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The Effect of Individual Uncertainty on the Specificity of Human Capital: Empirical Evidence from Professional Soccer

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Abstract

This study uses the case of professional soccer to investigate the determinants of human capital (HC) specificity. Inspired by labor market research, we formulate three hypotheses on how uncertainty about the usefulness of individuals' (more productive) specific skills affects their investment in (more flexible) general skills. The empirical analysis is based on unique panel data on school grades, soccer evaluations, and the sociodemographic characteristics of 90 elite players from the youth academy of a German Bundesliga club. We find that senior and long-serving players, who are comparably certain that their (soccer) specific capital will be sufficient to ensure a lucrative professional contract, invest less in general HC at school. Expected soccer performance, in contrast, has a counterintuitive positive effect. Our results expand knowledge on the factors influencing HC specificity from the macro to the subject level and highlight practical implications for institutions that train gifted individuals.

Keywords: Individual uncertainty; human capital; skill specificity; professional soccer; youth academy

JEL classification: J24; I20; D81; D84; L83

1. Introduction

Investment in human capital (HC), which comprises skills, knowledge, and abilities (Schultz, 1961; Becker 1962, 1964), are frequently made under conditions of uncertainty (Levhari & Weiss, 1974) because adolescents have a limited understanding of labor markets and risky lifetime returns to schooling when committing to decisions (Groot & Oosterbeek, 1992). According to Becker (1962, 1964), individuals can invest in either general HC, broadly applicable capital acquired through education, or specific HC, capital accumulated on the job that is more productive but less flexibly reallocated across firms, occupations, or

industries (Becker, 1993). Workers thus face a trade-off in their choice between general and specific HC (Gervais, Livshits, & Meh, 2008), one that is greatly affected by *macro-level* uncertainty. That is, large income variance (Anderberg & Andersson, 2003), high job turnover (Wasmer, 2006), or low unemployment protection (Estevez-Abe, Iversen, & Soskice, 2001) encourage students to remain in school until any ambiguity has resolved itself favorably (Hogan & Walker, 2007) or until their employment prospects have improved (Kodde, 1988). Macro-level uncertainty thus affects the optimal specificity of HC by rendering its utility less predictable while simultaneously augmenting the value of the option to acquire further general HC.

Despite considerable understanding of the effects of macro-level uncertainty, however, the influence of *individual uncertainty* on the specificity of workers' HC has received less attention. In this paper, therefore, we empirically study this relation using unique data from the youth academy of a German professional soccer club. In this institution, elite players aged 11 to 19 simultaneously invest in general (school) and specific (sports) HC (Stratton, Reilly, Williams, & Richardson, 2004), a combination that becomes increasingly difficult as they advance (Jung, Schmidt, & Torgler, 2012). Accordingly, the young players must efficiently split personal efforts between two potential career paths that could determine their future income. Whereas their (soccer) specific HC might yield very high returns, only 5% of the youngsters will sign a professional contract (Schmidt & Weiss, 2010). Investments in general HC, however, as reflected in school grades, promise lower potential short-term revenues but are obviously less risky.

Yet not all athletes are equally insecure about the economic utility of their soccer skills. In our case, all else being equal, senior, long-serving, and high-performing academy players have a better chance of turning professional. We thus examine the effects of particular uncertainty indicators through the lens of HC theory to answer the following

research question: *How does individual uncertainty about the usefulness of specific human capital affect investment in general human capital?* By answering this query, we expect to advance our understanding of the factors that determine skill specificity, especially at the individual level. For this purpose, youth academies provide a well-suited controlled setting in which all actors have relatively homogeneous job profiles and objectives (Jung et al., 2012).

The article proceeds as follows: we begin by theoretically developing two hypotheses about the effects of subject-level uncertainty indicators on investment in general HC. We then describe the sample and method and report the bi- and multivariate results. Finally, we discuss the conclusions and their practical implications, limitations, and directions for future research.

2. Theory and Hypotheses

2.1. The Trade-Off between General and Specific Human Capital

Seminal studies in the human capital literature distinguish between general HC, acquired at school and applicable in numerous contexts, and firm-specific HC, which, being obtained on the job, is only useful at the current firm and has low exchange value for other enterprises (Becker, 1993; Campbell, Coff, & Kryszynski, 2012). This dichotomy is complemented by intermediate forms such as occupation (Kambourov & Manovskii, 2009), industry (Neal, 1995), or skill specific HC (Poletaev & Robinson, 2008), which workers acquire in apprenticeships or vocational schools. The accumulation of HC thus resembles investment in physical or financial capital (Hogan & Walker, 2007): individuals deliberately trade off current costs (e.g., foregone earnings or tuition fees) with future benefits (e.g., promotions or wage increases), risks, and/or returns before deciding how to optimally

augment personal resources (Buchholtz, Ribbens, & Houle, 2003). Specific HC is more productive, can even generate a resource-based competitive advantage for an organization (Lepak & Snell, 1999), and yields higher rents for an employee in times of employment security. On the other hand, general HC can be flexibly redeployed across firms, occupations, or industries ex post at low transaction cost (Gervais et al., 2008). It also places no restrictions on worker mobility in turbulent times because of high exchange value and low co-specialization with idiosyncratic assets (Campbell et al., 2012). In brief, general HC promises lower expected returns but is less risky than specific HC.

This trade-off does, however, create a dilemma in that the decision to acquire either general or specific HC is often binary. That is, according to standard theory, resource constraints render both alternatives mutually exclusive: specific skills represent foregone educational opportunities (Campbell et al., 2012). Even recent studies that model academic attainment as a multistage real option problem are based on similar premises. If the decision to leave school and enter the labor market is irreversible, then investments in general and specific HC are somehow antagonistic (Jacobs, 2007; Bilkic, Gries, & Pilichowski, 2012).

2.2. The Effect of Uncertainty on Investment in General and Specific Human Capital

Although classical HC theory presumes frictionless labor markets and perfectly predictable future income streams with risk left aside (Levhari & Weiss, 1974; Hogan & Walker, 2007), most theoretical HC models include the concept of uncertainty. For example, risk apparently matters in individual schooling choice, not least because the optimal specificity of HC is entirely determined a priori. In addition, because HC is illiquid and (unlike physical or financial capital) inseparable from its owner (Friedman, 1962; Levhari & Weiss, 1974), it is not diversifiable. Moreover, returns to HC must be accumulated over a

very long period (Ben-Porath, 1967), and the resulting idiosyncratic insecurity cannot be insured against (Da Costa & Maestri, 2007). Finally, human beings, rather than being indifferent to the above-mentioned risks, are averse to them (Estevez-Abe et al., 2001).

