ISEG Undergraduate Students: Determinants of Academic Performance

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I - Introduction

Over the last three decades there has been in Portugal a quite huge public investment in the school system and the implementation of an effective compulsory education. Public expenditure in education increased from 1.5% of GDP in 1974 to 5.5% in 2001[1]. These changes came along with the democratization of school experience. The students' enrolments (20-24 years) in Portuguese universities (public or private) increased from 7% in 1974 to 53% in 2004 and registered from then on a small decline.

In spite of this significant growth Portugal remains one of the EU countries (15) with the lowest number of graduates and so the increase in the number of students in higher education is a national goal pursued by education policy. The government goal is to have 50% of all 20 years old in higher education and a survival rate of 80% by 2010[2]. This problem is even more serious since the lack of qualified labor market resources is the major source of a huge socio-economic inequality and a drawback to sustained development.

However, in spite of all the government and parents' investment in children education, school failure is a major problem that affects all levels of education. Basic education retention and school dropout at the end of compulsory education (9º) rates are still high compared to other EU countries (15).

Data reported by OECD (Education at a Glance, 2007) suggests that the survival rates at the university level are comparable to those reported at international levels. Nonetheless university level school failure affects mainly undergraduate students in their first year of

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* This paper has been developed in the framework of ISEG Pedagogic Observatory´s studies and use its data base.

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[1] Most of the figures in this section were taken from OECD Thematic Review of Tertiary Education – Country Background Report: Portugal, 2006

[2] In 2006, 44.3% of all 20 years old attended higher education and the survival rate was around 50%.

studies. This may be partly due to the fact that students are quite often placed in graduation programs that are not their first choice as a result of an higher education access system based on generalized *numeri clause.*

Evidence that academic performance can be adversely affected by family background is another factor of major concern, since increasing the financial burden on students through higher fees is likely to deteriorate performance mainly when family well-being tends to decrease as a result of a world economic crisis. According to OECD, 2006 family earnings are the main source of income for 87.7% of Portuguese undergraduate students. Besides, around 16% of undergraduate students support their higher education studies with work earnings.

Furthermore it is crucial to improve the understanding of the factors that influence the academic performance of university students now that the Portuguese government intends to base its policy towards the higher education institutions upon performance indicators.

There is also increasing evidence that academic performance at university level affects post-university earnings and success in the labor market therefore affecting the future of generations of students and the development of the whole country.

The OECD, 2006 states that the working population with a higher education degree has an activity rate (85.2%) higher than those with a secondary or post-secondary degree (67.3%) or an education level lower than 3rd cycle. Average monthly earnings of graduates are 2.3 times greater than the average for all workers and 3.4 times the average of those under basic education 1st cycle. The rate of return for higher education in Portugal has been and still is one of the highest among EU countries (15). Besides, evidence shows that graduates are less affected by unemployment (lower unemployment rates as well as lower unemployment spells) than those with lower educational levels even in periods when unemployment rates are growing.

For all this reasons, the research on which factors affect academic performance and to what extent, is a major concern for those involved in higher education political definition. This is why it becomes a research field of much interest for academics too.

This paper intends to shed some light on the determinants of academic performance of undergraduate students of the School of Economics and Management – Technical

University of Lisbon in their first year of each one of the graduation programs: Management, Economy, Applied Maths and Finance.

We hope to find answers for questions related to academic performance such as:

- Is there a gender determination?
- How big is the effect of family socio-economic background?
- What is the effect of upper secondary specialization track?
- Do pre-university school trajectory matters?
- What is the impact of labour market participation upon students' performance?

Following Dollado and Morales (2007) we will measure success in academic performance using the examinations grades in three 1st year\1st semester subjects with decreasing degrees of mathematical complexity, Maths I, Economy I and Introduction to Management. We chose these subjects because they are shared by all the four graduation programs taught in the school. .

In this paper we go further than Dollado and Morales (2007) since, besides type of school, upper secondary specialization track and scores obtained at the university entry-exam, we study the role of individual characteristics, family socio-economic background and pre-university school trajectory on the academic performance. We put an emphasis on the effect of transitions from public\private or private\public schools.

Section II presents the theoretical background, section III describes the data and methodology, section IV presents the main descriptive results, section V the results of model estimation and section VI resume the main conclusions.

