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Knowledge Growth, Academic Beliefs and Motivation of Students in Business and Economics - A longitudinal German Case Study

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Abstract

In this study we examine the determinants of and the relationship among economic knowledge, epistemological beliefs, and extrinsic and intrinsic motivation over the course of undergraduate studies in a sample of students of business and economics at a university in Germany. We found economic knowledge increased over the course of studies, extrinsic and intrinsic motivation declined, and students became more skeptical in their epistemological beliefs about the objectivity of economic content being taught in their courses. The students' level of economic knowledge was related to intrinsic motivation but unrelated to extrinsic motivation and epistemological beliefs. Furthermore, the students' tendency to become more skeptical over the course of their studies was mitigated by high levels of extrinsic motivation. The use of internationally established assessments such as the Test of Economic Literacy, developed by the Council of Economics Education, enables implications for higher education business and economics programs at the international level to be drawn from our findings.

Keywords: development of knowledge, economic education, economic knowledge, epistemological beliefs, extrinsic and intrinsic motivation; longitudinal study

1. Introduction

Although the content and structure of economics curricula appear to have reached a high level of uniformity in many countries (Yamaoka, Walstad, Watts, Asano, & Abe, 2010), relatively little is known about how undergraduate economics students change over the course of their studies. In a number of studies, determinants have been investigated of how economics students' perform in end-of-term examinations (e.g., Ballard & Johnson, 2004; Buckridge & Guest, 2007; Arnold & Straten, 2012; Da Wan & Cheo, 2012) and in standardized tests of economic knowledge (e.g., Gill & Gratton-Lavoie, 2011; Hwang, 2013; Denny, 2014; Happ, Förster, Zlatkin-Troitschanskaia & Carstensen, 2016a). However, relatively little seems to be known about how students' understanding of economics develops over the course of their studies and what the determinants of this development are. Apart from finding a limited number of studies which explore the pre- and post-course measurements of economic knowledge (e.g., Schuhmann, McGoldrick, & Burrus, 2005; Walstad & Rebeck, 2008), we were only able to find one article that focuses on the development of economic knowledge over the course of studies (Allgood & Walstad, 1999), and that was based on a sample of merely 127 students of economics.

Little is known about how students of economics change in other ways over the course of their studies, for example when it comes to their motivation to learn and their beliefs about economics. Understanding the motivation and beliefs of economics students has recently gained importance in research as the curriculum and structure of economics study programs have been subject to criticism since the financial crisis in 2008 (e.g., Shiller, 2010; Blinder, 2010; Abito et al., 2011). Critics claim that the typical undergraduate curriculum for economics is too theoretical and insufficiently connected to real-world economic problems, which is believed to be a factor that demotivates students. With regard to epistemological beliefs, little is known about whether students perceive economics as a 'hard' science such as physics or a 'soft' science such as sociology or whether, over the course of their studies, they become more confident in or grow disillusioned about what economics can reveal about society.

In this paper we investigate how, at a university in Germany, the economic knowledge, epistemological beliefs, and extrinsic and intrinsic motivation of undergraduate students of business and economics change over the course of their studies. We identify determinants of both the *initial* levels of these variables and their levels *over the course* of studies. A distinguishing feature of our study is its longitudinal design rather than the cross-sectional analysis at a specific point in time. Another feature is the multidimensional approach taken, meaning we explicitly consider possible cross-relations between the initial levels and the rates at which the variables that are being investigated change. Another aspect that makes our results interesting is the fact that in our data we observe students in the pre-Bologna "Diplom" degree system as well as students in the post-Bologna bachelor degree system in Germany (the latter with a shorter study duration and a more condensed curriculum) (Adelman, 2009; Happ & Zlatkin-Troitschanskaia, 2014). We therefore offer tentative evidence on the differences between students in the former (Diplom) and students in the new (bachelor) study programs.

Our study adds to the literature in at least three areas of research. First, it adds to the literature on the determinants of how undergraduate students perform in examinations and standardized tests of economic knowledge (see references above). We provide evidence on the relationship between personal characteristics such as gender, age, general cognitive ability, and prior knowledge of economics acquired before entering higher education and performance on standardized economics tests, hereby offering a longitudinal perspective. Second of all, our study adds to the literature on epistemological beliefs, in particular certainty beliefs (e.g., Hofer, 2000; Rodriguez & Cano, 2006; Trautwein & Lüdtke, 2007), of which little is related to the subject of economics and, to our knowledge, nothing to the change in epistemological beliefs over the course of economics study programs. Finally, our study adds to the substantial amount of literature on the importance of motivation for study performance (e.g., Bruinsma, 2003; Schiefele, Streblow, Ermgassen, & Moschner, 2003; Boekaerts, van Nuland, & Martens, 2010; Kusurkar, Ten Cate, Vos, Westers, & Croiset, 2012; Arnold & Straten, 2012). In line with Arnold and Straten (2012), we distinguish between extrinsic and intrinsic motivation (see also Ryan & Deci, 2000), and we expand knowledge on this topic by providing a longitudinal perspective on the growth of motivation.

2. Study Design

For this study we conducted a longitudinal survey of undergraduate students of business and economics at a university in Germany as part of the ILLEV project. (Note 1) In this project three samples of students were drawn at the beginning of winter terms 2009/10, 2010/11, and 2011/12 (for more information on the survey, see Happ, Zlatkin-Troitschanskaia, Beck & Förster, 2016c). Participants were drawn from several business and economics courses with large numbers of students in order to maximize the likelihood of participants being part of subsequent samples and reassessed at a later stage in their studies. The sample sizes of the three assessment waves were 658 (2009/10), 1045 (2010/11), and 1005 (2011/12) students. During each wave, students from various semesters were assessed to ensure a sufficient amount of variation to study change in the variables over the course of studies (see Table 6 in the Appendix). Overall, we examined data on 2112 undergraduate students of business and economics. The students completed a questionnaire on their economic knowledge, motivation, and epistemological beliefs, and they supplied some socio-demographic data. Students generated individual codes to allow us to trace individuals anonymously across the three samples. As a consequence of the sampling design, the three samples formed an unbalanced panel (Hox, 2011; see Table 7 in the Appendix). As the focus of our analysis was on students' development of economic knowledge and their change in motivation and epistemological beliefs over the first couple of semesters of a business and economics program, students who were in the initial semesters of their studies were overrepresented in our survey. Table 1 provides some statistics of the variables of interest. The main variables of our analysis were measures of economic knowledge, epistemological beliefs, and motivation.

