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The Effect of School Diversity on Academic Performance

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Abstract

Using the rich Growing Up in Ireland dataset, the effect of school diversity on academic performance is examined in the context of Irish secondary schools. Previous studies on the subject in Europe and the USA have had mixed findings. Initial estimates using OLS find a significant negative effect of immigrant concentration on academic performance, even when controlling for prior ability and various school- and individual-level factors. An instrumental variables approach is used to eliminate an anticipated negative selection bias, but the estimated negative effects using this method are stronger, albeit imprecise.

1. Introduction

In this paper I examine the effect of school diversity, measured by the immigrant concentration in Irish secondary schools, on academic performance. Previous papers on the subject, mainly in the USA and Europe, have had mixed results. Although some studies have found significant negative effects on native students' test scores, others have found negligible and even positive effects. Enhanced creativity, critical thinking and problem-solving skills have been identified as potential channels through which immigrant concentration may positively affect academic performance (Cook and Fletcher, 2018), while potential explanations for negative effects include behavioural and social issues and the necessity to slow down teaching to accommodate different languages and learning styles (Maestri, 2017).

I use data from Growing Up In Ireland (GUI), the national longitudinal study of children and youth in Ireland, to examine the effect of immigrant concentration in Irish secondary schools on student performance in the Leaving Certificate exams. These are standardised state examinations taken by all Irish secondary school students, typically at the age of 17 or 18. OLS regression is first used to provide a reference point. An instrumental variables approach is then used to address potential endogeneity in the initial model. The rich GUI dataset allows for the inclusion in the model of a number of other school- and individual-level factors likely to affect exam results, such as prior ability, socioeconomic status, and student-teacher ratio.

This is the first paper to examine these effects in the context of Irish schools, which have become more culturally and ethnically diverse in line with Irish society over the past number of decades. The Irish case is particularly interesting as the country has gone from being relatively culturally homogenous to being exceptionally diverse even by international standards over a short period of time. As of 2016, 17% of Irish residents were born in another country, including approximately 70,000 primary and secondary school students between the

ages of 5 and 18 (CSO, 2016). More recent figures are not available due to the postponement of the 2021 census to 2022, but considering the recent arrival of over 33,000 refugees from Ukraine (CSO, 2022), most of whom are women and children, it is reasonable to assume that a trend of increasing cultural diversity will continue at least in the short-term. Understanding and dealing with the potential challenges brought about by these changes should therefore be a key priority of educational authorities in Ireland.

Initial OLS regressions show that there is a statistically significant negative relationship between immigrant concentration at the school level and Leaving Certificate results. Some of this effect can be explained by a number of controls which are added to the model, particularly measures of prior ability. However, this does not account for potential negative biases which arise due to both immigrants and natives self-selecting into certain schools and neighbourhoods. An instrumental variables approach is used to address this anticipated negative bias, but results are inconclusive. The results imply a stronger negative effect once sorting is taken into account, which is somewhat surprising but supports the findings of Jensen and Rasmussen (2011) who use a similar approach and also find stronger negative effects once sorting is accounted for. However, in this case the variation in the regressor is not sufficient to extrapolate meaningful conclusions from the results, and the findings from the IV regressions are not statistically significant.

2. Literature Review

The majority of attempts to examine the effects of immigrant concentration and diversity on academic performance are relatively recent. One early study on the topic is by Tam and Bassett Jr (2004), who found that high school diversity had large positive effects on Freshman GPA in the University of Illinois. They used least squares regression models and

controlled for a number of other factors, but did not account for possible selection biases identified by a number of later papers.

Later papers faced the task of addressing two key selection issues. Firstly, native students, particularly those with a high socioeconomic status, tend to self-select into areas and schools with less immigrants. This phenomenon, referred to in the American literature as "white flight" (Fairlie and Resch, 2002) is likely to lead to high-achieving students with certain unobservable characteristics attending schools with lower levels of immigrant concentration, leading to negative selection bias.

Secondly, immigrants tend to self-select into more disadvantaged areas due to a number of economic factors such as housing costs. As a result, immigrant students tend to attend schools which cater to students from disadvantaged backgrounds, which also leads to negative selection bias.