II – Theoretical Background

Since the eighties a growing body of research focused on determinants of children attainment trying to examine which factors affect academic performance and in what extent. In the beginning the studies were mainly done by sociologist but later with Becker and his followers, economists have been trying to build more formal models for the attainment process. In most of the published studies academic performance is measured by school grades Based on a Human Capital framework, attainment process is modeled as an education production function:

$$G_i = f(S_i, X_i, PU_i, Sc_i, P_i, \varepsilon_i)$$

Where G_i - grades of student *i*;
S_i - Student *i* characteristics;
X_i - Family socio-economic background variables;
PU_i - Pre-university trajectory variables;
Sc_i - School quality
P_i - Peer group variables
ε_i - effect of unobserved variables

Education production functions take children school performance as a product of parents inputs like the amount and quality of time they devoted to their children and these are measured by parents' educational level and occupation, employment\unemployment status in empirical research. Most empirical studies found a positive effect of parents' educational level mainly the mother's one [3], although some more recent research [4] points to the fact that mother's educational level effect tends to decrease in high school and university levels. Results for Employment\unemployment status[5] influence on university *performance* are mixed.

Following the human capital approaches school performance at university level is also affected by pre-university trajectory characteristics. Frequent moves from school to school, number of failures and existence of breaks in school trajectory at primary and secondary levels tends to have a perverse effect on performance.

[3] Haveman & Wolfe(1995), Blau (1999), Smith & Naylor (2001), Ammermuller, *et al.* (2003), Cappellari (2004).
[4] Hassink,W. & Kiiver,H.(2007); Pronzato, C., 2008

[5] Stinebrickner, R. & Stinebrickner, T. (2003), Haveman & Wolfe(1995).

School quality characteristics like class size, student/teacher ratio or teacher quality are other studied determinants of academic performance. The empirical results concerning these variables showed mixed effects especially when family background variables are considered too[6].

There is also some evidence from empirical studies that labor market participation and civil status influence performance negatively since they reduce the time spent on academic work but also have a positive effect if they are associated with a higher degree of responsibility and maturity. Evidence from age and gender impact on performance is not clear with some studies reporting a gender effect [7], and others not[8].

One of the main problems in estimating production functions arises from correlation between observed explanatory and unobserved variables since some of the explanatory variables are choice variables and so endogenous. This is the case for some of the characteristics like having a part-time or full-time job, being married, family socio-economic background variables as parents' level of education or pre-university trajectory characteristics such as moves from private to public schools or from public to private schools, breaks in the school trajectory. However the scarcity of instruments makes it very difficult to deal with the endogeneity and that is why, in practice, only a limited amount of the endogeneity is usually handled.

III – Data and Methodology

We use a data base, gathered by the ISEG Pedagogic Observatory, of almost 1540 undergraduate students who are on Bologna 1st cycle at the School of Economics and Management – Technical University of Lisbon on 2007\2008 school year.

We have information on individual characteristics (sex, age, place of birth, civil status), type of labour market participation (no job \ part-time \ full-time job), parents socio-economic background (mother and father school level, situation towards occupation and employment, number of siblings), pre-university school trajectory (number of failures,

[6] Dolado & Morales (2007);Lazear (2001)
[7] Dolado & Morales (2007), Smith & Naylor (2001), Machin & McNally (2005)
[8] Carver & King (1994), Yang & Lu (2001), Ballard & Johnson (2005)

breaks in school trajectories, moves from school to school in the basic and secondary levels, changes from public to private or private to public schools in the secondary level, upper secondary specialization track, university entry-exam's grades, school where the student completed the secondary level). We don't have data on school quality or peer groups.

We also got data on 1st year\1st semester examination's scores for the following subjects: Maths I, Economy I and Introduction to Management.

We began to analyze correlations between grades in each of the above mentioned subjects and the variables considered. As most of these variables present discrete values and we considered grade intervals [9] we used Spearman correlation coefficient. In all cases where both variables are continuous, the Pearson correlation coefficient is calculated and every time one of the variables is continuous and the other discrete, the Kendall's tau_b correlation coefficient is the one analyzed. In all cases we will only report results for those variables which correlation coefficient is significant at 1% or 5% level.

For some of the variables we also did means of independent samples hypothesis tests and confidence intervals for difference of means were calculated to study the variable effect on grades.

As we have a continuous support of the dependent variable (numerical grades in a 0 to 20 scale) we run OLS regressions to estimate the above mentioned production function.

