverick may exist), only a single scenario exists under

which the application of a random quota implements an expected power ratio of $1/27$, as the next proposition states.

Proposition 4: Consider a four-player game between A, M, V, and P, in which A controls 5 votes, M holds one vote, while V and P share the remaining six votes. The expected power ratio between P and V equals $1/27$ and is independent of whether or not M is the chairperson of the supervisory board if, and only if, V has 4 votes and the quota $Q = 2/3$ is applied with probability $d = 0.89655\dots$, whereas the absolute majority is applied with probability $1 - d = 0.1034\dots$

Proof: With probability d , V's expected power amounts to $d/2 + (1-d)/6$, while P's expected power is $(1-d)/6$. The ratio equals 27 if, and only if,

$$\frac{(2d + 1)}{(1 - d)} = 27 \Leftrightarrow 29d = 26 \Leftrightarrow d = 0.89655\dots$$

With 3 votes for V (and P), their power is identical ($1/6$ each under absolute majority, $1/5$ each under $Q = 2/3$). With 5 and 6 votes for V, the power distribution among V and P would depend on the identity of the chairperson. \square

7 Conclusions

Shifting votes from P to V would in general not lead to a more adequate influence for the VW workforce in the Porsche SE supervisory board. However, some exceptions may exist. In this paper, the following five cases were identified:

1. V's power can be increased by making P completely powerless, which is not intended by the parties in the law suit under scrutiny.
2. If a maverick on the shareholders' side exists and the shareholders do not have a tie-breaking vote, see section 4.4.
3. Assigning 4 (or 5) seats to V would implement a power ratio of $1/27$ if the shareholders form a homogeneous player, the $2/3$ -majority is used with probability 0.9122, and the absolute majority is used with probability 0.0877, if there is no tie-breaking vote.

4. With 4 (or 5) seats for V, the same expected power ratio of $1/27$ is attained if the shareholders form a homogeneous player, the $2/3$ -majority is used with probability 0.945, and unanimity is applied with probability 0.0054 (which circumvents an existing tie-breaking vote).
5. If a maverick exists on the shareholders' side (regardless of whether or not he is the chairperson) and V holds 4 seats, then the power ratio of $1/27$ is implemented if the $2/3$ majority is applied with probability 0.89655, whereas absolute majority is applied with probability 0.1034.

In the first case, a simple shift of voting rights from P to V (under a deterministic decision rule) would never lead to a Banzhaf-power ratio B_P/B_V other than one or zero. 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.

Regarding the second case, it is not within the discretion of a labor court to implement the existence of a maverick on the shareholders side. The court can modify the statutes (or prohibit the usage of certain provisions), but it cannot oblige one shareholder to vote independently. The court should as well abstain from the attempt to shift power towards V as long as a maverick exists on the shareholder's side, because a constitutional decision should be valid for all possible preference profiles and not just a special case.

Using a randomized decision rule, as proposed by the three last cases, would give a court (or a general assembly when setting up the statutes) the chance to implement almost any power ratio. If a ratio of $1/27$ to one is desired, based on the idea of equal influence per represented worker, taking into account the current figures, and the quantitative analysis of influence is based on the Banzhaf power index concept, then this would be a solution.

A randomized decision rule may seem far fetched from a lawyer's point of view. Its implementation does, however, not require the voting body to toss a coin to determine the current decision rule before a vote is called for. The Banzhaf power index analyses power from an a priori point of view, i.e., it is limited to the analysis of power granted by the statutes of the

organization.²⁶ It is sufficient that the players anticipate the 2/3-rule will be used almost every time, while the absolute majority (case 3) or the unanimity rule (case 4) is used in just a few instances, and no one can fully anticipate which rule will be used in which instance.

The VW works council's claim for additional seats in the Porsche SE supervisory board was, thus unfounded, as far as it was limited to the additional seats and driven by the desire for equal representation or influence.²⁷ Without the accompanying measures, additional seats alone would not change the power ratio between P and V (unless P is reduced to zero). Quantitative power analysis, however, would sustain V's claim if the supervisory board obeys a randomized decision rule that puts a high probability on the 2/3-majority. In light of this analysis, Porsche's proposal to use this decision rule more often makes sense. The also discussed veto right for V, however, should not apply to V alone: If the unanimity rule is used occasionally as a part of a randomized decision rule (see case 4), this would not only endow V with an occasional veto right, but also P and S.

²⁶Felsenthal and Machover (2004) call this I-power, which denotes a player's influence over the outcome of a voting game (in front of a veil of ignorance, when players are still uncertain about their later preferences). The contrasting concept is P-power, which represents a player's expected share of a fixed pie gained by a winning coalition in a voting game. An example of the latter concept would be the Shapley-Shubik-index.

²⁷The VW works council may have had other motives, e.g., a desire to capture the position of the vice-chairperson in the Porsche SE supervisory board.

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