One consistent finding is that high uncertainty leads to low HC specificity. If individuals receive ambiguous ex ante signals about the future productivity of their specific HC, they will tend to accumulate the more flexibly portable general HC (Gervais et al., 2008). Put differently, "although [general] human capital investment is risky on average, it hedges against labor market risks on the margin" (Jacobs, 2007, p. 914) because education reduces individual exposure to systematic risk (Judd, 1998). Nevertheless, because HC investments are not independent of the aggregate state of labor markets, this phenomenon has predominantly been studied from a public policy perspective (Wasmer, 2006), which has generated three important observations: First, when income profiles in an economy are dispersed and variable, agents collect more general skills. Then, regardless of their risk preferences, students will voluntarily remain in secondary education to wait for the upside of "good draws" or at least until sufficient information is available on returns (Hogan & Walker, 2007; Jacobs, 2007). Second, when job turnover is high, individuals react to insecurity by acquiring general HC, which explains the differences between the U.S. workforce and its more specialized continental European counterpart (Wasmer, 2006). Likewise, macroeconomic vulnerability to turbulence causes workers to shy away from specialization, while frequent shocks that render entire sectors obsolete require high occupational mobility (Bai & Wang, 2003; Lamo, Messina, & Wasmer, 2011). Third, the absence of labor market institutions such as employment protection, unemployment benefits, and employee bargaining power increases uncertainty and stimulates the acquisition of general HC. That is, an individual will only collect risky idiosyncratic skills if returns are adequately insured; for

example, through high firing costs, long cancellation periods, and low wage losses after a layoff (Estevez-Abe et al., 2001; Wasmer, 2006).

2.3. Determinants of Individual Uncertainty for a Youth Academy Player

Whereas high *macroeconomic* insecurity leads to low HC specificity, the equivalent effect of *individual* uncertainty remains to be studied. We thus investigate this relation using three subject-level uncertainty determinants that are likely to influence a youth academy player's investment in general HC: seniority, length of service, and expected performance. These determinants are discussed in more detail below, together with the corresponding hypotheses derived from practical observation and prior empirical findings.

Seniority or length of service. All else being equal, senior players or long-serving academy players can afford to be less insecure about the usefulness of their soccer specific capital because they have fewer annual selection cycles left to survive and are closer to signing a professional Bundesliga contract (Jung et al., 2012). Not only have 94% of their peers aged 12 to 17 already been eliminated out of the national scouting system (Deutscher Fußball-Bund [DFB], 2010a), but having been promoted in many prior up-or-out cycles is a signal of quality and distinction from new entrants who are still in their "trial periods." Hence, whereas the club's Under 12 squad plays on the district level, its Under 17 and Under 19 squads participate in the federal championship, are highly competitive, and act as a link between the youth and the professional environment (Relvas, Richardson, Gilbourne, & Littlewood, 2009). Superstars also tend to be scouted relatively early and thus acquire tenure in their club's youth teams. For example, whereas 52% of the German national players and 45% of the Bundesliga stars had already joined an academy before age 14 (DFB, 2010a), only 7% of the typical Under 19 squad had done so. Moreover, as Carmichael (1983) shows,

contracts involving seniority rights – such as promotion ladders that attach high wages to senior ranks – make older workers reluctant to leave and thereby induce the acquisition of firm-specific HC. The accumulation of such skill over time is also stimulated by time-dependent up-or-out contracts with provisions to fire workers after a probationary period (Kahn & Huberman, 1988). Accordingly, we formulate the following hypothesis:

Hypothesis 1: The more senior a player or the longer his service to the academy, the less he invests in general HC.

Expected performance. Individuals with a high expected future performance can, all else being equal, be less uncertain about the utility of their soccer specific HC. In the academy, coaches assign a global rating to the soccer players' performance, which is otherwise hard to quantify (Christensen, 2009). With every additional point on the 10-point Likert scale (from 1 = *very low performance* to 10 = *very high performance*), the probability of being promoted after 1 and 2 years increases significantly (marginal effects of +.042 and +.075, respectively). Given previous considerations, we thus expect implicit lower uncertainty to foster the collection of further specific HC at the expense of general HC:

Hypothesis 2: The higher a player's expected performance, the less he invests in general HC.

3. Data and Methods

3.1. Participants

We investigate the effect of individual uncertainty on HC specificity by studying 90 male players aged between 11 and 19 from the youth academy of a German professional soccer club. All 36 clubs from the first and second Bundesliga must operate an academy

according to regularly audited standards (DFB, 2010b; Van Hoecke et al., 2011). These institutions train Germany's best players, contribute to the country's current success in soccer, and comprise the Under 12, 13, 14, 15, 16, 17, 19, and 23 squads (Deutsche Fußball Liga, 2010).

The participants are evaluated on both soccer and school work semiannually on almost the same date, meaning that each observation covers one half-year. We analyze three years of data ranging from the 2010/11 until the 2012/13 season, during which 274 players were observed across 973 half-years. Not all records were complete, however: 341 lacked a soccer performance rating because, for example, an athlete was injured or had only recently joined the academy, and 448 were for subjects who had already left school or had not provided a school report. Once such cases were excluded, the final sample consisted of 184 observations for 90 individuals, 19% of whom were not German citizens.

3.2. Procedure

A young player receives two types of assessments during the parallel appraisal process at the end of a half year: expected future soccer performance, evaluated on a 10-point Likert scale and then discussed in a feedback session and archived on the club's Intranet, and school performance, judged on up to 15 grades from advanced, intermediate, or basic classes[1] during the previous semester. After the second half-year, in July, the school decides whether to move students up to the next class level and the academy decides whether to promote players to the next age group or ask them to leave. Because coaches do not "move up" with player cohorts, athletes generally acquire a new supervisor when the next season starts,

[1]German secondary education starts in grade 5 and encompasses three types of general schools: advanced schools (Gymnasien), which qualify students for university entrance after grade 13, and intermediate (Realschulen) and basic schools (Hauptschulen), which prepare them for further studies or apprenticeships after grades 10 or 9, respectively (Hamburger Abkommen, 1971).

except in the Under 19 and Under 23 squads, which span two or more years. Because of personnel turnover, 15 coaches headed the 8 teams between 2010/11 and 2012/13.

3.3. Measures

The dependent variable in all our multivariate models is general HC. The regressors are measures for the three hypothesized uncertainty determinants and soccer/academy specific controls. Table 1 reports the summary statistics for all the variables, which are discussed separately below.