Several papers attempt to account for these biases by using fixed effects models. School fixed effects can be used to control for unobservable school characteristics by comparing different classes or cohorts (year groups) within the same school. This relies on the assumption that classes are randomly allocated within a school – it cannot be the case that classes are streamed based on ability, or that principals allocate resources based on the number of immigrants in the class. Ohinata and van Ours (2013) find that once school fixed effects are included in their model, the share of immigrant children in the classroom has no significant effect on the reading, science and mathematics test scores of 9- and 10-year-old Dutch students. Sensitivity analyses show that this is only the case after controlling for unobserved school characteristics by adding fixed effects to the model – the inclusion of student age and gender, number of books in student home, teacher experience, age and gender and class size are not sufficient to eliminate the selection bias. The same is also found to be the case in the

interesting but somewhat unique case of San Franciscan public schools (Mar, 2018), in which no single racial or ethnic group represents a majority.

Other papers include not only school, but also cohort fixed effects (Rao, 2019, Schneeweis, 2015). Rao (2019) analyses the effect of a policy change which forced private schools in Delhi to accept poorer students. In this case, the effect of increased diversity on academic performance is minimal, with a marginally significant negative effect on English scores, but no effects on other scores. Schneeweis (2015) examines the effect of immigrant concentration on a number of binary educational outcomes in Austria; grade repetition in primary school, grade repetition in secondary school, and whether a student attends a "high track" or "low track" secondary school. While the effect on non-migrant students is found to be negligible, there is a significant negative effect on the performance of migrant students, which increases as immigrant concentration increases.

Figlio et al. (2021) have access to birth records and are therefore able to include family-year fixed effects, comparing across siblings to account for all observable and unobservable family characteristics, including the fact that families may choose schools with less immigrants. Without family-year fixed effects, there is a significant negative correlation between immigrant exposure and native student performance. However, when family fixed effects are included, the effect of immigrant exposure on performance is positive and statistically significant for both reading and maths. The effect is largest for black and low socioeconomic status students.

Brunello and Rocco (2013) use data covering 19 OECD countries, and therefore face the additional issue of immigrants self-selecting into more affluent countries. To control for this, country fixed effects, GDP per capita, country-specific trends, education expenditure and number of immigrants in the country are included in the model. Information on test scores is

aggregated at the country level so the selection issues of white flight and immigrants self-selecting into disadvantaged neighbourhoods are not relevant. A higher share of immigrant students is found to have a small but statistically significant negative effect on the test scores of native students.

While the majority of these fixed effects papers reject the notion of a trade-off between ethnic diversity and academic outcomes, positive relationships between immigrant concentration and some social and behavioural issues within schools are observed. These include issues with social integration (Maestri, 2017), disciplinary infractions (Rao, 2019) and bullying (Ohinata and van Ours, 2013).

Other papers use instrumental variables approaches to overcome selection issues (Gould et al., 2009, Jensen and Rasmussen, 2011, Maestri, 2017). Maestri (2017) uses the difference in shocks between two cohorts as an instrument for the actual change in diversity between cohorts, where a shock is the difference between the levels of diversity predicted by parents when choosing schools and the actual realised level of diversity in a cohort. The level of ethnic diversity is found to have no significant effects on native students, but significant positive effects on the performance of minority students in reading and language. Ethnic diversity is also found to have a negative effect on social integration for both native and minority students.

Jensen and Rasmussen (2011) use an alternative IV approach to overcome the two selection issues outlined previously. Immigrant concentration in a wider geographical area (county) is used as an instrument for immigrant concentration in the school. Immigrant concentration in the county is unlikely to affect academic outcomes directly as counties are large, contain many schools, and contain schools with different immigrant concentration levels. The validity of the instrument relies on the assumption that individuals may be geographically

limited in their choice of housing (due to employment or family factors), and that this choice of housing is not based on the immigrant concentration of the wider county.

