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# Determinants of the Passing Behavior in National Soccer Teams

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- Motivation and research interest
- Theoretical considerations
- Hypotheses
- Used data
- Model specification
- Empirical results
- Conclusions and remaining questions



- Not only characteristics of the game, but also social factors influence the passing behavior of soccer players.
- In the following we investigate the received passes by a player from another one of the same team during the FIFA World Cup 2006.
- Therefore we try to answer the following question: What effect does “Blockbildung” have on the passing behavior of soccer players?



- “Blockbildung” describes the fact that two or more players of the same club team play in a national team.
- Another important factor associated with this term is that these players are positioned close to each other according to the team’s formation.
- A distinction between horizontal and vertical “Blockbildung” is possible:
  - Horizontal blocks: Players of the same team play in one part of a team (defense, midfield, offense).
  - Vertical blocks: Looking at a team’s formation a straight line can be drawn from the own to the opponent’s goal between players of the same team (e.g. central defender – central midfielder – central forward).



- Empirical evidence on the passing behavior of players is scarce, non-cumulative and ambiguous. (for a more detailed overview see the next page)
  - Klein/Christiansen (1966): a positive effect of friendship on the number of played pass to players (professional basketball players)
  - Salminen/Luhtanen (1990): no influence of sympathy on the number of played passes to players (junior national ice hockey players)
  - Alfermann (1992): significant effects of ability and gender on the mean number of ball contacts (different ball games during physical education)
  - Stössel (2005): no significant effect of the membership to the same team on the mean number of passes between to players (Greece and Portuguese national soccer players)
- Methodological problems of these studies
  - Small, selective samples
  - No control of relevant variables like a team's formation and the opponent's abilities
  - No consideration for the dynamics of the game
 → The results of previous studies may be biased, which could be an explanation for their ambiguity.



Study	Population	Sports type	Number of players	Method	Dependent variable	Observations	Independent variables	Sign.	Direction of effect
Salminen/Luhtanen (1990)	Junior national players (SWE, CZE, FIN)	Ice hockey	1985: 71 1986: 64 1987: 60	Two-way tables	Played passes	1985: 1309 1986: 525 1987: 1149	Friends	No	No effect
Stössel (2005)	National players (GRE, POR)	Soccer	Max. 48	Linear regression	Mean passes between two players	POR: 164 GRE: 140	Team-mates	No	?
Alfermann (1992)	Pupils (classes 3 and 6 to 10)	"Völkerball" "Parteiball" Handball Basketball	"Völkerball": 86 "Parteiball": 102 Handball: 63-144 Basketball: 173-270	Two-way tables	Mean number of ball contacts per player	See number of players	Gender and ability	Yes	Positive effect for boys and ability
Klein/Christiansen (1969)	Professional Players	Basketball	7	Two-way tables	Played pass	3 on 3: 1100 5 on 5: 380	Socio-metric Performance	Yes	Positive effect



Three theoretical approaches to passing:

1. The Theory of *Social Embeddedness* (Granovetter)
2. The Theory of *Signaling* (Akerlof, Spence and Stiglitz)
3. *Human Capital* Theory (Schultz and Becker)



- The term *Social Embeddedness* describes the fact „that economic action, outcomes, and institutions are affected by actors' personal relations, and by the structure of the overall network of relations“ (Granovetter 1990: 98).
- Raub (1999) systematizes this concept and distinguishes between temporal, network and institutional embeddedness.
- In this case especially the first two types of embeddedness are of further interest.



- Temporal Embeddedness in Soccer
  - Players are better informed of the behavior of their team-mates in club teams (learning effect).
  - They can better sanction non-cooperative team-mates than partners from other club teams (sanctioning effect).
  - Players will prefer to play to team-mates from their club teams.
- Network Embeddedness in Soccer
  - There are different roles in a team (e.g. captain), which have a different influence on the spread of information and the effect of sanctions.
  - Further the formal position of a player on the pitch determines the number of passes he will receive and play.