We run the same statistical model for adjusting production function for each subject but some of the explanatory variables are not the same in all equations. To correct for heteroskedasticity that is hardly not present on cross section data we did robust estimation. Results for robust estimation are registered in Appendix 1, 2 and 3. We also did post estimation tests for multicolinearity.

As the grades are censored at the lower and upper end a standard Tobit model is also to be estimated. To analyze the hypothesis of different impacts of the exogenous variables at different points of the dependent variable distribution we intend to run quantile regressions.

[9] Five grade intervals: [0, 5), [5, 10), [10, 14), [14, 17) and [17, 20]

IV – Some descriptive results

The 1st cycle Bologna's students at the School of Economics and Management – Technical University of Lisbon on 2007\2008 school year are mainly males, with an average age of 22.8 years old and bachelors. There are few foreigners and among those the larger group are from Portuguese Speaking African Countries and Brasil (4.4%). The great majority lives with parents. Except for gender our students' main characteristics closely replicate those of undergraduates in Portuguese higher education system.

Parents' education levels distribution is characterized by 35% of students´ fathers\mothers with up to a 9th degree, 32% of students' fathers and 34% mothers with a high school or post-high school degree and 30.5% fathers and 29% mothers with a superior degree. Values in table 1 show that our students come from households where parents have lower educational levels compared with national values either for public universities or in total.

Table 1

		2007	2004[10]	
Parents' level of schooling		ISEG	Public universities	Total
Secondary	Father´s	22.4	29.2	29.4
	Mother´s	24.8		
Higher	Father´s	29	40.8	35.7
	Mother´s	27.4		

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Both mothers and fathers are mostly employed (82.1% of fathers and 75.7% of mothers).

Around 10% of 1st cycle Bologna students at ISEG have a part-time or full-time job. Among those 36% are Management and 20.2% Economics undergraduates.

[10] OECD, 2006 – enrolments by level of schooling of the households.

Very few of them experienced failures in primary school (1.3%) and from those only 17.6% had two or more failures. Only 7.9% faced breaks of two or more years during primary school. Failures in high school are more frequent (11.9%) and repeated failures too (22.1% had two or more failures). Repeated failures among those who had already experienced failures or breaks on primary school trajectory could be traced for 6.8% and this can be a sign of the existence of a failure vicious cycle on school trajectories[11].

Moves from private to public schools (29.5%) are more frequent than those from public to private schools (14.8%). It is interesting to notice that students who move from private to public schools are different from those who experience moving in the opposite direction. The latter had experienced failures more often during high school and their grades in the university entry-exam are lower. This may point to the fact that moving to a private school helps to get access to university because most private schools are less demanding than public ones.

In the transition from high school to university 16.8% experienced a break spell of two or more years in their school life trajectory and from those 49% are Management, 37% Economics, 6.9% Applied Maths and 7.2% Finance undergraduates.

The analysis of correlations showed that gender, being married, participation in the labor market, number of failures in high school, upper secondary specialization track, entry exam score, and preference for ISEG are significantly correlated with grades.

For Economy I and Management Introduction, males have worse results than females ($\rho_{Eco\,I} = -0.160^{**}$, $\rho_{Man.Intr} = -0.248^{**}$) but no significant results were found for Math I. A crosstabs analysis of Interval Degrees and Civil Status shows that married students perform worse than bachelors in all three subjects analyzed but no significant correlations were found. Participation in the labor market seems to decrease grades in Management Introduction but increase grades in Math I ($\rho_{\downarrow}(Man.Intr) = \square - 0.120\square^{\uparrow} *, \rho_{\downarrow}(Math\ I) = \square 0.088\square^{\uparrow}(**)$) .

Number of failures in high school have a negative impact on grades for Economy I and Management Introduction but no significant impact for Math I ($\rho_{Eco\,I} = -0.079^{**}$, $\rho_{Man.Intr} = -0.071^{**}$). Although the crosstab frequencies between Math I´s grades and number of failures give some evidence that the percentage of students with negative

[11] Lopes, M.C. & Medeiros, J.C.(2004)

grades are bigger and the percentage of students with positive grades lower for those who have experienced failures on high school.