Their results are somewhat surprising – in an initial OLS regression, immigrant concentration is significantly negatively related to both reading and maths scores. The IV analysis, which should eliminate a negative bias, leads to a stronger negative effect on maths, implying that sorting may work in the opposite direction than expected. The authors hypothesise that this may be due to diverse schools receiving increased funding from local politicians, which is expected to improve test scores. The effects on reading are found to be insignificant.

Cook and Fletcher (2018) examine the effect of genetic diversity in the relatively homogenous setting of Wisconsin high schools in 1957. Genetic diversity is found to have a significant positive effect on years of schooling following high school graduation, job prestige, and income. Genetic diversity is also positively significantly related to indexes of personality traits related to creativity (openness to experience and extraversion), implying that creativity may be a primary channel through which diversity affects both academic performance and later-life outcomes.

To my knowledge, this is the first study of the effect of school diversity on academic performance in an Irish context. Doris et al. (2022) estimate value added of Irish secondary schools using Growing Up in Ireland (GUI) data but focusing on performance in the Junior Cert rather than the Leaving Cert. They control for a number of school- and individual-level variables including prior ability (using the results of Drumcondra maths and reading tests) and find that few school-level variables have significant effects on a school's value added. An exception is that schools with a female principal have a higher value added score. This paper uses a similar dataset and a similar set of controls.

My approach is most similar to that of Jensen and Rasmussen (2011). While they use immigrant concentration in the county as an instrument for immigrant concentration in the school, I use immigrant concentration in the Nomenclature of Territorial Units for Statistics (NUTS) regions, of which there are eight in total; Border, West, Mid-West, South-East, South-West, Dublin, Mid-East and Midland. Each NUTS region contains between two and five of Ireland's local government areas (CSO, n.d.).

3. Methodology

As mentioned previously, my empirical approach is based on that of Jensen and Rasmussen (2011). Before utilising an instrumental variables approach, two separate OLS regressions are used to provide a reference point. Each regression uses a different measure of school-level diversity. The regressions in question are:

$$y_i = \beta_0 + \beta_1 n_i + \beta_2 X_i + \varepsilon_i$$

$$y_i = \beta_0 + \beta_1 l_i + \beta_2 X_i + \varepsilon_i$$

where y_i is the total CAO points achieved by student i in their Leaving Certificate exams, n_i and l_i are two alternative measures of school-level immigrant concentration, and X_i is a vector of control variables. The variables included in X are Drumcondra maths test percentage score, Drumcondra reading test percentage score, equivalised household annual income, school student-teacher ratio, and dummy variables for student gender, principal gender and whether at least one of a student's parents has a third level degree.

Although this OLS regression provides a useful reference point, it does not address the two key sample selection problems. The first of these problems is that native and particularly high-income students and parents may self-select by choosing neighbourhoods and schools with a lower immigrant concentration. This leads to students from favourable socioeconomic

backgrounds, who are likely to have unobservable characteristics which will help them to perform well in the Leaving Cert, locating in less diverse schools. As such, it's likely that the correlation between school diversity and academic performance identified by the initial OLS regression will contain a negative bias, and cannot be interpreted as a causal effect. It is possible that some of the control variables in X will help to control for this selection bias (particularly household income and parental education) but previous papers on the topic have not found such measures to be sufficient (Figlio et al., 2021, Mar, 2018, Ohinata and van Ours, 2013).

The second selection issue is that immigrants tend to self-select into certain neighbourhoods. The primary issue is that immigrants tend to locate in low-income and disadvantaged neighbourhoods for a number of economic reasons such as housing costs. This also leads to a negative selection bias, whereby disadvantaged schools with negative unobservable characteristics (such as inferior funding or resources) will have a higher immigrant concentration. It's possible that the effect will be exacerbated by immigrants then self-selecting into areas which already have a higher level of immigrant concentration due to family or social factors. Like the first selection issue, it's possible to partially account for this by adding independent variables (such as student-teacher ratio) to the OLS regression, but this will not account for the bias in its entirety.