Table 1. Summary of Statistics

	M	*SD*	Min	Max
Knowledge indicator	11.71	3.14	0	19
Epistemological beliefs[a]	3.28	.696	1	6
Extrinsic motivation[b]	5.16	.690	1	6
Intrinsic motivation[b]	4.46	.853	1	6
Semester	3.95	2.56	1	10
Age	22.52	2.70	17	59
Female	.518	.499	0	1
Non-native speaker of German	.153	.360	0	1
Subject not first choice	.316	.465	0	1
Location not first choice	.326	.469	0	1
Before economics other studies	.201	.401	0	1
Mathematics as a major subject in high school	.365	.481	0	1
Economics as a major subject in high school	.276	.447	0	1
German as a major subject in high school	.325	.468	0	1
Completed vocational training	.265	.441	0	1
Commercial vocational training	.207	.405	0	1
WT 2009/10	.242	.428	0	1
WT 2010/11	.385	.486	0	1
WT 2011/12	.371	.483	0	1
High school GPA[c]	2.33	.492	1	4
Diplom degree course	.145	.352	0	1
Business and economics education	.207	.405	0	1
Attended a commercially specialized high school	.036	.188	0	1
From Baden-Württemberg	.050	.219	0	1
From Hesse	.363	.481	0	1
From Rhineland-Palatinate	.397	.489	0	1
Verbal intelligence	11.01	2.89	0	19

Notes. [a] Higher values indicate a lower belief in objectivity. [b] Higher values indicate higher motivation.
[c] 1=Very good, 2=good, 3=satisfactory, 4=sufficient

The indicator of students' economic knowledge was their sum score on a subset of 19 items of a German adaptation of the Test of Economic Literacy (TEL) (Soper & Walstad, 1987; adapted for use in Germany by Beck & Krumm, 2001). These 19 items covered issues from the areas of microeconomics, and macroeconomics (Note 3; for more details, see Happ et al., 2016c) and assessed students' understanding of basic economic concepts such as price and opportunity cost (Collett-Schmitt, Guest, & Davies, 2015, p. 115). Therefore, responses to the items were considered suitable for analyzing students' development of economic knowledge over the initial semesters of their undergraduate studies (Beck & Krumm, 2001, p. 3). (Note 4) Our measure of epistemological beliefs was the average score on five questions about the objectivity of economic knowledge to which students responded on a Likert scale ranging from 1 to 6 (the items were adapted for our purposes from Schiefele & Moschner, 2002). Our indicator of extrinsic motivation was the students' average score on four questions about whether they were studying business and economics to have a successful career (also adapted from Schiefele, Moschner, & Husstegge, 2002). Finally, our indicator of intrinsic motivation was students' average score on four questions about whether they were studying business and economics because they were interested in the content of their studies (adapted from Schiefele, Krapp, Wild, & Winteler, 1993). (Note 5) The background variables we examined are listed in Table 1. In addition to the students' current semester, age, and gender, we gathered information on whether the student was a native or non-native speaker of German, whether the subject of studies and the university were their first choice, and whether they had studied another subject before studying economics. We also collected information on whether or not the student had taken mathematics, economics, or German as a major subject in high school, whether they had attended a commercially specialized high school (in German "Wirtschaftsgymnasium"), and whether they had completed vocational training, in particular, commercial vocational training, prior to their studies. We controlled for general cognitive ability using students' high school grade point average (GPA) and for verbal intelligence using a test with 20 questions on verbal analogies (Liepmann, Beauducel, Brocke, & Amthauer, 2007).

Our study was conducted during a transition period from the former system of Diplom degrees to the new system of bachelor degrees (Adelman, 2009; Happ & Zlatkin-Troitschanskaia, 2014; Happ, Kuhn & Zlatkin-Troitschanskaia, 2016b) which was introduced in Germany as a result of the Bologna process (see European Higher Education Area, 1999). In our survey, we observed students in Diplom degree courses (for approximately nine semesters) and students in Bachelor of Science degree courses (for six semesters). The latter group constituted the vast majority of our sample and therefore served as the reference group. We also distinguished between students of business and economics (reference group) and students of business and economics education (i.e., pre-service teachers of economics and business administration). The two degree programs differ in specialization but have very similar curricula during the first four semesters. We controlled for potential effects where the student had attended high school in Germany because there are slight differences in how high school education is organized among the federal states in Germany (Hesse; Rhineland-Palatinate and Baden-Württemberg in Table 1).

3. Methods

Our goal was to investigate students' development of economic knowledge, change in epistemological beliefs, and extrinsic and intrinsic motivation over the initial semesters of an undergraduate program of business and economics. Our interest lay in measuring whether and to what extent their knowledge of basic economics principles developed and whether and how their epistemological beliefs and motivation changed over the course of their undergraduate studies.

The data set in our study has a longitudinal structure. Some students participated in the study once, twice or three times. In order to evaluate this longitudinal data set, statistical models that measure change are needed (for literature on growth curve modeling, see Grimm, Ram, & Estabrook (2017) and Panik (2014)). In view of the unbalanced data set of this study (Luke, 2004, p. 63), multilevel models for a longitudinal data set are especially suitable (Hox 2011; Raudenbush & Bryk 2002). Regarding the multilevel analyses, we had various options to measure time (for example, measurement points, study semesters). In our study, we based the modeling on the number of completed semesters as a measure of time.

We also measured the heterogeneity in both the *initial level* and the *rates of change over semesters* of these variables. We determined how the absolute initial level of economic knowledge as well as its rate of development varied with gender, cognitive ability, and other sociodemographic variables. For example, we tested whether high-ability students gained economic knowledge faster than low-ability students. Furthermore, we measured how much heterogeneity in both the *initial level* and the *rates of change* remained after we controlled for the individual characteristics. Finally, we examined the interrelations between the development of economic knowledge and changes in epistemological beliefs and in motivation. We considered the following multivariate heterogeneous growth curve model:

$$kn_{it} = \left(x_{it}\gamma_0^{kn} + u_{i0}^{kn}\right) + \left(x_{it}\gamma_1 + u_{i1}^{kn}\right)semester_{it} + \left(x_{it}\gamma_2 + u_{i2}^{kn}\right)semester_{it}^2 + v_{it}^{kn} \quad (1)$$

$$ep_{it} = \left(x_{it}\gamma_0^{ep} + u_{i0}^{ep}\right) + \left(x_{it}\gamma_1 + u_{i1}^{ep}\right)semester_{it} + \left(x_{it}\gamma_2 + u_{i2}^{ep}\right)semester_{it}^2 + v_{it}^{ep} \quad (2)$$

$$ex_{it} = \left(x_{it}\gamma_0^{ex} + u_{i0}^{ex}\right) + \left(x_{it}\gamma_1 + u_{i1}^{ex}\right)semester_{it} + \left(x_{it}\gamma_2 + u_{i2}^{ex}\right)semester_{it}^2 + v_{it}^{ex} \quad (3)$$

$$in_{it} = \left(x_{it}\gamma_0^{in} + u_{i0}^{in}\right) + \left(x_{it}\gamma_1 + u_{i1}^{in}\right)semester_{it} + \left(x_{it}\gamma_2 + u_{i2}^{in}\right)semester_{it}^2 + v_{it}^{in} \quad (4)$$

In these equations, kn_{it}, ep_{it}, ex_{it} and in_{it} denote the level of economic knowledge, epistemological beliefs, and the levels of extrinsic and intrinsic motivation of student i in wave t. The vector x_{it} represents the sociodemographic variables shown in Table 1. The variables $u_{i0}^j, u_{i1}^j, u_{i2}^j, j \in \{kn, ep, ex, in\}$ are person-specific time-invariant effects with standard deviations $\sigma_{u0}^j, \sigma_{u1}^j, \sigma_{u2}^j$.