--- Insert Table 1 about here ---

3.3.1. Dependent variable

General human capital. In line with Miller's (1998) argument that high school grades are a valid signal of general HC because teacher idiosyncrasies, subjectivity, and varying difficulties average out over time, general HC is operationalized as an individual's *Grade Point Average* (GPA). Miller also shows that grades positively correlate with long-term wages, which are themselves the result of an individual's HC stock (cf. Becker, 1964; Mincer, 1974). She even demonstrates through a path analysis that the direct impact of grades on labor market earnings is three times larger than that of years of schooling (Miller, 1998). Hence, compared to more classical temporal measures such as educational level, grades offer greater advantages in the approximation of general HC. To derive our measure, we compute GPAs with all school subjects weighed equally and then standardize them on the 15-point scale commonly employed in German upper secondary education, which ranges from 0 (very

poor/fail) to 15 points (very good). Figure 1 illustrates the distribution of the dependent variable.

--- Insert Figure 1 about here ---

3.3.2. Key independent variables

Seniority. Seniority is represented by a subject's *Age* in years, because age indicates which team a player belongs to, which in turn determines how many selection cycles he must still survive.

Length of service. An athlete's length of service is represented in months by the variable *Club Tenure*, which differs from age in that youngsters enter the academy at different ages. Nevertheless, both regressors are positively correlated.

Expected performance. A player's expected performance is measured by his lagged *Soccer Potential Evaluation*, as provided by his coach after the previous semester and rated on a scale from 1 (very low) to 10 (very high). Past evaluations of soccer potential (period t-1) are also assumed to have an impact on current grades (period t). To counteract different interpretations of the scale, all evaluations are standardized into coach specific z-scores. We use a lagged variable because a player's investment in general HC during the current period is a reaction to the previous assessment of his specific HC.

Control variables. We also include several controls related to soccer and the academy that might additionally influence a player's GPA. The first, *Relative Age*, is the day of a calendar year that corresponds to a subject's birthday and thus lies between 1 and 365. Previous research shows that individuals born shortly after a cutoff date perform better in, for instance, sports (Musch & Grondin, 2001), school (Bedard & Dhuey, 2006), and business (Du, Gao, & Levi, 2012). The second is a dichotomous variable *Foreign*, which equals 1 for

non-German citizens. It thus captures whether, as other authors suggest, individuals' origins affect the evaluations they receive (Kraiger & Ford, 1985). The third is a dummy for *Living at Home,* which equals 1 if a youngster resides with his family and 0 if he lives alone, at the academy boarding school, or with guest parents. We assume that place of residence might impact GPA because parental involvement benefits educational outcomes (Hoover-Dempsey & Sandler, 1995). The fourth, *Distance to Academy,* measures the number of minutes required to commute one way from a player's home to the academy by car, with the 39-minute average representing time that a student could have invested in learning or other activities. The fifth, *Second HY,* represents observations from the second half-year of a season and is meant to isolate potential effects of the decision to promote the individual in school or soccer, which coincide at that time. Anecdotal evidence, for instance, suggests that certain coaches assign more generous grades to prevent a protégé from being dismissed.

3.4. Methods

We empirically test the theoretical predictions in three steps. First, we conduct a bivariate analysis and calculate pairwise correlations, which provide a tentative impression of the relation between dependent and independent variables. Second, we perform several fixed effects regressions to control for unobserved heterogeneity and differences in abilities that would otherwise be barely detectable. Third, we investigate the robustness of our results by testing an alternative dependent variable specification, restricting the regressions to a relatively homogeneous subsample of students in advanced school, repeating the analysis with random effects, and re-estimating the fixed effects models for different categories of school subjects. All results display robust standard errors to minimize heteroscedasticity bias.

4. Results

4.1. Bivariate Results

The bivariate relations between general human capital and the three uncertainty indicators for a youth academy player are explored with pairwise correlations. As Table 2 shows, the results support the Hypothesis 1 assumption that senior and long-serving players who are relatively certain about the usefulness of their soccer-specific skills invest less in general HC: *Grade Point Average* is negatively correlated with both *Age* (-.29; p = .000) and *Club Tenure* (-.24; p = .001). The outcomes do not, however, support the negative relation assumed in Hypothesis 2 between expected performance and general HC: *Grade Point Average* and *Soccer Potential Evaluation(t-1)* are in fact positively connected (+.13; p = .082). In addition, several regressors are highly correlated – for example, *Age* covaries with *Club Tenure* (+.46; p = .000) and *Living at Home* (-.50; p = .000) – while *Grade Point Average* shows interesting interdependencies with such control variables as *Foreign* (-.25; p = .001) and *Living at Home* (+.29; p = .000).

Whereas Figure 2 gives more detail on how GPA is related to age, tenure, and soccer potential, the contour plot in Figure 3 takes a closer look at the relation between GPA and age or club tenure. According to this figure, which displays the z-dimension of GPA scores in colors, lower levels of age and club tenure are related with higher GPA scores, which prompts us to explore age and club tenure sequentially in subsequent specifications. Figure 4 then plots the relation between GPA, soccer potential, and age, revealing that players in the youngest and oldest category who rate well on their soccer performance evaluation also

generate higher GPA scores. Once club tenure is included in Figure 5, however, the results are more mixed.

--- Insert Table 2 about here ---

--- Insert Figures 2, 3, 4, and 5 about here ---

4.2. Multivariate Results

In a second step, we estimate several fixed effects regressions to quantify the effect of individual uncertainty on HC specificity. The results, displayed in Table 3, are consistent with the Hypothesis 1 argument that senior athletes invest less in general HC: *Age* has a negative coefficient of -.622 (p = .006), which further decreases to -.649 (p = .002) in Model 3 once a player's *Soccer Potential Evaluation(t-1)* is taken into account. Hypothesis 1 also predicts a negative impact of service length on general HC that cannot be rejected. In Models 2 and 4, *Club Tenure* is also significantly negative (-.064; p = .001 and -.069; p = .000, respectively). We find no support, however, for Hypothesis 2, which proposes a negative effect of expected performance on general HC. Rather, the value of *Soccer Potential Evaluation(t-1)* is in fact positive once we control for seniority (+.228; p = .048) and length of service (+.236; p = .042), which confirms our bivariate results.