Other papers based on more comprehensive datasets have used school-, cohort- and even family-level fixed effects to address these issues, but this is not a viable option in this case. All of the observations in the GUI sample were born in the same year and are therefore likely to be in the same school year, making it impossible to compare cohorts within schools. The GUI data also does not contain information on how students within cohorts are split into class groups, making it impossible to compare students within a given cohort. The dataset does not contain information on how immigrant students are distributed throughout the school, but

simply the total number of immigrant students in the school. Even with this information, the GUI data is based on a sample of students across the country, meaning that there is likely to be only a handful of observations in each school.

Instead, I address these selection issues by using an instrumental variables approach similar to that of Jensen and Rasmussen (2011). Immigrant concentration in a larger geographical area is used as an instrument for immigrant concentration at the school level. In the absence of information on the county in which each school is located due to confidentiality issues, I use immigrant concentration in the NUTS region. In order for this to be a viable instrument, it must be both relevant and valid.

For the instrument to be considered relevant, it must be correlated with immigrant concentration at the school level. The strength of this correlation is examined in the Results section.

For the instrument to be considered valid, it must be the case that the level of immigrant concentration in the larger geographical area is exogenous and does not have an effect on Leaving Cert results except through immigrant concentration at the school level. Using the same reasoning as Jensen and Rasmussen (2011), it's reasonable to assume that immigrant concentration in the NUTS region only affects Leaving Cert results through immigrant concentration in the school as NUTS regions are large, contain many schools and have schools with different immigrant concentration levels.

In order for the instrument to be exogenous, it must be the case that although individuals might choose which areas to live in they are somewhat restricted in this choice (due to family reasons, social ties, and employment or other economic reasons). Their choice of where to live may be partially based on levels of immigrant concentration in the local area, but it's unlikely that it will be based on immigrant concentration in the wider NUTS region, i.e. it is

unlikely that people will choose to relocate across the borders of NUTS regions on the basis of immigrant concentration in that region. Individuals cannot therefore control immigrant concentration in the NUTS region, and it is exogenous.

School-level diversity n_i (and, separately, l_i) is estimated based on diversity in the NUTS region r_i and the vector of control variables X_i outlined above for the OLS regression. CAO points y_i are then regressed on the predicted school-level diversity from the first regression $\hat{n}_i$ (and, separately, $\hat{l}_i$) and X_i. The first model, which uses n_i as the measure of diversity, is shown below:

$$n_i = \alpha_0 + \alpha_1 r_i + \alpha_2 X_i + \nu_i$$

$$y_i = \beta_0 + \beta_1 \hat{n}_i + \beta_2 X_i + \varepsilon_i$$

The second model, which uses l_i as the measure of diversity, is therefore:

$$l_i = \alpha_0 + \alpha_1 r_i + \alpha_2 X_i + \nu_i$$

$$y_i = \beta_0 + \beta_1 \hat{l}_i + \beta_2 X_i + \varepsilon_i$$

4. Data

The data used in this analysis is from the Child Cohort of the Growing Up in Ireland (GUI) survey, the national longitudinal study of children and youth in Ireland. The Child Cohort is a cohort of children born between November 1997 and October 1998. Data for this cohort were collected in four waves; when the children were 9, 13, 17/18, and 20 years old. In wave 3, when the students were 17 or 18 years old, their school principals completed a questionnaire providing several pieces of information about the school, including the total number of students in the school who were foreign nationals and the total number of students with a first language other than English or Irish (Economic and Social Research Institute, 2016).

These responses are used to form the two measures of diversity. The main measure of diversity used is the proportion of students in the school who are foreign-nationals n_i. However, a second measure of diversity is also examined separately; the proportion of students in the schools whose first language is not English or Irish l_i. This second measure essentially excludes students who are foreign-nationals but who are originally from the UK or other English-speaking countries. As of 2016, over 19% of foreign nationals living in Ireland were from the UK (CSO, 2016). These students are likely to be ethnically and culturally similar to native Irish students, so the second measure could be considered a truer measure of ethnic and cultural diversity. The same instrument (proportion of people in the NUTS region whose nationality is not Irish) is used for both school-level measures of diversity. Data on diversity in NUTS region is taken from the 2016 census.

The outcome variable is CAO points. These are calculated based on results in the Leaving Certificate and are used to determine which students are offered places in third level courses with limited capacity. Students therefore generally sit the Leaving Cert exams with the aim of maximising CAO points.