- In line with this argument Coleman (1988) stated, that a rising density in the social network of sport teams reduces the number of free riders and raises the number of zealots. Thus with a higher average of individual performances a better team performance can be expected.
- This last hypothesis seems to be supported by a rich research tradition in social psychology about social cohesion and productivity. Inspired by an early experimental study by Schachter et al. (1951) dozens of studies examining this relationship and its causality has been conducted. The results indicate a positive effect of social cohesion on the performance for interactive sport types (for an useful overview see Carron, Colman and Wheeler 2002).



- The *Signaling* approach emphasizes the role of information for the efficient functioning of markets (e.g. Akerlof's lemons market)
- Signals can help to provide important information and encourage otherwise risky actions, e.g. by achieving graduation certificates, offering warranties or a menu of different insurances.
- In general this approach supposes the possibility of active signaling. As an supplement to this, here it is argued, that passive signals are carriers of information.



- Assumptions: Players prefer actions that serve their interests best. They react to monetary and social incentives, so they try to take part in successful and try to avoid unsuccessful actions.
- Thus players will pass the ball to those team-mates, that have the highest success- and the lowest mistake-rate. Popularity among team-mates and fans and the social role of the captain may also have a positive influence, since they seem to be connected with social acknowledgement.
- It is important to emphasize, that there will be no absolute concentration of passes on the best players of a team, because simultaneously with a rising number of passes to one player the „pass-interception-probability“ rises, too.



- Human capital includes all kinds of abilities an individual possesses, that have a positive effect on his productivity and thus on his income.
- Distinction between general and specific human capital:
  - General human capital: Abilities that are easily transferable from one team to another, e.g. technical and physical abilities and general tactical knowledge.
  - Specific human capital: Abilities that are only useful in a certain team, e.g. knowledge about the names of certain tactical maneuvers and about the behavior of team-mates on the pitch.
- On the one hand the older a player is, the more experienced he will be. On the other hand we assume a devaluation of “physical capital” with rising age. Therefore we expect a quadratic relationship between age and performance respectively the number of passes a player receives.



- H1: A player will receive more passes from another player, if both of them play in the same club team.
- H2: Captains of a team will receive more passes than other players, unless the goalkeeper is the captain.
- H3: Midfielder will receive more passes than defenders and forwards.
- H4: The better the abilities of a player, the more passes he will receive.
- H5: There exists an inverse u-turned relationship between the age of a player and the number of passes he will receive.



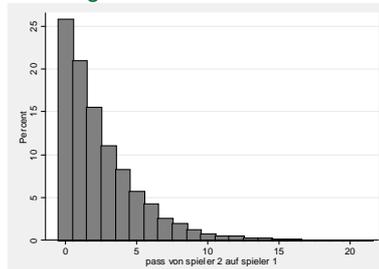
- The smaller the distance between two players on the pitch, the more passes they will receive from each other.
- Passes in direction of the opponent's goal occur more often than passes across the pitch and these again occur more often than passes in the own goal's direction.
- The more offensive an opponent team 2 is playing, the more passes each player of team 1 will receive.
- The more often a game is interrupted, the less passes each player will receive.
- The longer the joint time of players on the pitch, the higher the number of passes each of them will receive from the other.



- The used datasets includes the number of passes played and received for every possible pair of players (goalkeeper and substituted players excluded) for the first, second and fourth (round of the last sixteen) match and covers 7,200 cases manually recorded from [www.eurosport.de](http://www.eurosport.de).
- These data have been combined with information about team membership, age, size, number of international matches, playing position, whether the player is the team captain or not and the estimated market value for both the players playing as well as receiving passes ([www.transfermarkt.de](http://www.transfermarkt.de)).
- Finally variables indicating the distance and the direction of the pass according to the formation have been supplemented to the dataset. Additionally the opponent's formation and the number of each team's fouls and cards have been recorded (Gottschalk 2006).