The change of kn_{it}, ep_{it}, ex_{it} and in_{it} over the course of studies was modeled as a (potentially) quadratic trend starting at an intercept $\left(x_{it}\gamma_0^j + u_{i0}^j\right), j \in \{kn, ep, ex, in\}$. We centered the semesters of study at zero so that $\left(x_{it}\gamma_0^j + u_{i0}^j\right), j \in \{kn, ep, ex, in\}$ represented the general initial levels of knowledge, epistemological beliefs, and extrinsic and intrinsic motivation at the beginning of studies, and the coefficients $\left(x_{it}\gamma_1^j + u_{i1}^j\right), \left(x_{it}\gamma_2^j + u_{i2}^j\right)\ j \in \{kn, ep, ex, in\}$ described their rate of development over the course of studies (Enders & Tofighi, 2007). In this way, the model allowed us to examine individuals' development and the rates of their development of knowledge, epistemological beliefs, and extrinsic and intrinsic motivation depending on observed individual characteristics x_{it} and unobserved characteristics $u_{i0}^j, u_{i1}^j, u_{i2}^j, j \in \{kn, ep, ex, in\}$. (Note 6)

To investigate cross effects among the four variables, we included the levels of economic knowledge, epistemological beliefs, and extrinsic and intrinsic motivation as direct covariates in the equations where they were not the dependent variable. For example, we included motivation as a potential determinant of the initial level or rate of development of economic knowledge, or we included economic knowledge as a potential

determinant of the initial level or rate of change of epistemological beliefs. We did not aim to identify causal effects in this way, which is impossible without imposing sufficient exclusion restrictions; rather, we considered this an informative way to measure partial correlations among the variables.

4. Results

4.1 Growth of Economic Knowledge

The basic structure of the study program under consideration was similar to comparable undergraduate programs offered in many countries (Yamaoka et al., 2010). During the first two years of study (i.e., the initial four semesters), students attended basic introductory courses in economics (Introduction to Economics, Microeconomics, Macroeconomics, Empirical Economics) and in methods (Mathematics, Statistics, Econometric Methods). From the third year on, students specialized in particular subjects such as Economic Policy, Public Economics, International Economics, Finance and Accounting, Management, or Marketing. The Diplom programs and Bachelor of Science programs had the same general structure over the first three years (approximately 80% of the students assessed were in their initial three years of studies); however, the bachelor program had a more condensed curriculum than the Diplom program and bachelor students were expected to graduate after completing six rather than nine semesters. During their first two years of studies, students of business and economics education attended selected courses from the above curriculum, but they also attended courses on teaching methods and on the subjects they wanted to teach (e.g., languages or social sciences).

Figure 1 displays the average development of economic knowledge over the course of studies and illustrates that economic knowledge increased and did so most rapidly at the beginning of studies. We also observed a concave growth pattern, suggesting that our quadratic growth model was adequate. (Note 7) The leveling off of knowledge acquisition after six semesters might have been due to our choice of indicator of knowledge, which measured basic economic understanding only and therefore might have been less suitable to measure the development of the more refined knowledge acquired towards the end of undergraduate studies (for a German test instruments to assess more in-depth economic knowledge, see Zlatkin-Troitschanskaia, Förster, Brückner & Happ, 2014). (Note 8)

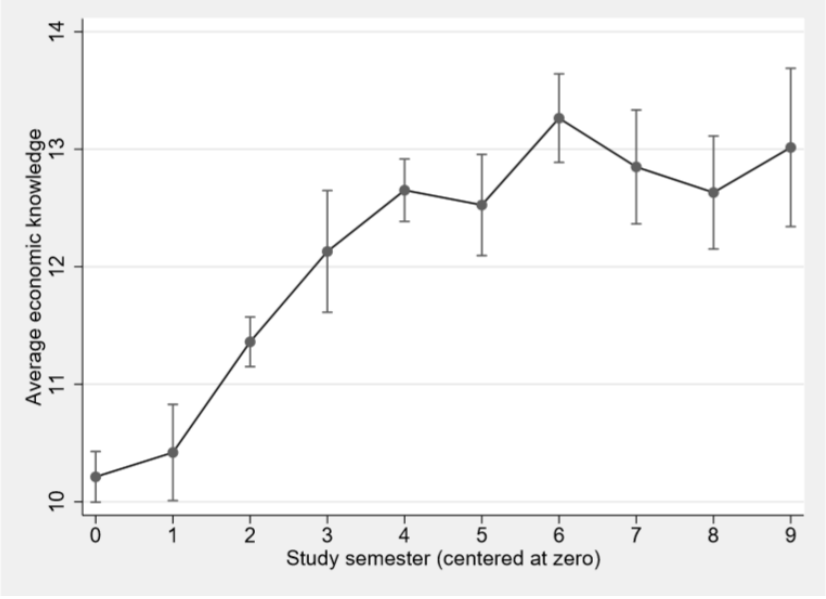

Figure 1. Development of economic knowledge over the study semesters (lines represent the 95% error bars confidence intervals)

Table 2 shows our regression estimates for the indicator of economic knowledge as the dependent variable. Column 1 shows the estimates before, and column 2 after, epistemological beliefs and extrinsic and intrinsic motivation were included as covariates of the initial level and rate of development of economic knowledge. We observed a highly significant quadratic pattern of development over the course of studies. In addition, students' average initial level of economic knowledge showed statistically significant positive correlations with taking economics as a major subject at high school, completing vocational training, being in the Diplom system, and

having a high score in verbal intelligence. It also showed significant negative correlations with being female, being a non-native speaker of German, having preferred to study at another university, and having had a high GPA (Note 9) at high school in Germany (see Table 1). Overall, these results were consistent with findings from cross-sectional studies on the determinants of performance on end-of-term examinations or on knowledge tests (e.g., Ballard & Johnson, 2004; Fann & Tsai, 2010; Gill & Gratton-Lavoie, 2011; Arnold & Straten, 2012). We did not find a significant relationship between the initial level of economic knowledge and age, degree course (i.e., economics and business education or economics), or attendance at a commercial high school (Note 10).

Table 2. Development of economic knowledge

	(1)		(2)	
Semester	.899***	(.077)	.963***	(.075)
Semester squared	-.061***	(.010)	-.071***	(.010)
Age	.032	(.027)	.047	(.029)
Female	-1.040***	(.113)	-1.043***	(.113)
Non-native speaker of German	-.785***	(.166)	-.911***	(.171)
Subject not first choice	-.130	(.126)	-.033	(.125)
Location not first choice	-.274**	(.114)	-.205*	(.113)
Economics as a major subject in high school	.772***	(.211)	.627***	(.208)
Commercial vocational training	.698***	(.156)	.738***	(.156)
WT 2010/11	-.741***	(.147)	-.463***	(.147)
WT 2011/12	-.442***	(.155)	-.348**	(.155)
High school GPA	-.645***	(.117)	-.691***	(.119)
Diplom degree course	2.754**	(1.362)	3.074**	(1.326)
Business and economics education	-.239	(.153)	-.352**	(.153)
Attended a commercially specialized high school	.466	(.321)	.500	(.320)
Verbal intelligence	.285***	(.020)	.258***	(.020)
Epistemological beliefs			.175	(.139)
Extrinsic motivation			.063	(.138)
Intrinsic motivation			.352***	(.114)
Semester interacted:				
Economics as a major subject in high school	-.454***	(.126)	-.411***	(.122)
Diplom degree course	-.907**	(.434)	-1.075**	(.424)
Epistemological beliefs[a]			-.040	(.085)
Extrinsic motivation[a]			.105	(.087)
Intrinsic motivation[a]			-.038	(.070)
Semester squared interacted:				
Economics as a major subject in high school	.049***	(.015)	.044***	(.014)
Diplom degree course	.058*	(.034)	.075**	(.034)
Epistemological beliefs[a]			.003	(.010)
Extrinsic motivation[a]			-.020*	(.011)
Intrinsic motivation[a]			.004	(.008)
Constant	8.804***	(.670)	6.286***	(1.221)
$\hat{\sigma}_{u0}$	1.56		1.612	
$\hat{\sigma}_{u1}$	5.604e-08		1.83e-04	
$\hat{\sigma}_{u2}$	9.695e-08		.004	
No. of obs.		2525		2332
No. of individuals		1938		1811

Notes. Semester centered at zero. Standard errors in parentheses. *** / ** / * statistically significant at 1% / 5% / 10%-level. [a] Recentered at sample average.