Points are awarded based on the grade achieved in each subject and whether the student took the subject at higher level or ordinary level. For example, a student who receives a percentage grade between 90% and 100% receives 100 points at higher level (referred to as a H1) and 56 points at ordinary level (referred to as an O1). A student who receives a percentage grade between 80% and 89% receives 88 points at higher level (H2) and 46 points at ordinary level (O2). An extra 25 is added to the number of points allocated for higher level mathematics assuming the student receives at least 40% - for example, a student who receives a grade of 95% in higher level maths receives 125 points (for the full points scale, see Central Applications Office (n.d.)).

Students can sit as many Leaving Cert subjects as they wish, but typically taken seven subjects. Their points from their best six subjects are aggregated to calculate their total. The maximum number of points that a student can receive is therefore 625 (six H1's including higher level maths).

Summary statistics for these variables, along with the control variables, are shown in Table 1.

Although there are 8,568 study children in wave 1, the sample used in this analysis contains 2,196 observations. The reduction is largely due to sample attrition, but also due to the removal of a number of observations because of missing or erroneous data. In particular, several observations were removed from the sample due to missing or obviously inaccurate responses in the principal surveys.

Average CAO points across the sample are 430. It's likely that this is higher than the average in the population (62.6% of students in 2019 achieved less than 400 points (Central Applications Office, 2019)). The average is higher among immigrant students than native students, which is at odds with much of the literature from other countries, but this may be explained by the fact that only 225 immigrant students are included in the sample. The points range from 40 (an O4 and an O6, or an O5 in two subjects) to 625 (a H1 in six subjects including maths).

The average percentage of students who are foreign nationals and who have a first language other than English or Irish are 7% and 2% respectively. In both cases, there are schools with no students who fit this criteria, while some principals report having up to 50% foreign national students and up to 36% of students with a different first language.

The average percentage of the population in each NUTS region whose nationality is not Irish is 11% (9% when people from the UK are excluded), and varies from 9% to 15%. As may be expected, Dublin is the region with the highest concentration. When people from the UK are

excluded, the Border region is the region with the lowest concentration both in terms of birthplace and nationality.

Drumcondra maths and reading tests are taken by all study children at the age of 9, thus providing a measure of prior ability which is measured before this ability can be influenced by the level of diversity in the student's secondary school. The scores are similar for native and immigrant students, with immigrants performing marginally better in both. This is slightly surprising but it does correspond to high Leaving Cert results among immigrant students in the sample. As noted previously, this may be a feature of this relatively small sample of immigrant students. Variance is slightly higher in maths than in reading. In both maths and reading, scores range from 0% to 100%.

Equivalised household annual income is taken from wave 3. The average is €18,245, and values range from €3,369 to €785,235. The maximum value is high but feasible. The minimum value represents poverty, but is unlikely to be an error, as any values under €5,000 were replaced by wave 2 responses, meaning that observations with incomes lower than €5,000 reported these incomes in both waves 2 and 3.

Again, it is somewhat surprising that immigrant families have higher incomes. If this was representative of the country as a whole it would imply that immigrants may self-select into better schools in more affluent areas (as opposed to the opposite effect which is suggested by the existing literature on the topic), but it seems more likely that this is simply a feature of this sample.

49% of students in the sample are male, as are 59% of school principals. 48% of students have at least one parent with a third level degree. Again, this is higher among immigrant students, so it appears to be the case that the 258 immigrant students in this sample are relatively high-performing students from wealthy backgrounds.

The average student-teacher ratio is 15.1 students per teacher and ranges from 5 to 24.7. The national average was 13.7 in 2017 (CSO, 2018).

5. Results

The analysis is carried out in three parts. Firstly, raw correlations are identified by regressing CAO points solely on the diversity measures. Secondly, a number of control variables are added to the OLS regression to isolate the effect of diversity. These regressions provide a useful reference point but do not address the issues of endogeneity discussed earlier in this paper. Thirdly, these issues are addressed through the use of an instrumental variables approach.