A specialization track on Science and Technology seems to help students to get higher grades in all of the three subjects analyzed ($\rho_{Eco\ I} = -0.1^{\bullet}$, $\rho_{Man.Intr} = -0.1^{\bullet}$, $\rho_{Math\ I} = -0.131^{**}$). Those with higher entry exam grades perform better than those with lower grades ($\rho_{Eco\ I} = 0.36^{**}$, $\rho_{Man.Intr} = 0.33^{**}$, $\rho_{Math\ I} = 0.173^{**}$). However it is also true that their grades in the subjects analyzed are in general lower than their entry exam mark except for Management Introduction and specially for Math I.

Those which placed the School of Economics and Management as the highest preference[12] in their application to university have higher grades than their colleagues. It seems that being in the most preferred school has a positive effect on grades ($\rho_{Eco\ I} = -0.138^{**}$, $\rho_{Man.Intr} = -0.145^{**}$, $\rho_{Math\ I} = -0.178^{**}$).

V - Results of model estimation

So far we did only OLS estimations of grades in a number of the variables mentioned in section II. The estimates and p-values are presented in Appendix 1, 2 and 3 for Economy 1, Management Introduction and Maths 1 respectively.

We estimate one equation for each subject since explanatory variables are not the same in all the equations as we mentioned before.

All three estimated models have no problems of multicolinearity (VIF values for the explanatory variables are in the interval [1.01, 1.57]). The White test for heteroskedasticity accepts homoskedacity for the estimation of Management Introduction and Maths 1's grades models. And the Ramsey RESET test for over specification shows that these two models have no specification problems

V.1 The model for Economy 1

The best results for estimation of Economy 1 grades were found for the model:

[12] In the application form, 1 indicates the highest preference, 6 the lower one.

$$\ln G\_El = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_{6_j} X_{6_j} + u$$

Where : X_1 – ln university entry exam grade

X_2 – dummy for 1 year retention in Basic School (1st to 9th standard)

X_3 – number of years of retention in High School

X_4 – dummy for finishing High School in another country

X_5 – dummy for change from a public to private institution during High School

X_{6_j} – dummy for year when student did last exam on the subject (j = 2000, …, 2006)

These dummies for year when student did last exam on the subject are included to measure the effect on grades of the subject's teacher team and its organization which may have registered changes from one year to the other.

We have tried to introduce parents' socio-economic background variables in the regression equation but none of them was significant at 5% level. This is in pace of recent empirical results that show that these variables lose their influence at this stage of life[13]. In a way we can say that they are already imbedded in the school entry exam grades. Actually a regression of the school entry exam grades on mother's level of education shows that these variables have a significant positive influence on grades.

No gender effect is traceable also since this variable showed no impact on Economy 1 grades in the regressions where we introduce it. The same is true for the impact of labor market participation.

From the estimates and their statistics in Table 1 Appendix 1 we can say that:

- Grades in Economy 1 are 0.90% higher when university entry exam grade increases 1%;
- Grades are 2% lower for each year retention in High School;
- Changing from public to private institution during High School had a negative effect on grades lowering them by 13% but this result is only significant at 10% level;

[13] Hassink,Wolter & Kiiver,Hanna,(2007); Pronzato, Chiara, 2008

- Those who finish High School in another country are penalized in 11% in their grades;
- The dummies for the subject´s teacher team and its organization are significant and have a positive effect on grades but this effect varies from one year to another. This can be interpreted as a positive effect on grades from changes in teachers, the way the subject is taught or examination rules.

So we can say that, as expected, grades in Economy 1 increase with university entry exam grade and decrease with number of years of retention in high school. The coefficient estimate of retention in Basic School has an odd positive sign but is significant at 5% level.

As we noticed above students who change from public to private institutions in high school seem to have been unsuccessful more often than their colleagues during high school and so they go on being unsuccessful at university.

As most of our foreign students have an African origin it is not a surprise that those who finish high school in those countries tend to have lower grades. This result is in pace with other studies findings[14].

These results seem to prove once again that previous school trajectory characteristics are the main determinants of success in Economy 1.

V.2 The model for Management Introduction

The best results for estimation of Management Introduction grades were found for the model:

$$\ln G\_MI = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + u$$

Where : X_1 – gender (female)

X_2 – ln university entry exam grade

X_3 – dummy for retention in Basic School (1st to 9th standard)

X_4 – dummy for 1 year retention in High School

[14] Smith & Naylor (2001)

X_5 – number for 2 or more years retention in High School

X_6 – dummy for finishing High School in another country

X_7 – dummy for change from a public to private institution during High School

Only gender, two or more years of retention in High School and university entry exam grade are significant at 5% level. The coefficient estimates tell us that:

- Females have grades that are 7% higher than their male colleagues;
- Those who have two or more retentions in High School have grades that are 6.5% lower than those who don't;
- The grades are 0.47% higher when university entry exam grade increase by 1%.