- In the following estimations, we regard all passes received by one player from another one in a certain game as the dependent variable
- We regard every possible pair of players (excl. goalkeeper and substitutes)
- Therefore we have 90 cases per game and team
- Histogram:



- Distance between two players: a dummy variable (1 = connection according to the formation)
- Direction of the pass: a variable with three categories (forward, parallel, backward) according to the formation
- The opponent's playing style (defensive (4-4-2 d., 3-6-1, 4-5-1 d.), "normal" (4-4-2 o., 4-5-1 o.), offensive (4-3-3, 3-4-3, 3-5-2))
- The duration of interruptions: total number of fouls in a game
- Ability of a player: market value estimation in mio. Euros
- The other operationalizations seem to be rather unambiguous: team-mates, captain, formal position, age, joint time and dummies for the game played.



- A model for count data is used – due to overdispersion negative binomial regression models are estimated
- The data is characterized by a multilevel structure
  - Level 1: Pairs of players (7,200 cases)
  - Level 2: Teams (32 nations)
  - 180 or 270 cases per team (depending on whether a team reached the round of last sixteen or not)
- Accordingly we estimate multilevel negative binomial regression models with random effects.



	Model 1	Model 2	Model 3	Model 4
Side by side player	1.924***	1.925***	1.925***	1.888***
Pass in direction of own goal	0.755***	0.756***	0.756***	0.763***
Pass in direction of opponent's goal	1.124***	1.121***	1.090**	1.021
Offensive opponent	0.870***	0.869***	0.867***	0.868***
Defensive opponent	0.944	0.944	0.928*	0.929*
Number of fouls in game	0.999	0.999	1.000	1.000
Joint time of players	1.014***	1.014***	1.014***	1.015***
Age		1.040	0.993	1.000
Age squared		0.999	1.000	1.000
Market value of player			1.009***	1.008***
Pass receivers position: midfield				1.142***
Pass receivers position: forward				1.133**
Pass receiver is team captain				0.999
Players are team mates				1.053
Second game	1.052*	1.052	1.048	1.051
Game in the round of the last 16	0.910**	0.910**	0.899**	0.899**
Observations	7,200	7,200	7,200	7,200
Groups	32	32	32	32

\* p&lt;.05, \*\* p&lt;.01, \*\*\* p&lt;.001



- Considerations regarding the influence of the experience of a player and his devaluation of “physical capital” over time can not be confirmed.
- The ability, measured by the market value, has a highly significant positive influence on the number of received passes. Therefore we can confirm these considerations following the Signaling approach.
- Furthermore it seems that a team captain does not receive more passes than other players.
- We can not identify an effect of “Blockbildung” on passing behavior.
- Midfielders and forwards receive more passes than the defenders.
- As expected players receive more passes from their side by side player than from other players – as well as it can be shown, that the joint time of two players on the pitch increases the number of received passes of a player



- If the opponent team is offensive positioned, the number of received passes is significantly lower; a (slight) relationship between “normal” and defensive positioning can only be found in models 3 and 4.
- Along our proposition we find more passes in direction of opponent’s goal than in the direction of one’s own goal or crossway passes.
- The number of fouls – as an indicator for the interruption time of a game – has no effect on the number of received passes by a player.
- In round of the last sixteen matches, less passes received by each player can be interpreted in the sense that the opponent’s abilities have risen.



- Overall we find only assorted support for our theoretical considerations.
- The control variables like formation of a team, distance between two players on the pitch and joint time are relevant and should not be ignored by comparable analyses.
- There are still remaining duties we want to face in future work:
  - Inclusion of further theoretical approaches, e.g. workings from organizational sociology to working groups
  - Enhancing the adequacy of the operationalization of the theoretical constructs, e.g. better provision for network structure, inclusion of friendship
  - Facing with the problem of unobserved heterogeneity due to the dynamics of the match
  - Investigate the consequences of “Blockbildung” on the team’s performance on the macro level



Thank you for your attention!