5.1. Raw Correlations

To identify raw correlations between academic performance (as measured by CAO points) and school diversity (as measured by immigrant concentration), a simple linear regression is used. CAO points are regressed first on the proportion of students in the school who are foreign nationals, and then separately on the proportion of students in the school with a first language other than English or Irish.

The first regression is $y_i = \beta_0 + \beta_1 n_i + \varepsilon_i$, where y_i is the CAO points for student i and n_i is the proportion of students in student i's school who are foreign nationals. The estimated coefficient b_1 is –220.12. As the variable n_i ranges from 0 to 1, this coefficient can be interpreted as the expected effect on CAO points of an increase in school diversity by 100 percentage points. For instance, moving a student from a school with almost no students who are foreign nationals to a school with almost 100% foreign national students would cause an expected decrease of approximately 220 CAO points. A more useful interpretation is that if the percentage of students who were foreign nationals was to increase by 10 percentage points (from 5% to 15%, for example), expected CAO points would decrease by 22. The

standard error is 30.74, meaning that this strong negative effect is statistically significant even at the 1% significance level.

The second regression uses the alternative measure of proportion of students in student i's school whose first language is not English or Irish. As mentioned previously, this could be considered a truer measure of diversity as it excludes students who are foreign nationals but who come from similar ethnic or cultural backgrounds as the native students. The regression in question is $y_i = \beta_0 + \beta_1 l_i + \varepsilon_i$. The estimated coefficient b_1 is –134.83. The standard error is 68.51, meaning that although this is statistically significant at a 5% significance level, it is not statistically significant at a 1% (or even at a 4%) significance level.

5.2. Control Variables

It would not be reasonable to suggest that the coefficients in the previous section are reflective of the true effect of diversity on academic performance. There are several other factors which may partially explain these negative effects, a number of which are added to the model in this section.

Controls are added for prior ability (results from Drumcondra maths and reading tests taken by the students at the age of 9), student gender, socioeconomic and family background (equivalised household income and whether at least one of the student's parents has a third level degree), and school-level characteristics (student-teacher ratio and principal gender).

As might be expected, the estimated coefficients for the two measures of prior ability are both positive and statistically significant even at a 1% significance level in both models. In both models, each additional percentage point earned in the reading (maths) Drumcondra tests translates to an additional 1.8 (1.4) CAO points, holding all other variables fixed.

The expected points for male students are 19 lower than the expected points for female students holding all other variables fixed. This figure is supported by national averages.

Across all Leaving Certificate candidates in 2019, female students outperformed male students by an average of 6.5 points on a composite scale of 0 to 140 (State Examinations Commission, 2021). The gap in the models in this paper is 19 points on a scale of 0 to 625, which is a smaller proportionate gap, implying that some of the national gap can be explained by other factors included in this model such as prior ability.

The effect of equivalised household annual income is negligible when the other variables in the model are taken into account.

The student-teacher ratio is the number of students per full-time teacher employed in the school. One would therefore expect that the coefficient should be negative, as a lower student-teacher ratio would imply that teachers spend more time teaching and assisting each individual student. This is not the case in this model, although the effect is statistically insignificant even at a 10% significance level.

The coefficient for principal gender is also somewhat surprising. This variable was included partially based on Doris et al. (2022), who found that having a female principal is one of the few school-level variables which enhances a school's value-added. In this case, expected points are 2.3 higher in schools with male principals, although this, like household incomes, is not statistically significant even at a 10% significance level.

Perhaps most striking is the coefficient on the dummy variable for a parent with a third-level degree; this increases expected points by 48.9, holding all other factors fixed.

Table 2 shows the results of the initial OLS regression using n_i, the proportion of students who are foreign nationals, as the measure of school diversity. The estimated coefficient b_1 is –101.03. This is still negative and statistically significant even at the 1% significance level, but represents a much weaker effect than was identified in the initial regression without controls. This implies that a large portion of the negative effect identified in the initial

regression is explained by the controls that have been added. Specifically, the addition of the two measures of prior ability to the regression decreases the coefficient from –220.12 to –107.53.