--- Insert Table 3 about here ---

4.3. Robustness Analyses

We conduct four types of analyses to verify the robustness of our results. First, we experiment with an alternative specification of the dependent variable by computing a GPA

that double weights the major subjects German and math. The outcome barely changes: only the significance of *Age* (p = .012), *Club Tenure* (p = .002), and *Soccer Potential Evaluation(t-1)* (p = .052) decreases slightly in Models 5 and 6. Next, we restrict the investigation to students in advanced school. Yet again, the independent variable coefficients remain largely unaffected, with only *Soccer Potential Evaluation(t-1)* (+.164; p = .248) dropping below 10% significance. This finding also applies to the third robustness test, a re-estimation using random effects and additional control variables such as *Foreign* (-1.245; p = .003) or *Living at Home* (+.953; p = .003). The complete results are presented in Table 4.

--- *Insert Table 4 about here* ---

Finally, we re-run the fixed effects regressions, this time using a student's GPA in languages (Models 1–4), social sciences (Models 5–8), or natural sciences[2] (Models 9–12) as the dependent variable. Although the key regressors maintain their signs in all equations, the effects of *Age* and *Club Tenure* increase successively for languages (-.368, p = .200; -.037, p = .110), social sciences (-.516, p = .072; -.052, p = .042), and then natural sciences (-.683, p = .021; -.071; p = 006). This observation is not readily interpretable. Several studies have found positive effects of study time (Keith, 1982; Schuman, Walsh, Olson, & Etheridge, 1985), motivational regulation (Wolters, 1999), out-of-school homework (Keith, Diamond-Hallam, & Fine, 2004), or effort management (Schwinger, Steinmayr, & Spinath, 2009) on high school GPAs *in general*. Moreover, numerous researchers have compared the *overall* academic performance of intercollegiate athletes and regular students (e.g., Aries, McCarthy, Salovey, & Banaji, 2004; Maloney & McCormick, 1993; Robst & Keil, 2000). However, to the best of our knowledge, no such investigation has yet been conducted *stratified by school subject category*. A potential interpretation of the above mentioned result is that earning

[2]The division of school subjects into languages (German, English, French, Spanish, Latin), social sciences (history, politics, economics, geography, religion, ethics), and natural sciences (mathematics, biology, chemistry, physics, information technology) is common in German secondary education (see OAVO, 2013).

higher grades in social and natural sciences might require more effort than in languages, which are more stable and less dependent on the level of preparatory effort. The *Soccer Potential Evaluation(t-1)* coefficient is only significant when *Social Sciences Grade Point Average* is the dependent variable (Table 5).

--- *Insert Table 5 about here* ---

5. Discussion

In the empirical investigation, we adopt the lens of sporting achievement to explore whether insecurity about the value of individual specific skills affects investment in general HC. We conclude that uncertainty, as reflected by the three indicators, does indeed matter. For example, the Hypothesis 1 claim that senior players acquire less general HC because of relative certainty about the productivity of their soccer specific capital is congruent with the significantly negative influence of *Age* on *Grade Point Average* (standardized beta -1.099), which is stronger than the effect of *Club Tenure* (standardized beta -.715). This result extends Jung et al.'s (2012) finding that senior athletes report a higher willingness to quit school for a soccer career which, as our results suggest, translates into a lower GPA. Hypothesis 1 also posits that youngsters with long academy tenure invest less in general HC, an assumption matched by the negative *Club Tenure* values, which exert less impact than *Age*. One potential reason is that although academy tenure is a powerful signal of distinction, many gifted "late bloomers" from regional bases of the national soccer association join an academy rather late (DFB, 2010a). Moreover, as Jung et al. (2012) point out, "the more selection cycles players have 'survived,' the greater their awareness […] that they might not be good enough" (p. 6). Hence, the promising signal of long tenure is apparently compensated to some extent by the

fact that long-serving players judge experiences collected over time in the academy more cautiously, which increases their risk aversion and acceptance of a secure school career.

As regards Hypothesis 2, which proposes that high soccer performance expectations lead to low investment in general HC, empirically, we observe a counterintuitive positive (albeit mostly insignificant) influence of *Soccer Potential Evaluation(t-1)* on *Grade Point Average*. It seems that, especially when the academy's time demands are still manageable in younger age groups, sports do not substantially impede the effort allocated to learning. Thus, better soccer players might achieve higher GPAs because of superior self-regulatory skills (Jonker, Elferink-Gemser, & Visscher, 2010).

Nevertheless, the grades of the academy athletes overall (M_{GPA} = 8.69), particularly of those not attending advanced school (M_{GPA} = 8.34), are significantly lower than those of regular German students (M_{GPA} = 9.68, see Figure 1), with the GPA of the average player located in the 39th percentile of the entire country's distribution. This placement might raise concerns if the results were attributable to self-selection – good students could voluntarily leave the academy to preserve their academic performance, whereas bad students could stay. However, as only a small percentage (around 9%) of young players willingly quit during the three-year period, this explanation appears unlikely.

5.1. Practical Implications

In addition to advancing HC theory, our results highlight several practical implications. Most important, institutions that train gifted individuals in specializations such as sports, music, or the arts should also facilitate investment in general HC by their protégés. Otherwise, promising talents may neglect school to pursue their dreams even when a professional soccer career is improbable. In the case of the academy, two control variables

reveal potentially helpful measures, which some clubs have already implemented. First, *Living at Home* positively affects school grades (+.953; p = .003 in Model 4) because parental involvement benefits educational outcomes. Hence, club sponsorship of a commuter bus that enables youngsters to reside at home even when their parents cannot take them to the academy is a very positive step. Second, the negative effect of *Distance to Academy* on *Grade Point Average* (-.024; p = .084 in Model 7) underscores the fact that time on the road reduces time available for schoolwork (among other activities). Hence, the onsite learning facilities already provided by many academies are a good way to avoid multiple daily commutes (European Club Association, 2012).

5.2. Limitations and Future Directions

Although this paper contributes positively to the HC literature by examining the effects of individual uncertainty on HC specificity, it does suffer from certain limitations, which nevertheless also point to useful avenues for future research. First, because soccer skills are in principle transferable to any professional club, this investigation focuses only on insecurity about the usefulness of *occupation* specific HC (Kambourov & Manovskii, 2009). Future research should thus broaden this approach to test whether uncertainty about *firm* idiosyncratic capital affects HC specificity equivalently. Second, because the sample consists only of adolescent, male, competitive, and mostly German soccer players, the results' validity across age groups, genders, or races cannot be guaranteed. Including a higher number and diversity of subjects, therefore, would help determine whether our findings arise from soccer specific peculiarities. Third, the weakly pronounced longitudinal structure of the data set barely permits measurement of the long-term influence of uncertainty on investment in general HC, suggesting that further studies should extend the observation period to more than

three years. Fourth, as a measure of general HC, high school grades are not only subjective (Miller, 1998) but reflect cognitive ability, personality traits, and work drive, in addition to the conscious decision to invest in HC (Lounsbury, Sundstrom, Loveland, & Gibson, 2003). It would thus be interesting to use classical temporal proxies for general HC (e.g., years of schooling) to determine whether more gifted soccer talents attain higher academic qualifications in the long run.