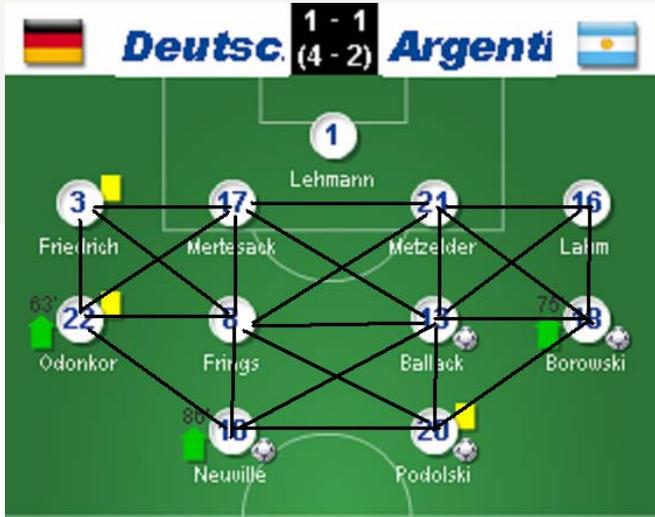


## Backup slides

### 1. Data



- The advantages of this data set:
  - Process-produced data: largely unbiased, reliable and valid.
  - Passing data have a high grade of external validity: very strong and highly significant correlation ( $r = 0.943^{***}$ ) of a random sample ( $n = 207$ ) with data from the book „Fussball-WM 2006“ (Gottschalk 2006).
  - Possibility of the simultaneous control of several relevant variables like the own and the opponent's formation.
- The disadvantages of this data set:
  - Important dynamic processes of a soccer match are not registered.
  - No direct measure for friendship, popularity and ability.



Backup slides

2. Macro level investigation



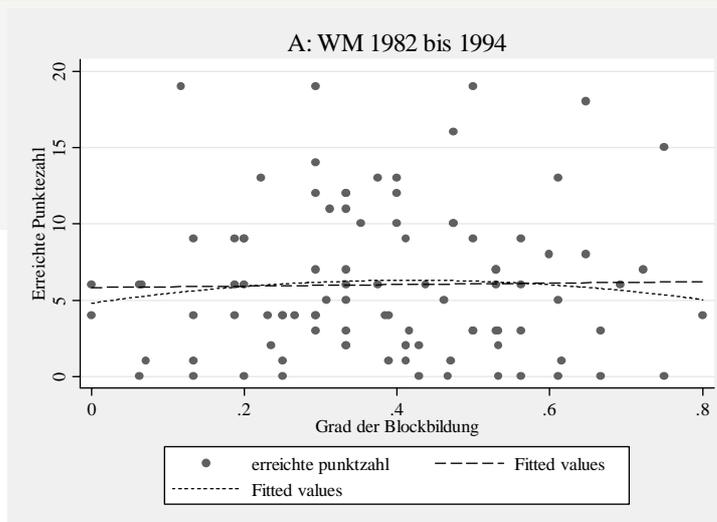
	Degree of block building	Average market value of players in team		Degree of block building	Average market value of players in team
Angola	.179	.866	Niederlande	.365	9.945
Argentinien	.285	10.815	Paraguay	.130	1.347
Australien	.199	3.373	Polen	.158	3.418
Brasilien	.303	20.368	Portugal	.122	10.943
Costa Rica	.391	.637	Saudi-Arabien	.744	.609
Deutschland	.366	8.550	Schweden	.080	5.865
Ecuador	.385	.786	Schweiz	.099	3.683
Elfenbeinküste	.051	5.617	Serbien-Montenegro	.079	5.788
England	.386	19.824	Spanien	.399	14.913
Frankreich	.356	15.056	Südkorea	.183	2.119
Ghana	0	3.215	Togo	0	.957
Iran	.107	1.575	Trinidad und Tobago	.084	.722
Italien	.511	16.675	Tschechien	.081	5.883
Japan	.137	2.116	Tunesien	.077	1.964
Kroatien	.111	5.500	Ukraine	.446	5.159
Mexiko	.365	2.481	USA	.107	1.997