As for the Economy 1 grades' model, parents' socio-economic background variables as well as labor market participation variables were not significant in any of the model equations that include them. Subject's organizational features don't seem to influence grades in Management Introduction.

V.3 The model for Maths 1

The best results for estimation of Maths 1 grades were found for the model:

$$\ln G\_M1 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_{9_k} X_{9_k} + \beta_{10_j} X_{10_j} + u$$

Where : X_1 – gender (female)

X_2 – ln university entry exam grade

X_3 – dummy for retention in Basic School (1st to 9th standard)

X_4 – dummy for 1 year retention in High School

X_5 – number for 2 or more years retention in High School

X_6 – dummy for finishing High School in another country

X_7 – dummy for change from a public to private institution during High School

X_8 – dummy for preference for ISEG bigger than 1

X_{9k} – dummy for participation on labour market (k = part-time, full-time)

X_{10_j} – dummy for year when student did last exam on the subject (j = 2000, …, 2006)

Only university entry exam grade and subject's organizational features in years 2002 to 2005 are significant at 5% level. Not have chosen ISEG as first choice is significant at 10% level. The coefficient estimates tell us that:

- The grades are 0.93% higher when university entry exam grade increase by 1%;
- It is interesting to notice that the coefficient of the dummies for year when student did last exam on the subject increase when the year is farther from 2007. Because those who did the subject in past years are those who have tried to do it several times in the past, this may mean that grades tend to increase after some trials.
- Students who didn´t put the actual school as first choice have grades that are 10% lower than those who put it as first choice. It seems that not being in their first choice graduation program or school affects the students performance negatively.

As in the other subject's grades models, parents' socio-economic background variables were not significant in any of the model equations where we introduced them.

VI. Some main conclusions

The results of the empirical estimation of the three core subjects' grades allow some interesting conclusions.

Despite some general results for the Portuguese university that points to the fact that women' academic performance is better than that of their male colleagues, at ISEG no gender determination was found except for Management Introduction. However correlation analysis shows that there is a significant correlation between the grades in Economy 1 and Management Introduction and gender [$\rho_{Eco.1} = -0{,}160^{**}, \rho_{Intr.Gest.} = -0{,}248^{**}$].

The family socio-economic background doesn't seem to have a significant influence on grades at university level. Correlation analysis shows no significant correlation between these characteristics and academic performance too. Although most research on Basic and High School performance points to family socio-economic background as one of the main determinants of school performance it is also true that some more recent studies found that the influence of such variables tend to decrease along school

trajectory[15] . Actually at university level these factors were most probably already imbedded in basic and high school students' characteristics and this is the reason why their influence faded when these characteristics are taken in account.

We expected a specialization track effect since Scientific-Technological track appears in some studies[16] with a positive impact on grades when compared to the Economic-Sociological track. In this study we didn't find any such influence. This variable doesn't show any significant correlation with grades in correlation analysis too.

Previous school trajectory' characteristics are the main determinants of academic performance in any of the subjects considered. It is clear from our results that University entry exam's grades have a positive effect on grades. Retention at basic school and at high school, mainly if its frequency is bigger than one, have a negative effect on grades. These results confirm the ones from correlation analysis where a positive significant correlation was found ($\rho_{Eco} = -0.079^{**}$, $\rho_{Intr.Gest} = 0{,}071^{**}$).

The grades in Math 1 seem to be influenced by the ranking of ISEG among other university institutions in student's choice. This points to *numeri clause* as a factor that distort students' allocation from the corresponding preferences henceforth allowing for scores downgrading once in the compulsory Higher Education establishment.

Not in pace with our expectations but confirming correlation results, labor market participation both in part-time or full-time don't seem to influence academic performance.

It is interesting to notice that subject's teacher team and organization have a positive influence on academic performance in recent years. This outcome is not so surprising since it can be the result of a weaker formalization on the way the subjects are taught as well as of a less demanding evaluation of student's knowledge, particularly in Economy 1 and Maths 1 where the contents tend to require a heavier formalization. The fact that these variables are not present in the Management Introduction seems to confirm this thesis.