Table 3 shows the results of the OLS regression using l_i, the proportion of students with a first language other than English or Irish, as the measure of school diversity. The estimated coefficient b_1 was –134.83 in the initial regression without controls, and has decreased (in absolute terms) to –34.57. The standard error is now 56.12, meaning that the effect is no longer significant even at a 10% significance level.

5.3. Instrumental Variables

As discussed previously, the results of these regressions cannot be interpreted as causal effects as there are issues surrounding endogeneity; both native students and immigrants tend to self-select into neighbourhoods and schools in a manner which causes negative selection bias. It is therefore expected that the above models exaggerate the negative effects of school diversity. To test whether this is the case, an instrumental variables approach is used. Immigrant concentration in a wider geographical region (NUTS region) is used as an instrument for immigrant concentration at the school level. Specifically, the instrument being used is r_i, the proportion of people in the NUTS region whose nationality is not Irish. The validity of the instrument is discussed in the Methodology section.

To investigate the strength of the instrument, the F-statistic for the first-stage regression is calculated. In the first model, where school diversity is measured by the proportion of students who are foreign nationals n_i, the F-statistic is 59. In the second case, where school diversity is measured by the proportion of students whose first language is not English or Irish l_i, the F-statistic is 28. In both cases, the percentage of people in the NUTS region whose nationality is not Irish r_i can be considered a strong instrument.

Table 4 shows the results of the instrumental variables regression using n_i as the measure of diversity. Somewhat surprisingly, the estimated coefficient b_1 is –160.18, which represents a stronger negative effect than in the OLS regression (where b_1 was –107.53). However, the standard error in the instrumental variables model is 147.27, meaning that the effect is not statistically significant even at a 10% (or 20%) significance level.

Table 5 shows the results of the instrumental variables regression using l_i as the measure of diversity, and again using r_i as an instrument for l_i. Again, the absolute value of the coefficient has increased significantly to –489.28 (from –34.57), but again the standard error is high at 460.37, meaning that the effect is not statistically significant even at a 20% significance level.

The larger standard errors are to be expected as the instrumental variables approach eliminates some of the variation from the measure of school diversity, thus increasing the standard error. The issue in this case is that the remaining variation is not sufficient to estimate causal effects precisely. The cause of the issue is made evident by comparing the standard deviations of the raw measures of diversity used in the OLS regressions previously (n_i and l_i) and the standard deviations of the predicted measures of diversity from the first stage regression ($\widehat{n_i}$ and $\widehat{l_i}$). The standard deviation of $\widehat{n_i}$ is 0.019, while the standard deviation of n_i is 0.074. Likewise, the standard deviation of $\widehat{l_i}$ is 0.008, while the standard deviation of l_i is 0.034. In both cases, the standard deviation of the predicted diversity measure is approximately a quarter of the standard deviation of the original diversity measure.

As a result, it's difficult to extrapolate meaningful conclusions from the results of the IV regressions, which attempt to estimate effects by exploiting the variation in the estimated measures $\widehat{n_i}$ and $\widehat{l_i}$. The 95% confidence interval for b_1 when using n_i as the measure of

school diversity, for example, is –448.83 to 128.46. The lower value implies that moving a student from a school with immigrant concentration of 5% to a school with immigrant concentration of 15% (but no other differences in the school-level characteristics included in the model) would cause an expected decrease of 44.8 CAO points. The higher value implies that the same exercise would cause expected an increase of 12.8 CAO points. In any case, it is not possible to come to any confident conclusions on the nature of the actual causal effect.

It is not the case, however, that a clear reduction in the negative effects of diversity is observed when sorting is taken into account. The motivation behind using this approach was to eliminate a negative bias from the results which is caused by sorting. The elimination of this bias is expected to bring the value of the estimated coefficients closer to 0. Although the standard errors have increased, the absolute values of the coefficients have also increased, implying that the magnitude of the negative effects have increased, not decreased. Jensen and Rasmussen (2011) also found that using such an approach increased the absolute value of the coefficients, and on this basis they inferred that sorting occurs in the opposite direction than was previously expected. However, their standard errors were much lower than those in this paper and their results were statistically significant while these aren't. It would therefore be premature to come to the same conclusions on the basis of these results. While the effects of sorting are not observed as clearly as may have been expected, this may be partially due to the lack of variation in the regressor when an instrument is used. As a result, the results of the instrumental variables analysis are quite inconclusive.