Next, we examined the relationships between the rate of development of economic knowledge and the observed variables. We analyzed interactions of both semester and semester squared with all possible covariates listed in Table 1. In our final specification, shown in Table 2, we included only interactions that were jointly significant with a p-value of at least 10%. Only two variables were correlated to the rate of development of economic knowledge: a major in economics at high school and enrollment in the Diplom system. In both cases, the rate of development of economic knowledge was significantly lower. Interpreted together with the results at the initial level of economic knowledge, this means that students who had taken economics as a major subject in high school had a higher initial level of economic knowledge but experienced a smaller increase in knowledge during their studies. This result sheds new light on existing findings about the retention of economic content knowledge acquired at high school (e.g., Gill & Gratton-Lavoie, 2011 and the references cited there). The slower rate of development of Diplom students' economic knowledge might be related to the longer and less condensed Diplom curriculum, although we cannot rule out that the composition of our subsample of Diplom students differed in unobservable ways from the subsample of bachelor students. However, we controlled for cognitive ability and other differences between the two groups. An interesting finding illustrated in Table 2 is that there was no evidence of heterogeneity in the speed of knowledge acquisition among other observed characteristics such as cognitive ability (see also Happ et al., 2016c). Students with a higher score on verbal intelligence and better high school GPAs had a higher initial level of economic knowledge, but the same rate of development of economic knowledge over the course of their studies as students with lower abilities.

Given that there was little heterogeneity in the development of economic knowledge among the observed characteristics (see also Happ et al., 2016c), we analyzed how growth trajectories would vary when we controlled for all observed characteristics. The estimates for the standard deviations σ_{u1}, σ_{u2} of the unobserved components in the rates of development were close to zero. This means there was no evidence of much additional heterogeneity in developmental patterns. However, we did find some unobserved heterogeneity σ_{u0} in the initial levels of economic knowledge. Variance in students' initial level of economic knowledge that could not be explained by the observed variables amounted to approximately 1.6 correct answers (of 19 test items).

In column 2 of Table 2, estimates are presented for epistemological beliefs and extrinsic and intrinsic motivation included as regressors for the initial level and rate of development of economic knowledge. As indicated above, we did not intend to infer causal effects in this way because the initial level and rate of development of economic knowledge was likely to be jointly determined with extrinsic and intrinsic motivation and epistemological beliefs. For example, it was evident that the initial level of economic knowledge would be influenced by students' motivation, but it was also reasonable to assume that a high initial level or fast rate of development of economic knowledge could enhance students' motivation. We found that neither epistemological beliefs nor extrinsic motivation was significantly correlated to the initial level or rate of development of economic knowledge (coefficients were not statistically significant). In contrast, a higher level of intrinsic motivation was correlated to a higher initial level of economic knowledge but not to a faster development of knowledge. The former result was also found by Arnold and Straten (2012). Taking into account the results for the other covariates, we thus confirmed the finding by Arnold and Straten (2012) that intrinsic motivation can compensate somewhat for a lack of other determinants of performance such as cognitive ability or knowledge of mathematics.

4.2 Change in Epistemological Beliefs

We examined how students' epistemological beliefs about business and economics changed over the course of a business and economics undergraduate program because they can influence learning success (Rodriguez & Cano, 2006). In addition, they shed light on the image a typical undergraduate business and economics program conveys of economics as a science. We were interested in analyzing the extent to which students believed in the objectivity of the information they were taught. Our indicator of epistemological beliefs was constructed in a way that low values represented the belief that economic information taught was highly objective, and high values represented the belief that it was rather subjective (see test items on epistemological beliefs in Table 8 in the Appendix).

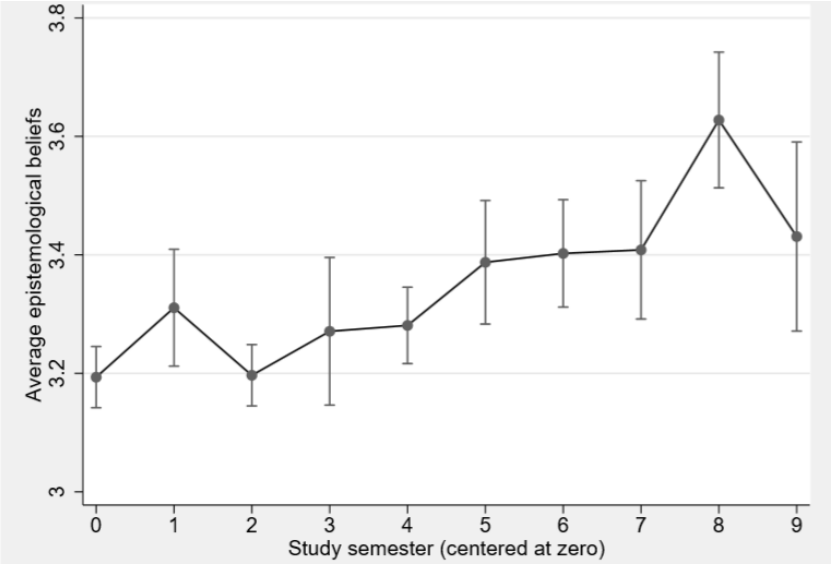

Figure 2. Development of epistemological beliefs over study semesters (lines represent the 95% error bars confidence intervals)

Figure 2 shows the average change in epistemological beliefs about the objectivity of economic knowledge over the course of studies. Our results indicated that, on average, students are neither very confident nor very skeptical at the beginning of their studies, but tend to become more skeptical of the objectivity of economic knowledge over the course of their studies. Beliefs declining in certainty also have been found for other disciplines (e.g., Jehng, Johnson, & Anderson, 1993). The observed pattern was almost linear; therefore, we used a linear growth model (quadratic terms were not significant in our estimates) as follows.

Table 3. Development of Epistemological Beliefs

	(1)		(2)	
Semester	.027***	(.008)	.016**	(.008)
Age	.011	(.007)	.009	(.007)
Female	.007	(.031)	.005	(.031)
Non-native speaker of German	-.112**	(.045)	-.060	(.046)
Location not first choice	.056*	(.030)	.045	(.030)
WT 2010/11	.092**	(.033)	.055	(.033)
WT 2011/12	.013	(.036)	.007	(.036)
High school GPA	-.028	(.047)	-.032	(.047)
Diplom degree course	.125**	(.058)	.115**	(.058)
Verbal intelligence	.018***	(.005)	.016***	(.005)
Economic knowledge			.005	(.007)
Extrinsic motivation			-.075**	(.030)
Intrinsic motivation			-.098***	(.025)
Semester interacted:				
High school GPA[a]	-.025**	(.010)	-.022**	(.010)
Economic knowledge[a]			-.000	(.001)
Extrinsic motivation[a]			-.015*	(.007)
Intrinsic motivation[a]			-.001	(.006)
Constant	2.746***	(.188)	3.643***	(.276)
$\hat{\sigma}_{u0}$	.449		.434	
$\hat{\sigma}_{u1}$	.035		.034	
No. of obs.		2423		2332
No. of individuals		1865		1811

Notes. Semester centered at zero. Standard errors in parentheses. *** / ** / * statistically significant at 1% / 5% / 10%-level. [a] Recentered at sample average.