Summing up, from this study we can conclude that the main determinants of academic performance at university level are previous school trajectory's characteristics.

[15] Hassink, Wolter & Kiiver, Hanna, (2007)
[16] Smith & Naylor (2001)

Therefore a closer look into upper secondary contents, programme organization and evaluation methodologies, mostly in public education, would be advisable. The meaningful role still played by failure in previous school trajectory (a proxy for ability) points to the need of a more effective mentoring and coaching at least during the 1st year of graduation in order to ease the transition from upper secondary into university.

As we said before it seems that family background factors influence were not present anymore probably because their effect were already embedded in previous school trajectory's characteristics.

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Appendix 1 – Regression results for ln G_E1

Source	SS	df MS	Number of obs	= 973	
	F(12, 960)	= 25.98			
Model	14.8107754	12 1.23423129	Prob > F	= 0.0000	
Residual	45.6111592	960 .047511624	R-squared	= 0.2451	
			Adj R-squared	= 0.2357	
Total	60.4219346	972 .062162484	Root MSE	= .21797	
Ln_G_E1	Coef.	Std. Err.\ t	P>|t|	[95% Conf.	Interval]
d_ret_bas_school	.1328304	.063803 \ 2.08.	0.038	.007621	.2580398
Nret_highschool	-.0294356	.0150431\-1.96	0.051	-.0589567	.0000855
d_countryfinhighsch	-.1287063	.0638311 \-2.02	0.044	-.2539708	-.0034418
Ch_pub_priv_d	-.1074071	.0605736 \-1.77	0.077	-.2262791	.0114649
Ln univ_entrygrade	.9042207	.0884047 \10.23	0.000	.7307319	1.07771
d_00	.3120916	.0753288 \4.14	0.000	.1642634	.4599198
d_01	.2519435	.0849131 \2.97	0.003	.0853068	.4185803
d_02	.2126817	.0509316 \4.18	0.000	.1127315	.3126319
d_03	.2272777	.0297741 \7.63	0.000	.1688478	.2857076
d_04	.2035909	.0268691 \7.58	0.000	.150862	.2563197
d_05	.2024118	.0244338 \ 8.28	0.000	.1544619	.2503616
d_06	.2890459	.0182793 \ 15.81	0.000	.253174	.3249178
_cons	-2.17155	.4404436 \ -4.93	0.000	-3.035893	-1.307206

Variable |	VIF	1/VIF
d_06 |	1.51	0.662114
Ln univ_entrygrade |	1.38	0.725707
d_04 |	1.27	0.790031
d_03 |	1.26	0.793723
d_05 |	1.20	0.835658
Nret_sec |	1.14	0.875512
d_02 |	1.07	0.935006
Ch_pub_priv_d |	1.07	0.938424
d_00 |	1.06	0.939011
d_01 |	1.05	0.948174
d_countryfinhighsch |	1.02	0.983884
d_ret_bas_school |	1.02	0.984751
Mean VIF |	1.17	

White's test for Ho: homoskedasticity

against Ha: unrestricted heteroskedasticity

chi2(47) = 162.96

Prob > chi2 = 0.0000

Ramsey RESET test using powers of the fitted values of ln G_E1

Ho: model has no omitted variables

F(3, 957) = 15.42

Prob > F = 0.0000

Appendix 2

Regression results for ln G_MI

Source	SS	df MS	Number of obs	= 962	
	F(7, 954)	= 19.26			
Model	4.2643517	7 .6091931	Prob > F	= 0.0000	
Residual	30.1780282	954 .031633153	R-squared	= 0.1238	
			Adj R-squared	= 0.1174	
Total	34.4423799	961 .035840146	Root MSE	= .17786	
Ln G_MI	Coef.	Std. Err. \ t	P>|t|	[95% Conf.	Interval]
d_fem	.0734269	.011735 \ 6.26	0.000	.0503974	.0964564
d_ret_bas_school	-.1083255	.0542313 \ -2.00	0.046	-.214752	-.001899
Ret_highschool_1	-.0198899	.0167996 \ -1.18	0.237	-.0528584	.0130786
Ret_highschool_2	-.0654426	.032236 \ -2.03	0.043	-.1287042	-.002181
d_countryfinhighsch	-.0096041	.0543499 \ -0.18	0.860	-.1162632	.0970551
Ch_pub_priv_d	-.0323362	.0513068 \ -0.63	0.529	-.1330233	.0683509
Ln univ_entrygrade	.470572	.0646117 \ 7.28	0.000	.3437746	.5973694
_cons	.1642153	.3177692 \ 0.52	0.605	-.459392	.7878226