6. Conclusions

The results of this analysis of the school grades, soccer evaluations, and sociodemographic characteristics of elite players from the youth academy of a German Bundesliga club are consistent with predictions from the labor market literature about the effect of insecurity on HC specificity. That is, once individuals are relatively certain about the usefulness of their (soccer) specific skills, then all else being equal, they reduce investment in more flexible but less productive general HC. In our case, senior and long-serving players, with better prospects for earning a living from professional soccer, have lower GPAs in school, implying that, at least in higher age groups where a Bundesliga career becomes realistic, high-performing athletes are worse students.

These findings contribute to HC theory by advancing our understanding of the factors that influence skill specificity. In particular, this paper extends knowledge about the effects of uncertainty from the macro to the subject level. Specifically, using the academy example, we sketch practical conditions that facilitate the formation of general HC, such as stable coach-player relationships, parental support, or integrated learning facilities. Further studies might profitably extend our work by testing for the equivalent effects of firm specific HC,

augmenting the sample size and diversity, and collecting panel data to strengthen the validity and generalizability of our results.

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Table 1

Descriptive Summary Statistics for the Study Variables

Variable	*Mean*	*Median*	*SD*	*Min*	*Max*
Dependent variable					
Grade Point Average	8.687	8.805	1.655	4.250	11.900
Independent variables					
Age	14.469	14.485	1.826	11.150	18.730
Club Tenure	27.842	27	16.000	8	75
Soccer Potential Evaluation(t-1)	.244	.500	.781	-2.630	2.070
Control variables					
Relative Age	134.196	106	99.522	3	362
Foreign[a]	.190	0	.394	0	1
Living at Home[a]	.777	1	.417	0	1
Distance to Academy	38.734	39	17.935	2	98
Second HY[a]	.522	1	.501	0	1

[a]Dummy variable (1 = foreigner/ living at home/ observation from 2nd half-year).

Table 2

Correlations Between Variables

		1	2	3	4	5	6	7	8
Dependent variables									
1	*Grade Point Average*								
Independent variables									
2	*Age*	**-.29**							
3	*Club Tenure*	**-.24**	**.46**						
4	*Soccer Potential Evaluation(t-1)*	.13	**-.18**	-.03					
Control variables									
5	*Relative Age*	.03	**-.28**	.02	**.16**				
6	*Foreign*[a]	**-.25**	.08	-.09	.13	.03			
7	*Living at Home*[a]	**.29**	**-.50**	**-.15**	-.02	-.03	-.07		
8	*Distance to Academy*	-.04	**-.15**	.08	-.06	.06	**-.22**	.14	
9	*Second HY*[a]	.03	**.14**	.02	.07	-.03	.02	-.09	-.03

Note. Bold correlations are significant at the $p < .05$ level.
[a]Dummy variable (1 = foreigner/ living at home/ observation from 2nd half-year).

Table 3

Effects of Individual Uncertainty Indicators on General Human Capital (fixed effects)

Variable	All players						Adv. school	
	GPA				GPA alternative		GPA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	-.622**		-.649**		-.559*		-.890**	
	.219		**.208**		**.218**		**.268**	
	-2.84		*-3.12*		*-2.56*		*-3.31*	
Club Tenure		-.064**		-.069***		-.060**		-.101***
		.018		**.018**		**.019**		**.018**
		-3.47		*-3.76*		*-3.19*		*-5.79*
Soccer Potential Evaluation(t-1)			.228*	.236*	.231†	.241†	.164	.142
			.114	**.114**	**.122**	**.122**	**.140**	**.136**
			2.00	*2.07*	*1.90*	*1.97*	*1.17*	*1.04*
Constant	17.687	10.467	18.024	10.472	16.376	9.954	21.391	11.534
Adjusted R^2	.754	.773	.759	.779	.764	.782	.805	.865
Observations	184	184	184	184	184	184	87	87
Groups	90	90	90	90	90	90	44	44

Note. Unstandardized regression coefficient in normal font; robust standard error in bold; *t*-value in italics.
† < .1. * < .05. ** < .01. *** < .001.

Table 4

Effects of Individual Uncertainty Indicators on General Human Capital (random effects)

Variable	All players						Adv. school	
	GPA				GPA alternative		GPA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	-.299***		-.284**		-.247*		-.393*	
	.081		**.097**		**.100**		**.164**	
	-3.71		*-2.91*		*-2.46*		*-2.40*	
Club Tenure		-.034***		-.033***		-.030***		-.059***
		.009		**.008**		**.009**		**.011**
		-3.64		*-3.90*		*-3.48*		*-5.16*
Soccer Potential Evaluation(t-1)	.164	.188†	.150	.182	.167	.195	.066	.075
	.109	**.110**	**.115**	**.112**	**.122**	**.119**	**.134**	**.116**
	1.51	*1.71*	*1.31*	*1.62*	*.137*	*1.63*	*.49*	*.64*
Relative Age			-.001	.000	-.001	.000	.000	.004*
			.002	**.002**	**.002**	**.002**	**.002**	**.002**
			-.62	*.14*	*-.60*	*.01*	*.11*	*1.97*
Foreign[a]			-1.080*	-1.245**	-1.158*	-1.309**	-1.689**	-1.75***
			.443	**.425**	**.472**	**.454**	**.601**	**.488**
			-2.44	*-2.93*	*-2.46*	*-2.88*	*-2.81*	*-3.58*
Living at Home[a]			.399	.953**	.470	.951**	.969	1.832**
			.410	**.317**	**.428**	**.339**	**.802**	**.581**
			.97	*3.01*	*1.10*	*2.80*	*1.21*	*3.15*
Distance to Academy			-.011	-.008	-.012	-.009	-.024†	-.022†
			.007	**.007**	**.008**	**.007**	**.014**	**.013**
			-1.57	*-1.20*	*-1.54*	*-1.24*	*-1.72*	*-1.68*
Second HY[a]			.383**	.345**	.331*	.296*	.723***	.657***
			.121	**.115**	**.130**	**.124**	**.149**	**.120**
			3.16	*3.01*	*2.55*	*2.39*	*4.85*	*5.48*
Constant	13.007	9.536	13.013	9.107	12.151	8.805	14.389	8.999
Adjusted R^2	.759	.779	.776	.795	.775	.790	.869	.912
Observations	184	184	184	184	184	184	87	87
Groups	90	90	90	90	90	90	44	44

Note. Unstandardized regression coefficient in normal font. Robust standard error in bold. *t*-value in italics.
[a]Dummy variable (1 = foreigner/ living at home/ observation from 2nd half-year).
† < .1. * < .05. ** < .01. *** < .001.