The regression results for our model with epistemological beliefs as the dependent variable are given in Table 3. Again, column 1 shows the results before the other three dimensions knowledge, extrinsic motivation, and intrinsic motivation were included as covariates. Our analyses showed that epistemological beliefs were only weakly correlated to the observed variables, except for a highly significant linear change in beliefs over the course of studies. We found that students who were non-native speakers of German tended to believe significantly more in the objectivity of the content taught in their economics courses. In contrast, Diplom students and students with a high level of verbal intelligence tended to have a more skeptical view of the objectivity of content taught in their economics courses. A positive relationship between ability measures and greater skepticism in epistemological beliefs also has been observed for other subjects (e.g., Hofer, 2000).

High school GPA was the only variable among our standard covariates that interacted significantly with the linear change in our indicator of epistemological beliefs. Interaction effects were centered at sample averages; therefore, the main effect of study progress in semesters (.027 in column 1 of Table 3) represented the average rate of change in our indicator of epistemological beliefs of a student with an average high school GPA. We observed a statistically significant negative interaction effect of -.025, meaning that individuals with a GPA of one grade point above the sample average (low-ability individuals) did not exhibit an upward trend in this indicator, because the main effect was offset by the interaction effect. In contrast, individuals with a GPA of one grade point below the sample average (high-ability individuals) tended to become more skeptical over the course of their studies about the objectivity of the economic content being taught. We thus found another relationship between beliefs and cognitive ability: Low-ability students did not show a decline in certainty in their beliefs about the objectivity of economic content being taught in their courses whereas high-ability students exhibited a great decline in their certainty. We also measured variance among unobserved characteristics of the change in epistemological beliefs. This variance was of sizable magnitude ($\hat{\sigma}_{u1}$ =.035) compared to the magnitude of the linear trend. This means that the upward trend in the average change in epistemological beliefs in our sample masked a lot of individual heterogeneity.

In column 2 of Table 3 we added the indicators economic knowledge, extrinsic motivation, and intrinsic motivation as observed covariates of epistemological beliefs. We found a statistically significant correlation between students' initial epistemological beliefs and motivation. Individuals who reported high levels of motivation tended to have more trust in the objectivity of the economic content being taught in their courses. An explanation might be that motivated individuals generally are more 'optimistic' (and vice versa). Interestingly, we found no statistically significant relationship between epistemological beliefs and economic knowledge. As to the change over time, we identified a (weakly) statistically significant relationship between the rate of change in beliefs and extrinsic motivation but not between economic knowledge and intrinsic motivation. This means that individuals with high levels of extrinsic motivation were to a certain extent shielded against the general increase in skepticism over the course of their studies.

4.3 Growth of Extrinsic Motivation

Motivational factors are important because they may impact students' study strategies (Schiefele et al., 2003; Kusurkar et al., 2012) and their study success (Bruinsma, 2003; Boekaerts et al., 2010; Arnold & Straten, 2012). Moreover, the determinants and growth of motivational factors over the course of studies are interesting in their own right because they reflect students' attitudes towards the subject matter and towards study conditions. The growth of extrinsic motivation over the course of studies is shown in Figure 3 (see test items on extrinsic motivation in Table 8 in the Appendix). Students started with a rather high level of extrinsic motivation but then, on average, experienced a decline over the first four semesters. There was a tendency of further loss of motivation in later semesters, but the pattern there was quite volatile (probably due to small sample sizes for later semesters of studies). In our estimations, we found that the average growth of extrinsic motivation was best described by a quadratic trend, which is why we maintained our original model specification.

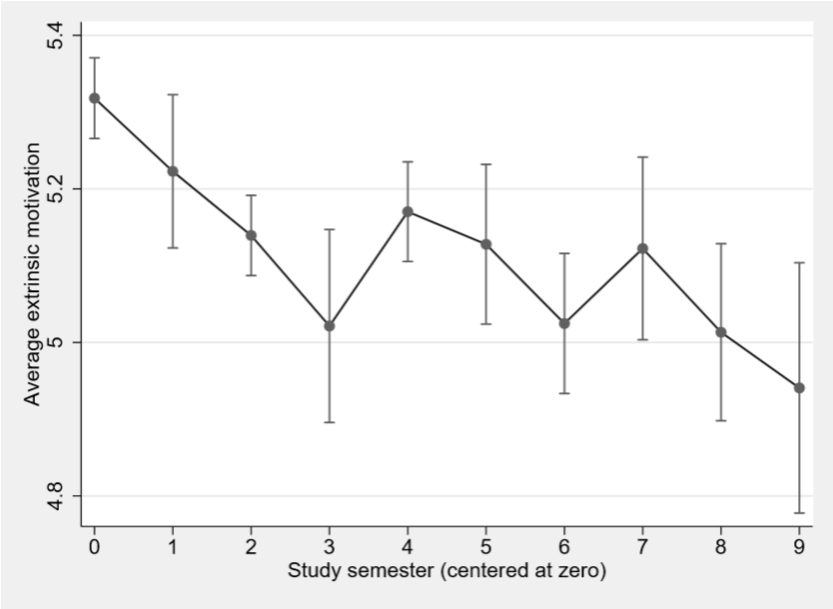

Figure 3. Development of extrinsic motivation over study semesters (lines represent the 95% error bars confidence intervals)

The estimates given in Table 4 confirmed a statistically significant downward sloping quadratic trend in students' extrinsic motivation. The initial level of extrinsic motivation was lower for older students, students who would have preferred to study another subject, students with a better high school GPA, and students of business and economics education. Regarding determinants of the decline in extrinsic motivation, we found that of the standard covariates we examined only age and enrollment in the Diplom system were correlated significantly to the downward trend in extrinsic motivation over the course of studies (again, we considered only covariates whose interaction terms were jointly significant with a p-value of at least 10%). The decline in extrinsic motivation over the course of studies was significantly lower for older students and Diplom students.