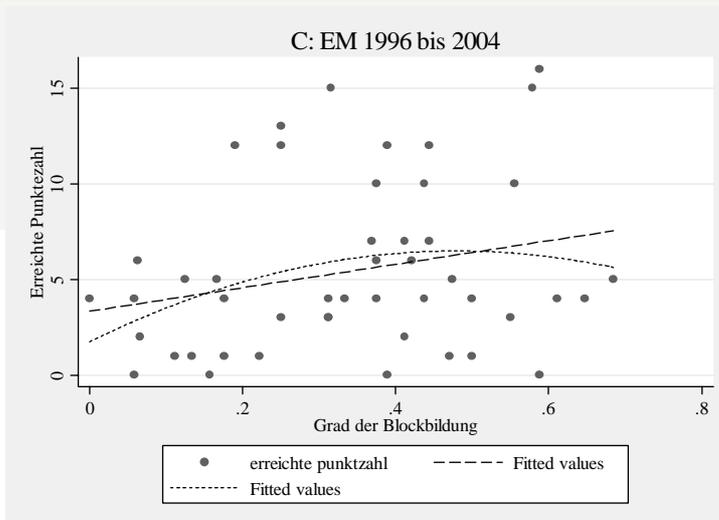
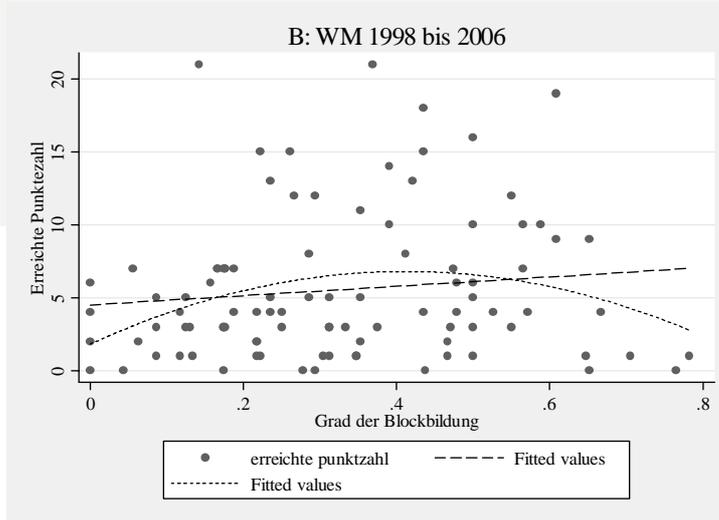


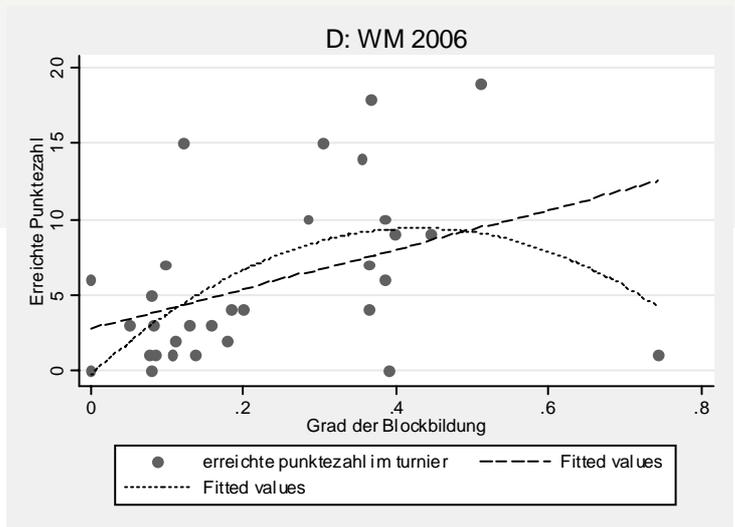
- Bivariate analysis of data on team's success and their degree of "Blockbildung" at the last seven World Cups (n=96 (1982-1994); n=96 (1998-2006)) and the last three European Championships (n=48 (1996-2004)) indicates an inverse u-turned relationship.
- Multivariate regression analysis for the degree of "Blockbildung" and two performance indicators (number of points and final position in the tournament) supports this notion (n=32) (see next page).
- Due to the low number of cases and the macro-level of the data, these results should be interpreted with caution.