Table 5

Effects of Individual Uncertainty Indicators on General Human Capital (fixed effects | by subject category)

Variable	GPA languages				GPA social sciences				GPA natural sciences				GPA best category				GPA worst category			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Age	-.368		-.373		-.516†		-.562*		-.683*		-.702*		-.561*		-.583*		-.285		-.323	
	.285		**.287**		**.283**		**.269**		**.291**		**.283**		**.266**		**.255**		**.247**		**.241**	
	-1.29		*-1.30*		*-1.82*		*-2.09*		*-2.35*		*-2.48*		*-2.11*		*-2.29*		*-1.16*		*-1.34*	
Club Tenure		-.037		-.038		-.052*		-.056*		-.071**		-.072**		-.057*		-.059*		-.035†		-.038†
		.023		**.023**		**.025**		**.024**		**.025**		**.024**		**.024**		**.023**		**.021**		**.021**
		-1.61		*-1.62*		*-2.06*		*-2.31*		*-2.84*		*-2.97*		*-2.44*		*-2.62*		*-1.68*		*-1.86*
Soccer Potential Evaluation(t-1)			.039	.044			.384*	.390*			.202	.209			.191	.199			.313†	.322*
			.183	**.184**			**.172**	**.173**			**.186**	**.184**			**.138**	**.138**			**.159**	**.159**
			.22	*.24*			*2.23*	*2.26*			*1.09*	*1.14*			*1.38*	*1.43*			*1.97*	*2.02*
Constant	13.17	8.89	13.23	8.89	16.12	10.11	16.69	10.12	17.79	9.87	18.01	9.86	17.36	10.85	17.65	10.85	11.18	8.03	11.64	8.03
Adjusted R^2	.693	.697	.690	.694	.671	.680	.683	.692	.731	.745	.733	.747	.733	.744	.735	.746	.685	.691	.693	.700
Observations	184	184	184	184	184	184	184	184	184	184	184	184	184	184	184	184	184	184	184	184
Groups	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90

Note. Unstandardized regression coefficient in normal font; robust standard error in bold; *t*-value in italics.
† < .1. * < .05. ** < .01. *** < .001.

Youth academy										
%	3.7	10.1	16.0	17.9	17.5	19.4	10.8	4.1	0.4	0.0
Cumulative %	3.7	13.8	29.9	47.8	65.3	84.7	95.5	99.6	100.0	100.0
Germany (in comparison)										
%	1.0	4.4	13.3	14.6	15.9	15.4	12.6	11.1	8.7	3.1
Cumulative %	1.0	5.4	18.8	33.4	49.3	64.7	77.3	88.3	97.0	100.0

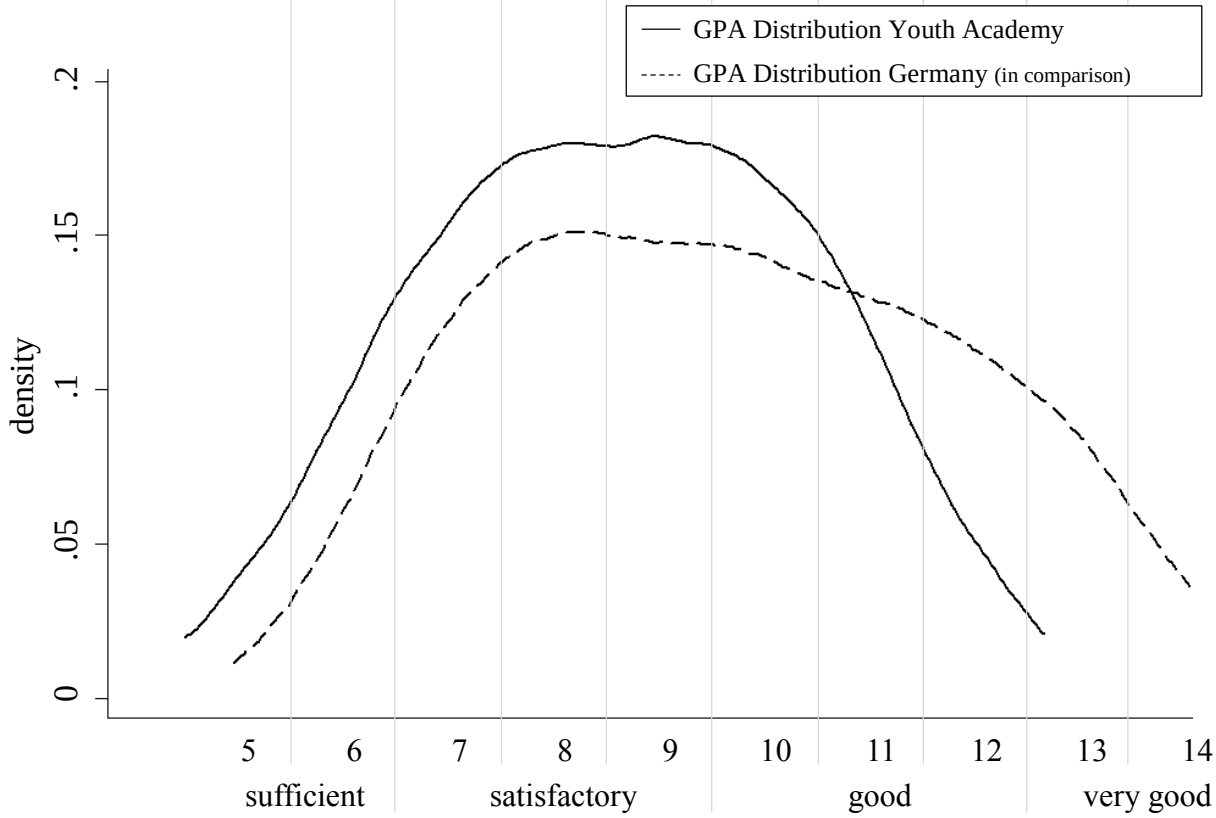

Figure 1. Distribution of *Grade Point Average* (density kernel: Epanechnikov). GPAs are displayed on a 15-point Likert scale commonly used in German upper secondary education: 15–13 points = very good; 12–10 points = good; 9–7 points = satisfactory; 6–4 points sufficient; 3–1 points = poor (fail); 0 points = very poor (fail). GPAs at the upper (e.g., 12 points) and lower (e.g., 10 points) boundaries of a category indicate a positive or negative distinction, respectively.