Table 4. Development of Extrinsic Motivation

	(1)		(2)	
Semester	-.069***	(.019)	-.061***	(.020)
Semester squared	.008***	(.002)	.008***	(.002)
Age	-.034***	(.011)	-.035***	(.011)
Female	-.003	(.031)	.005	(.030)
Non-native speaker of German	.068	(.046)	.045	(.046)
Subject not first choice	-.079**	(.034)	-.037*	(.033)
Mathematics as a major subject in high school	-.034	(.031)	-.051	(.031)
WT 2010/11	-.132***	(.040)	-.057	(.040)
WT 2011/12	-.132***	(.042)	-.096***	(.041)
High school GPA	.062*	(.032)	.063**	(.032)
Diplom degree course	-.557	(.377)	-.541	(.368)
Business and economics education	-.157***	(.040)	-.166***	(.039)
From Baden-Württemberg	.141**	(.068)	.184***	(.066)
From Hesse	.099***	(.032)	.104***	(.031)
Verbal intelligence	-.000	(.005)	-.000	(.005)
Economic knowledge			.005	(.009)
Extrinsic motivation			-.072**	(.037)
Intrinsic motivation			.154***	(.030)
Semester interacted:				
Age[a]	.014**	(.006)	.012**	(.006)
Diplom degree course	.197*	(.122)	.200*	(.120)
Economic knowledge[a]			.003	(.005)
Extrinsic motivation[a]			-.032	(.022)
Intrinsic motivation[a]			.014	(.018)
Semester squared interacted:				
Age[a]	-.001*	(.000)	-.001*	(.000)
Diplom degree course	-.019*	(.009)	-.019**	(.009)
Economic knowledge[a]			-.000	(.000)
Extrinsic motivation[a]			.003	(.002)
Intrinsic motivation[a]			-.003	(.002)
Constant	6.021***	(.261)	5.438***	(.322)
$\hat{\sigma}_{u0}$	.458		.447	
$\hat{\sigma}_{u1}$	7.02e-12		2.16e-09	
$\hat{\sigma}_{u2}$	1.90e-12		6.91e-09	
No. of obs.		2352		2332
No. of individuals		1826		1811

Notes. Semester centered at zero. Standard errors in parentheses. *** / ** / * statistically significant at 1% / 5% / 10%-level. [a] Recentered at sample average

Column 2 of Table 4 shows the results after we added our indicators of economic knowledge, epistemological beliefs, and intrinsic motivation as potential covariates of the initial level and rate of growth of extrinsic motivation over the course of studies. Interestingly, neither the initial level of extrinsic motivation nor its growth over time was significantly correlated with the students' level of economic knowledge. Furthermore, consistent with the results for epistemological beliefs discussed in the previous section, higher levels of extrinsic motivation were correlated significantly with a less skeptical view on the objectivity of economic content being taught. We did not find a negative relationship between extrinsic motivation and intrinsic motivation, which refutes the hypothesis that individuals with a high level of extrinsic motivation tend to have a low level of intrinsic motivation and vice versa. We also did not find any significant partial correlation between epistemological beliefs or intrinsic motivation and the rate of growth of extrinsic motivation over time. After controlling for the observed correlates of the initial level and growth of extrinsic motivation, we again found very little unobserved heterogeneity in individual growth paths (the estimates for $\hat{\sigma}_{u1}$, $\hat{\sigma}_{u2}$ were close to zero) but some in initial levels of extrinsic motivation ($\hat{\sigma}_{u0}$ = .458).

4.3 Growth of Intrinsic Motivation

As discussed above, intrinsic motivation was the only significant correlate of the level of economic knowledge among our motivational and epistemological indicators. Therefore, it was interesting to study this indicator in more detail. The average growth of students' intrinsic motivation over the course of their studies is shown in Figure 4 (see test items on intrinsic motivation in Table 8 in the Appendix). The average level of intrinsic motivation of the students in our sample was quite high, but it was lower than their average level of extrinsic motivation. The students' intrinsic motivation declined over the first four semesters; however, it seemed to pick up again after the first four semesters, possibly due to the increased freedom to choose areas of specialization after completing the introductory parts of the curriculum. In our regressions, we found that the overall pattern was well described by a quadratic term (a cubic term was not statistically significant). As shown in Figure 4, intrinsic motivation seemed to decline again for later semesters of studies, but this could have been due to sampling error, as the corresponding group of students made up only a small part of our sample, or to our selection processes for these students who were studying overly long to complete their degrees.

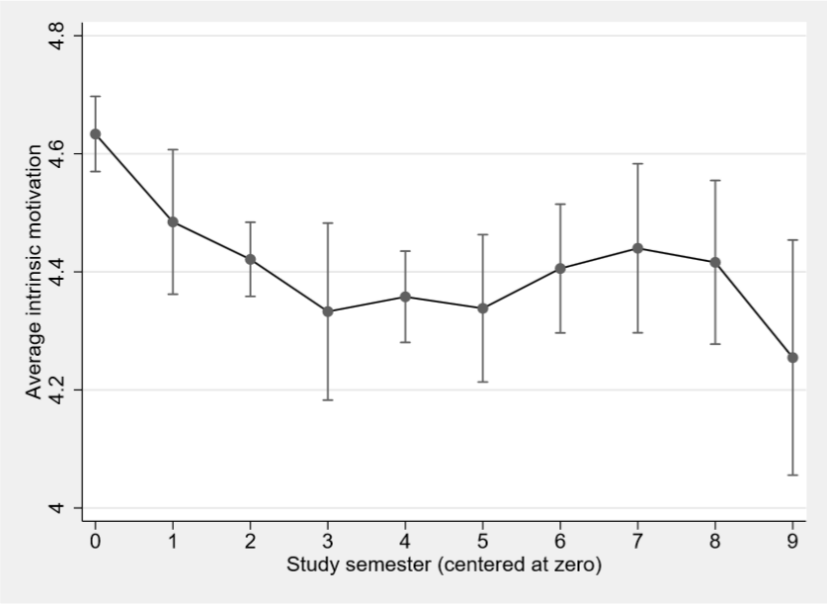

Figure 4. Development of intrinsic motivation over study semesters (lines represent the 95% error bars confidence intervals)

The regression results for intrinsic motivation as the dependent variable are given in Table 5. We found a highly significant quadratic trend in the growth of intrinsic motivation over the course of studies. The initial level of intrinsic motivation was significantly higher for older students and students who had taken mathematics or economics as major subjects at high school. Intrinsic motivation was significantly lower for students who would have preferred to study another subject and for students from some federal states. There also was evidence that a better high school GPA was correlated to a lower initial level of intrinsic motivation to study economics and business administration. Furthermore, a higher test score on verbal intelligence correlated significantly with a lower initial level of intrinsic motivation to study business and economics, which might have been due to the fact that verbal intelligence requires abilities that are non-mathematical and therefore less related to economics.

We found that two of our standard covariates were significantly correlated with growth of intrinsic motivation over the course of studies. The intrinsic motivation of Diplom students interacted positively with their progress in studies, which completely neutralized the decline in intrinsic motivation over the first two years. Effectively, this means that we did not observe a decline in intrinsic motivation in Diplom students over the course of studies as we did in bachelor students. Similarly, our results indicated that higher levels of verbal intelligence mitigated the decline in intrinsic motivation over the first two years of studies. Finally, the estimates for $\hat{\sigma}_{u1}$, $\hat{\sigma}_{u2}$ showed a modest amount of remaining unobserved heterogeneity in the growth of motivation over the course of studies but a more significant amount of unobserved heterogeneity in the initial level of intrinsic motivation ($\hat{\sigma}_{u0}$ =.605).