Variable |	VIF	1/VIF
Ln univ_entrygrade |	1.09	0.915727
Ret_highschool_2|	1.08	0.928131
Ch_pub_priv_d |	1.07	0.937042
Ret_highschool_1	1.06	0.942549
d_fem |	1.03	0.971792
d_countryfinhighsch |	1.02	0.984798
d_ret_bas_school |	1.01	0.989108
Mean VIF |	1.05	

White's test for Ho: homoskedasticity

against Ha: unrestricted heteroskedasticity

chi2(26) = 16.91

Prob > chi2 = 0.9119

Ramsey RESET test using powers of the fitted values of ln G_MI

Ho: model has no omitted variables

F(3, 951) = 1.33

Prob > F = 0.2623

Appendix 3

Regression results for ln G_M1

Source	SS	df MS	Number of obs	= 557	
	F(16, 540)	= 5.15			
Model	32.1863149	16 2.01164468	Prob > F	= 0.0000	
Residual	210.744933	540 .390268394	R-squared	= 0.1325	
			Adj R-squared	= 0.1068	
Total	242.931248	556 .436926704	Root MSE	= .62471	
Ln G_M1	Coef.	Std. Err. \ t	P>|t|	[95% Conf.	Interval]
d_fem	-.0279209	.0544155 \ -0.51	0.608	-.134813	.0789712
d_ret_bas_school	-.1447107	.2255645 \ -0.64	0.521	-.5878021	.2983807
Ret_highschool_1	-.080137	.0787058 \ -1.02	0.309	-.234744	.07447
Ret_highschool_2	.2534739	.1463318 \ 1.73	0.084	-.0339753	.5409232
d_countryfinhighsch	.0255714	.2139837 \ 0.12	0.905	-.3947711	.4459139
Ch_pub_priv_d	-.3663187	.2445859 \ -1.50	0.135	-.846775	.1141377
d_prefer_b~1	-.1009976	.0578506 \ -1.75	0.081	-.2146375	.0126423
Ln univ_entrygrade	.9311262	.3579961 \ 2.60	0.010	.2278905	1.634362
d_parttime	.0040551	.1047102 \ 0.04	0.969	-.2016341	.2097444
d_fulltime	.2315664	.1959982 \ 1.18	0.238	-.1534459	.6165787
d_00	(dropped)				
d_01	.626172	.6619485 \ 0.95	0.345	-.6741376	1.926482
d_02	.7983003	.3700702 \ 2.16	0.031	.0713467	1.525254
d_03	.6234267	.2611472 \ 2.39	0.017	.1104378	1.136416
d_04	.5307786	.1126856 \ 4.71	0.000	.3094228	.7521344
d_05	.5694805	.092817 \ 6.14	0.000	.3871539	.7518071
d_06	.1670568	.0703405 \ 2.37	0.018	.0288823	.3052314
_cons	-2.656837	1.791203 \ -1.48	0.139	-6.175416	.8617426

Variable	VIF	1/VIF
Ln univ_entrygrade	1.57	0.635122
d_06	1.52	0.657213
d_05	1.27	0.789015
d_04	1.21	0.827812
d_03	1.21	0.827917
d_fulltime	1.16	0.865240
d_prefer_b~1	1.15	0.867086
Ret_highschool_1	1.12	0.891967
d_01	1.12	0.892268
Ch_pub_priv_d	1.06	0.943833
Ret_highschool_2	1.06	0.945229
d_fem	1.05	0.949445
d_02	1.05	0.955035
d_countryfinhighsch	1.04	0.962574
d_ret_bas_school	1.03	0.972780
d_parttime	1.02	0.981400
Mean VIF	1.16	

White's test for Ho: homoskedasticity

against Ha: unrestricted heteroskedasticity

chi2(79) = 69.53

Prob > chi2 = 0.7679

Ramsey RESET test using powers of the fitted values of ln G_M1

Ho: model has no omitted variables

F(3, 537) = 1.96

Prob > F = 0.1184