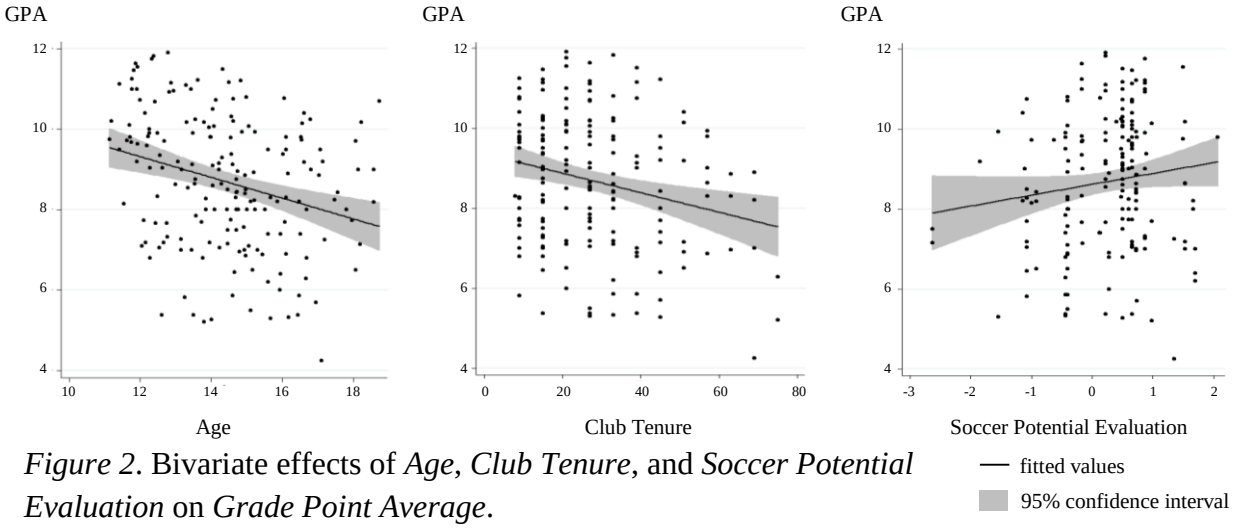

Figure 2. Bivariate effects of *Age*, *Club Tenure*, and *Soccer Potential Evaluation* on *Grade Point Average*.

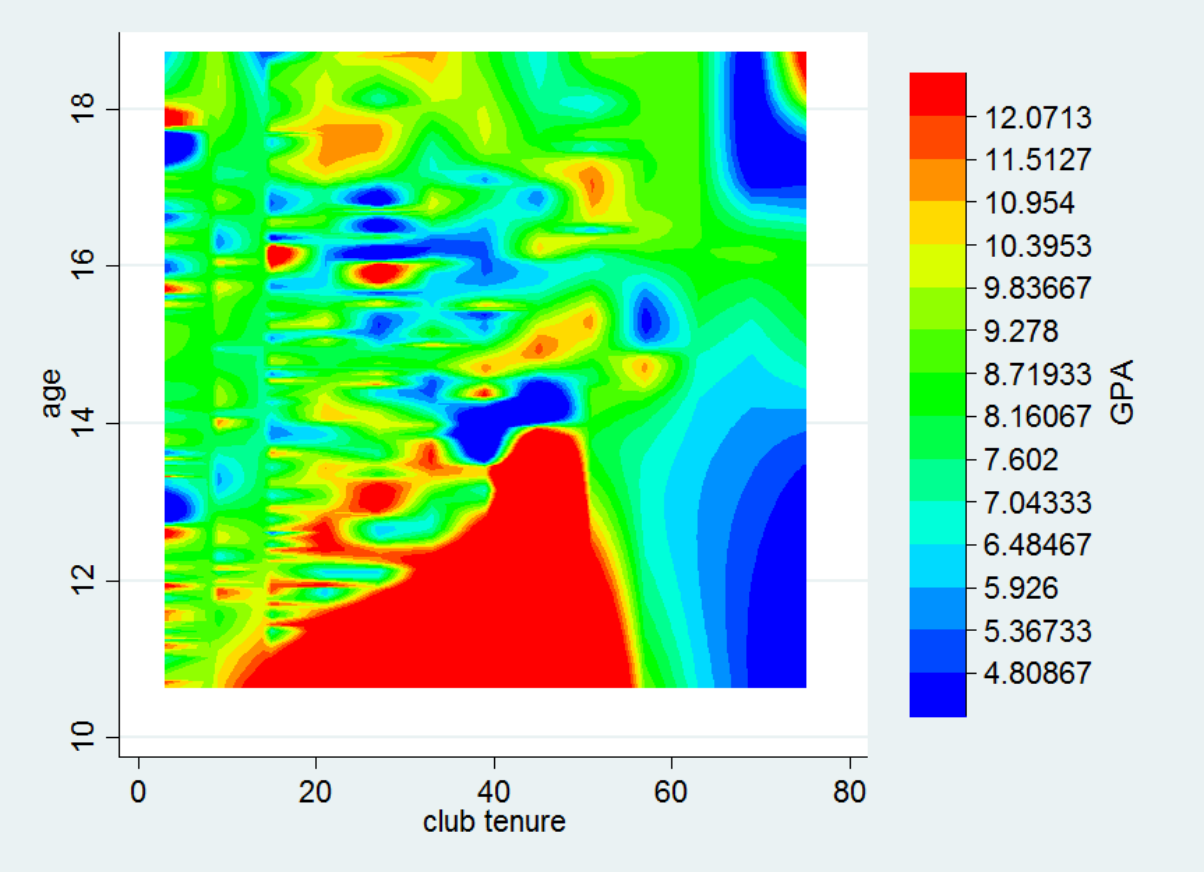

Figure 3: Contour plot of the relation between *Age*, *Club Tenure*, and GPA scores.