Table 5. Development of Intrinsic Motivation

	(1)		(2)	
Semester	-.151***	(.020)	-.159***	(.022)
Semester squared	.014***	(.002)	.014***	(.003)
Age	.016*	(.008)	.024***	(.008)
Female	-.016	(.038)	.016	(.038)
Subject not first choice	-.203***	(.040)	-.186***	(.039)
Location not first choice	-.062*	(.037)	-.059	(.036)
Mathematics as a major subject in high school	.077**	(.039)	.086***	(.038)
Economics as a major subject in high school	.166***	(.042)	.151***	(.041)
WT 2010/11	-.334***	(.048)	-.288***	(.047)
WT 2011/12	-.168***	(.050)	-.142***	(.049)
High school GPA	-.071*	(.040)	-.087**	(.039)
Diplom degree course	-.559	(.458)	-.540	(.444)
From Baden-Württemberg	-.251***	(.084)	-.290***	(.082)
Verbal intelligence	-.022*	(.011)	-.030***	(.011)
Economic knowledge			.031***	(.011)
Extrinsic motivation			-.089**	(.044)
Intrinsic motivation			.251***	(.043)
Semester interacted:				
Diplom degree course	.243*	(.145)	.250*	(.142)
Verbal intelligence[a]	.014**	(.006)	.017**	(.007)
Economic knowledge[a]			-.002	(.006)
Extrinsic motivation[a]			-.054**	(.026)
Intrinsic motivation[a]			-.004	(.027)
Semester squared interacted:				
Diplom degree course	-.023**	(.011)	-.024**	(.011)
Verbal intelligence[a]	-.001**	(.000)	-.002**	(.000)
Economic knowledge[a]			.000	(.000)
Extrinsic motivation[a]			.007***	(.003)
Intrinsic motivation[a]			-.001	(.003)
Constant	4.919***	(.245)	3.458***	(.377)
$\hat{\sigma}_{u0}$	.630		.605	
$\hat{\sigma}_{u1}$	.011		.024	
$\hat{\sigma}_{u2}$	2.06e-07		1.42e-07	
No. of obs.		2350		2332
No. of individuals		1824		1811

Notes. Semester centered at zero. Standard errors in parentheses. *** / ** / * statistically significant at 1% / 5% / 10%-level. [a] Recentered at sample average.

Column 2 of Table 5 shows how the initial level and growth of intrinsic motivation over time were related to economic knowledge, epistemological beliefs, and extrinsic motivation. Consistent with the results for economic knowledge as the dependent variable, we found a significant positive correlation between a higher initial level of intrinsic motivation and a higher initial level of economic knowledge. Also consistent with previous results, we found that students who were less skeptical in their epistemological beliefs had a significantly higher initial level of intrinsic motivation; moreover, we found a positive correlation between high initial levels of intrinsic and extrinsic motivation. Finally, there was a significant interaction between epistemological beliefs and growth of intrinsic motivation: Students who showed greater skepticism in their epistemological beliefs experienced a faster decline in intrinsic motivation. Put differently, students who were more confident in the objectivity of economic knowledge were, to a certain extent, shielded from a loss in intrinsic motivation over the course of studies. All other interactions were not significant: Higher levels of economic knowledge or higher levels of extrinsic motivation were not related to faster or slower change in intrinsic motivation over the course of studies.

5. Summary and Discussion

One of the main results of our study was that the amount of economic knowledge increased over the initial

semesters of undergraduate studies, indicating that the study program under consideration was to some extent effective in presenting basic economic concepts. We also found that higher levels of cognitive ability and intrinsic motivation and previous exposure to economic principles acquired by taking economics as a major subject at high school or completing commercial vocational training prior to studying had a positive effect on the level of economic knowledge; being female or being a non-native speaker of German had a negative effect. Remarkably, we measured no significant relationship between economic knowledge and extrinsic motivation or epistemological beliefs. Overall, the rate at which economic knowledge developed showed no significant correlation with the majority of the variables measured. This means that the development of economic knowledge was relatively uniform and not greater among high-ability students or students with high levels of intrinsic or extrinsic motivation. An exception was the significantly less developed knowledge of students who had previously learned about economics in high school, suggesting these students had acquired knowledge that they did not have to acquire again at university. The relative uniformity of the development of knowledge also implies that any kind of heterogeneity in students' initial level of knowledge will be sustained rather than reduced by the study program (see also Happ et al., 2016c).

Our results also indicate that epistemological beliefs and extrinsic and intrinsic motivation declined over the course of undergraduate studies. At first, this finding might lead one to believe that the undergraduate syllabi for economics demotivated the students. Indeed, intrinsic motivation declined rather strongly during the introductory semesters and picked up again after the fourth semester, when students had more freedom to choose areas of specialization. We also found that intrinsic motivation declined faster if students were more skeptical; skepticism towards the objectivity of the content presented in economics courses and a lack of motivation may reinforce each other. Furthermore, we observed a decline in extrinsic motivation over the course of studies; however, extrinsic motivation was unlikely to be determined by study structure. Declining levels of motivation have also been found in other educational contexts (e.g., Zelick, 2007); hence, declining levels of motivation may simply be a typical phenomenon that occurs in every subject. The finding that students tended to become more skeptical over the course of their studies also seems to confirm criticism of the economics curriculum. However, declining certainty in the belief that the content covered in courses was objective has also been found to apply to other fields of study, indicating that this finding is not specific to economics. Interestingly, we found this decline in certainty to be particularly strong among high-ability students, while low-ability students and students with high levels of extrinsic motivation exhibited no decline in certainty in their beliefs about the objectivity of the content covered. Given the nature of economics, it might be more difficult to avoid a loss of certainty in one's beliefs concerning the objectivity of the content presented in economics courses than in courses in other subjects such as physics or engineering (for the discussion, see Shiller, 2010). In any case, our results indicate that motivational and epistemological aspects may play an important role in how economics studies are organized.

The curricula of economics education are internationally comparable and an international core curriculum can be identified (Zlatkin-Troitschanskaia et al., 2014; Zlatkin-Troitschanskaia et al., 2016b). In teaching economics, similar teaching and learning methods are used worldwide (e.g., Hoyt & McGoldrick, 2012), and, for example, many economics textbooks are translated into various languages for international use. The findings of this study are therefore relevant at an international level (Zlatkin-Troitschanskaia et al., 2017; Zlatkin-Troitschanskaia, Shavelson, & Pant, 2018). Even though the study was carried out in Germany, increasing harmonization in the course of the Bologna reform (Adelman, 2009) has led to the implementation of a Bachelor and Master structure in the German higher education system that is similar to English-speaking countries. While an international transferability of the findings is possible, the data base should be further extended in order to enable further economics education studies of an internationally comparable character (for internationally comparative studies in the field of economics between Germany, Japan, and the U.S., see Brückner et al., 2015; Förster et al., 2015; Zlatkin-Troitschanskaia et al., 2016b).

When examining economics knowledge development, most studies neither consider further facets such as the students' extrinsic and intrinsic motivation nor their epistemological beliefs. The findings of this study provide evidence that, aside from knowledge, other facets such as the students' academic interest and self-regulating skills should be taken into account when analyzing knowledge acquisition in higher education.

The findings from longitudinal modeling highlight the crucial importance of formative performance assessments in economics in higher education (Dolan & Burling 2012; Zlatkin-Troitschanskaia et al., 2017). Process diagnostics at a degree course level and at an individual level are urgently needed. For teachers in higher education, it would be a major advantage to have access to information on students' preconditions, made available through valid assessment and analyses at the beginning and over the course of their studies (Happ et al., 2016c; Zlatkin-Troitschanskaia et al., 2017). This evidence could enable teachers in higher education to address

the needs of their students in an informed and adequate way when designing curricula, preparing learning opportunities, selecting instructional methods, and delivering courses. Based on such data, university teachers are able to offer students appropriate economic education.