Points*Blockbildung	Correlation	R-Quadrat: linear	R-Quadrat: kurvilinear	N
WM 1982 – 1994	0,018	0,0003	0,0052	96
WM 1998 – 2006	0,121	0,0145	0,0675	96
EM 1996 – 2004	0,252	0,0633	0,0867	48







	ln(points)	ln(points)	position	position
Constant	0.141	189.270*	26.887**	-1888.879*
Degree of "Blockbildung"	9.360**	7.478**	-83.507**	-67.465**
Degree of "Blockbildung": sq	-11.925**	-8.344*	106.131**	75.780*
National matches (GK excluded)		-0.023		0.192
Size (GK excluded) in cm		-0.067		0.790
Age (GK excluded)		-13.473*		135.150*
Age (GK excluded): sq		0.255*		-2.565*
Gini-coefficient for market value		1.435		-10.399
ln (market value (GK excluded) in mio. €)		0.565**		-5.698**
ln (market value GK in mio. €)		-0.059		1.093
R-Quadrat	0.325	0.795	0.311	0.787
Adjusted R-Quadrat	0.278	0.711	0.263	0.699
Observations	32	32	32	32

Number of national matches, size, age and market prizes in mean numbers per team. Degree of "Blockbildung" ∈ (0;1). \* p<.05, \*\* p<.01, \*\*\* p<.001



## Backup slides

### 3. Further micro level analyses



- A comparison of the different models regarding their explanation power is difficult, due to the lack of a goodness-of-fit-measure.
- We computed a likelihood ratio test between model 4 and 1 to have at least an approximately comparison of the contribution of the theoretical relevant variables.
- The likelihood ratio test is highly significant and therefore a hint to prefer Model 4 against Model 1.
- We can find also strong support for using multilevel models irrespective the kind of model we use – the appropriate tests are always highly significant and indicate therefore the use of the multilevel model.
- Finally we find support for combing our random effects model with the game dummies as level 3 variables (highly significant likelihood ratio test)



	Model 1	Model 2	Model 3	Model 4
Side by side player	1.927***	1.923***	1.923***	1.887***
Pass in direction of opponent's goal	1.120***	1.118***	1.088**	1.021
Pass in direction of own goal	0.753***	0.754***	0.754***	0.761***
Offensive opponent	0.876***	0.877***	0.876***	0.877***
Defensive opponent	0.986	0.987	0.971	0.973
Number of fouls in game	0.998	0.998	0.998	0.998
Joint time of players	1.014***	1.014***	1.014***	1.014***
Age		1.045	0.999	1.006
Age squared		0.999	1.000	1.000
Market value of player			1.008***	1.007***
Pass receivers position: midfield				1.138***
Pass receivers position: forward				1.130**
Pass receiver is team captain				1.002
Players are team mates				1.054
Observations	7,200	7,200	7,200	7,200
Groups	32	32	32	32

\* p<.05, \*\* p<.01, \*\*\* p<.001



	Model with all games	Model only with first rounds
Side by side player	1.887***	1.852***
Pass in direction of own goal	1.021	1.014
Pass in direction of opponent's goal	0.761***	0.761***
Offensive opponent	0.877***	0.911*
Defensive opponent	0.973	1.010
Number of fouls in game	0.998	0.999
Joint time of players	1.014***	1.015***
Age	1.006	1.026
Age squared	1.000	0.999
Market value of player	1.007***	1.008***
Pass receivers position: midfield	1.138***	1.151***
Pass receivers position: forward	1.130**	1.143**
Pass receiver is team captain	1.002	0.996
Players are team mates	1.054	1.093
Observations	7,200	5,760
Groups	32	32

\* p<.05, \*\* p<.01, \*\*\* p<.001



	Difference between fixed and random effects coefficients
Side by side player	-.0003309
Pass in direction of own goal	.0006275
Pass in direction of opponent's goal	.0010489
Offensive opponent	-.0014127
Defensive opponent	-.0235872
Number of fouls in game	.000197
Joint time of players	.0000216
Age	-.0007255
Age squared	.0000187
Market value of player	-.0007484
Pass receivers position: midfield	.0025433
Pass receivers position: forward	.0056781
Pass receiver is team captain	.0005155
Players are team mates	-.0043323
Second game dummy	.002159
Game in the round of the last 16	-.0172881
Chi <sup>2</sup> (16)	112.84***

\* p<.05, \*\* p<.01, \*\*\* p<.001