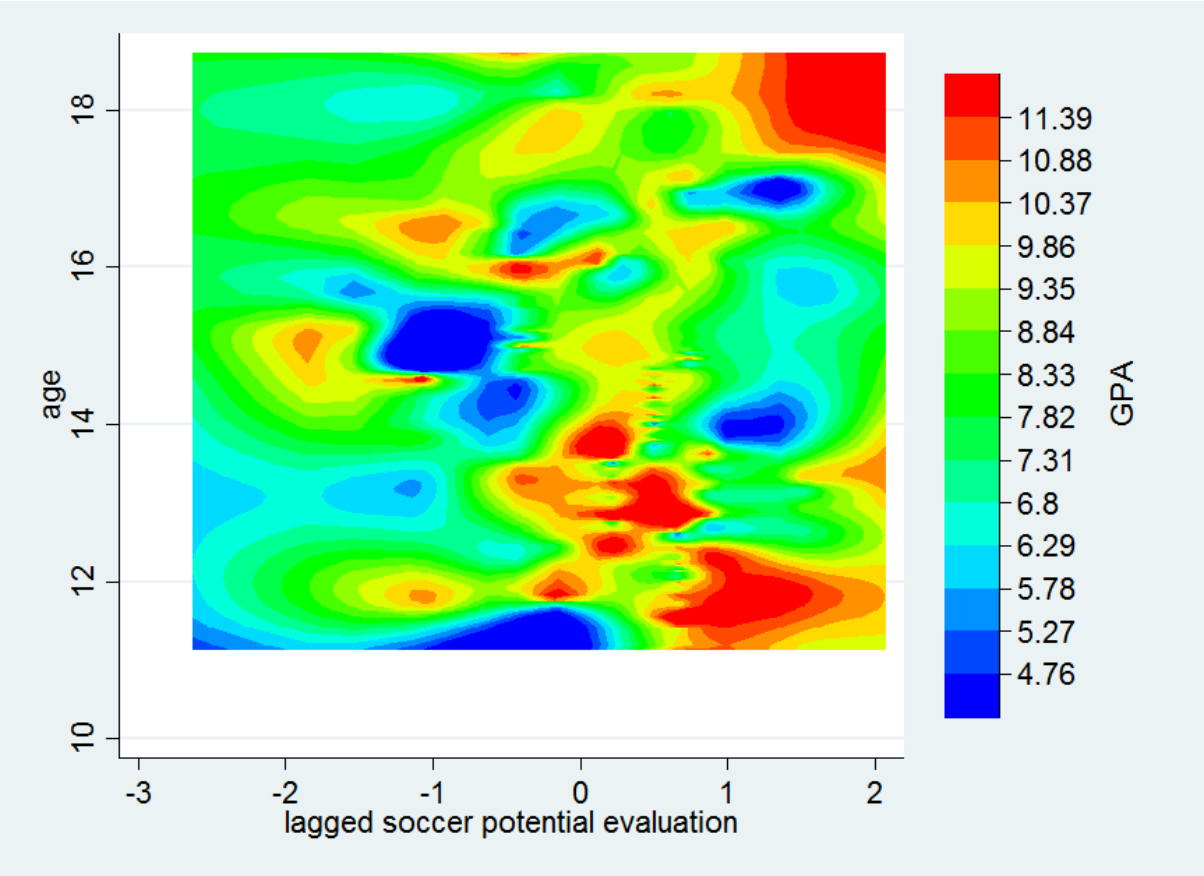

Figure 4. Relation between *Age*, *Soccer Potential Evaluation*, and GPA scores.

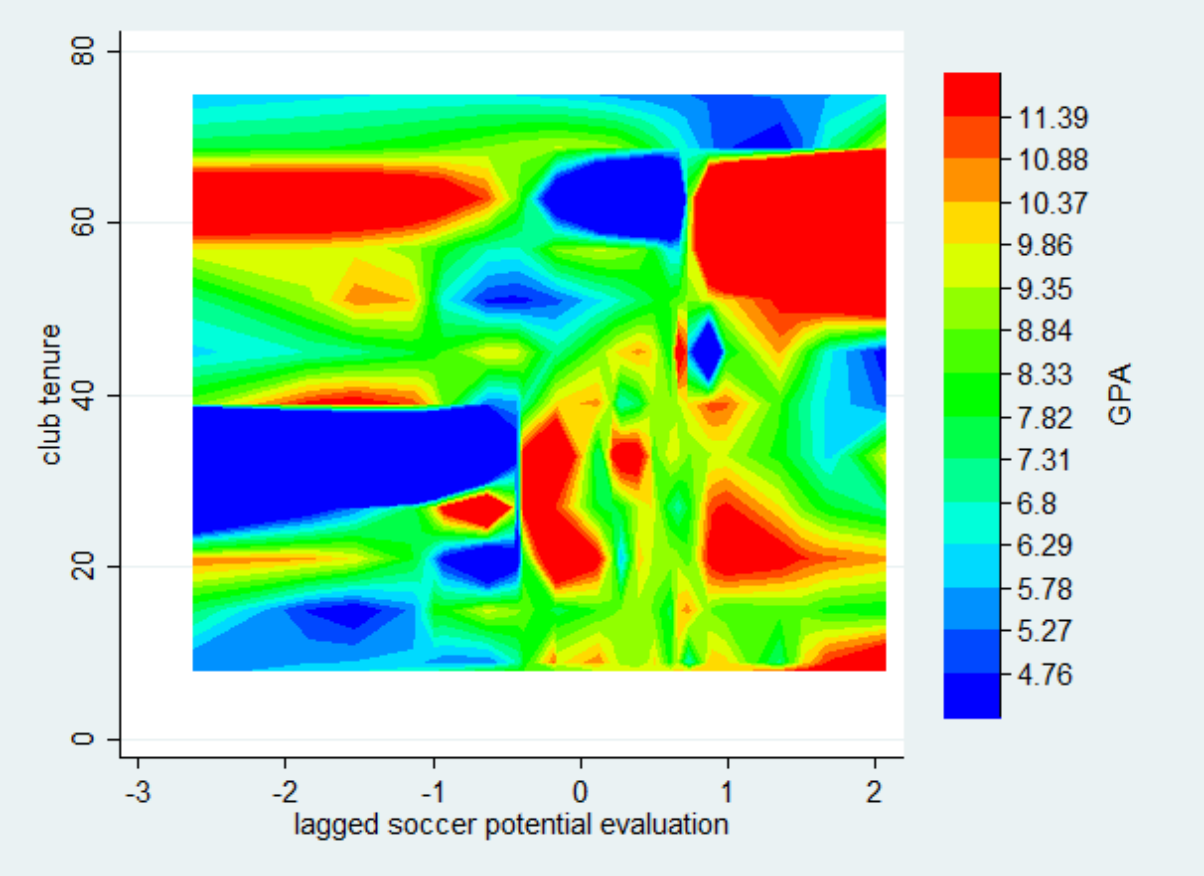

Figure 5. Relation between *Club Tenure*, *Soccer Potential Evaluation*, and GPA scores.