Finally, some of our results confirmed expectations about the Bologna reform. In particular, we found Diplom students to have generally higher levels of economic knowledge but much slower rates of developing that knowledge over the course of studies. This finding supports both the critics of the reform, who expected the new study program to produce less knowledgeable graduates, and its proponents, who criticized the slow study progress and long study durations in the old study program. However, the Diplom students in our sample showed no decline in motivation over the course of their studies, confirming another criticism of the reform that too dense and too demanding study programs leave insufficient time for critical thinking. The latter hypothesis is consistent with our result that Diplom students on average were more skeptical about the objectivity of economic content being learned. While we consider these findings interesting, we view them only as tentative, as the selection of the study program might have had an effect given that the two systems co-existed for some time at the institution from which our sample was drawn. When considering the implications of our findings for higher education economics programs, one should bear in mind the limitations of standardized assessments. To obtain indications for the optimization of economics study programs, it is imperative that assessments be designed to assess various indicators of teaching-learning processes in addition to input such as students' prerequisites and output such as students' economic knowledge level (Guest, 2013).

Our study also has certain limitations that provide implications for further research. The students' family background was only assessed in their respective mother tongue (non-native speakers of German vs. native speakers of German), and, due to the test time, details on the socio-economic background of the students could not be assessed (such as the International Socio-Economic Index of Occupational Status by Ganzeboom, de Graaf & Treimann, 1992). Some studies indicate a relation between the migration background and the socio-economic status of the family home of the students (Jackstadt & Grootaert, 1980; Shim et al., 2010). Their socio-economic status should therefore be examined in further studies.

For reasons of curricular validity, an abbreviated version of the Test of Economic Literacy was used as a test instrument to measure economic knowledge in the study. Although the items used in the test are valid for higher education (Happ et al., 2017c), the relatively small item pool comprised only 19 tasks. In follow-up studies, additional instruments should be used to measure economic expertise that comprehensively reflect various sub-dimensions such as microeconomics, macroeconomics, and international relations (Zlatkin-Troitschanskaia et al., 2014).

The sample presented here has limitations from various points of view. Firstly, the sample refers only to one university in Germany. The resulting generalizability of the findings must be critically examined. For future research, the sample should be extended to several institutions. This is currently being implemented in the new research project WiWiKom II, in which a nationwide sample is being examined that comprises students from more than 40 universities (Zlatkin-Troitschanskaia et al., 2016c).

Secondly, from a longitudinal perspective, the data set should also be viewed critically. As Table 7 in the Appendix demonstrates, the dataset is highly unbalanced (Luke, 2004). Only a few of the students who participated in the study were assessed at all measurement points. Consequently, distortions in the sampling can be observed, which limit the generalizability of the findings. It cannot be ruled out that participants with better test results participated in the study at a later measurement point, which could lead to a positive selection in the sampling. This is a general problem of longitudinal studies, especially in higher education. The advantage of longitudinal studies in schools is that students stay within fixed classes from year to year. This means that, for example, after one year, students are usually in the same class again. This is not the case in higher education, which is why longitudinal studies in particular pose greater challenges in higher education (Zlatkin-Troitschanskaia & Pant, 2016a). This is also the reason why there are so few longitudinal studies in empirical higher education research (Zlatkin-Troitschanskaia et al. 2016a; Zlatkin-Troitschanskaia et al., 2017). All in all, despite its limitations, this study makes an important contribution to this research desideratum, providing longitudinal findings that open up many perspectives for further studies.

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Notes

Note 1. ILLEV was an intervention project running from 2008 to 2012. Financial support for the project from the German Federal Ministry of Education and Research was gratefully acknowledged.

Note 2. We discarded from our original sample a small number of students who reported their current semester as being at least the eleventh because they were not representative of the population of interest. The original survey involved a first wave in 2008/09, which we could not use because it did not cover all the variables considered in our analysis (see Happ et al., 2016c).

Note 3. The items of the test have a MC format. To assess higher order cognitive skills and generic skills such as collaborative problem solving we examined other test formats (see Guest, 2013, p. 57).

Note 4. We would have used more sophisticated instruments to test economic knowledge, but the German adaption of the TEL was the only standardized test of economic knowledge available in German at the time the survey was conducted.

Note 5. On the scales of extrinsic and intrinsic motivation, high values represent high levels of extrinsic (profession-oriented) and intrinsic (content-oriented) motivation.

Note 6. The model is a multilevel mixed-effects model that can be estimated under the assumption of normally distributed errors using maximum likelihood (see Rabe-Hesketh & Skrondal, 2012).

Note 7. The pattern shown in Figure 1 remained the same when we controlled for the observed covariates.

Note 8. Therefore, in studies of more advanced students the adapted American Test of Understanding in College Economics (TUCE) might be preferred (Walstad & Rebeck, 2008; Zlatkin-Troitschanskaia, Förster, Brückner & Happ, 2014; Zlatkin-Troitschanskaia et al., 2016b).

Note 9. In Germany a lower GPA at high school represents a better GPA. So, the negative sign shows a positive influence of the high school GPA on economic knowledge.

Note 10. We also tested all other potential covariates listed in Table 1 but omitted highly insignificant ones from our final specification.

Note 11. The German Federal Ministry for Education and Research funding number for this project is 01PK15001 (Zlatkin-Troitschanskaia et al., 2016c). For further information please visit the project's website: www.wiwi-kompetenz.de.

Appendix

A longitudinal german case study

Table 6. Distribution of the Study Semester Across Samples

Semester	WT 2009/10	WT 2010/11	WT 2011/12	Total
1	126	328	203	657
	4.65	12.11	7.50	24.26
2	27	95	71	193
	1.00	3.51	2.62	7.13
3	165	230	266	661
	6.09	8,49	9.82	24.41
4	33	37	38	108
	1.22	1.37	1.40	3.99
5	99	140	164	403
	3.66	5.17	6.06	14.88
6	63	60	36	159
	2.33	2.22	1.33	5.87
7	74	53	77	204
	2.73	1.96	2.84	7.53
8	35	46	47	128
	1.29	1.70	1.74	4.73
9	24	36	69	129
	0.89	1.33	2.55	4.76
10	12	20	34	66
	0.44	0.74	1.26	2.44
Total	658	1.045	1.005	2.708
	24.30	38.59	37.11	100.0

Notes. Number of observations (first line), cell frequencies (second line).

Table 7. Composition of Sample

Individuals	Percent	Cumulated	Pattern
596	28.22	28.22	. . 1
593	28.08	56.30	. 1 .
396	18.75	75.05	. 1 1
118	5.59	93.18	1 1 .
75	3.55	96.73	1 . 1
69	3.27	100.0	1 1 .
2112	100.0		

Notes. Example: '. 1 1' = person appears in 2010/11 and 2011/12.

Table 8. Sample Items of the Epistemological beliefs, extrinsic and intrinsic motivation

Epistemological beliefs	Questions on extrinsic motivation	Questions on intrinsic motivation
EB1: "There are many scientific findings taught in the field of economics that will always be valid."	EM1: "I study in order to have good career prospects."	IM1: "I study because I like the content of the subject."
EB2: "Most of the knowledge taught in the field of economics will not be obsolete in the future."	EM2: "I study in order to have a financially secure life."	IM2: "I study because the content suits my personal interests."
EB3: "The main insights taught in the field of economics are objective to a high degree."	EM3: "I study in order to have a well-paid job later on in life."	IM3: "I study because I find the content very important."
EB4: "When considering an economic question, all professors of economics probably arrive at similar conclusions."	EM4: "I study in order to increase my chances of getting a job."	IM4: "I study because I am extremely interested in the content."
EB5: "If one reads something in an economics text book, one can be sure that it is true."		