It should be noted that the results outlined above concern the effect of immigrant concentration on all students, both native and non-native. As the sample contains only 225 immigrant students, it was not feasible to examine the effects on these students separately. However, the effect on just the native students in the sample was carried out (n=1,971). The results were qualitatively the same as when using the full sample. The coefficients of interest

in each regression increased in absolute value when examining only native students, but so do the standard errors as the sample decreases in size.

6. Conclusion

The levels of ethnic and cultural diversity in Irish schools has been rapidly increasing in recent decades. No research has been undertaken to date on the effects of this change on student outcomes. Using a rich GUI dataset, I examine the effect of school diversity on academic performance, controlling for prior ability, socioeconomic factors and school characteristics.

Initial OLS regressions show a strong negative relationship between immigrant concentration at the school level and Leaving Cert results. These results are likely to contain a negative bias due to immigrants and natives self-selecting into particular schools and neighbourhoods. An instrumental variables approach is used in an attempt to eliminate this bias with the expectation that the negative effects will be lessened. Although it's not possible to estimate precise effects, this does not appear to be the case.

Although the results are somewhat inconclusive, they do imply a negative relationship between immigrant concentration and academic performance. Immigrant concentration may therefore be considered a useful indicator which could help educational authorities to identify schools which are likely to benefit from additional resources or support. Furthermore, the results imply that policies which encourage immigrant students to locate across a broad range of schools may be beneficial, as this would prevent situations whereby a small number of schools have very high immigrant concentrations.

There is scope for further research utilising a more comprehensive dataset which would allow for the use of school, cohort and even family fixed effects to address the selection issues while retaining enough variation to estimate precise effects. In the absence of such a dataset,

analysis using the GUI data but with information on the county in which each school is located may yield more informative results, as the instrument would be the immigrant concentration in one of 26 counties, rather than the immigrant concentration in one of 8 NUTS regions.

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Tables

Table 1: Summary Statistics

	Country of birth		
	Ireland (N=1,971)	Other (N=225)	Total (N=2,196)
Total CAO points			
Mean	428.23	444.96	429.95
Standard deviation	(109.06)	(102.51)	(108.50)
Minimum value	40	110	40
Maximum value	625	625	625
Proportion of students in school who are foreign nationals			
Mean	0.07	0.08	0.07
Standard deviation	(0.07)	(0.08)	(0.07)
Minimum value	0	0	0
Maximum value	0.5	0.5	0.5
Proportion of students in school with first language other than English/Irish			
Mean	0.02	0.02	0.02
Standard deviation	(0.03)	(0.04)	(0.03)
Minimum value	0	0	0
Maximum value	0.36	0.33	0.36
Proportion of population in NUTS region whose nationality is not Irish			
Mean	0.11	0.11	0.11
Standard deviation	(0.02)	(0.02)	(0.02)
Minimum value	0.09	0.09	0.09
Maximum value	0.15	0.15	0.15
Drumcondra Reading test - percentage correct			
Mean	75.81	76.05	75.83
Standard deviation	(18.82)	(17.93)	(18.73)
Minimum value	0	10	0
Maximum value	100	100	100
Drumcondra Maths test - percentage correct			
Mean	61.43	61.52	61.44
Standard deviation	(20.06)	(19.52)	(20.00)
Minimum value	0	0	0
Maximum value	100	100	100
Male			
Mean	0.50	0.48	0.50
Standard deviation	(0.50)	(0.50)	(0.50)
Minimum value	0	0	0
Maximum value	1	1	1
Equivalised household annual income			
Mean	18,196.64	18,674.59	18,245.61
Standard deviation	(20,298.17)	(14,813.49)	(19,803.96)
Minimum value	3,369.33	5,033.56	3,369.33
Maximum value	785,234.90	137,362.60	785,234.90
At least one parent has a third level degree			
Mean	0.46	0.63	0.47
Standard deviation	(0.50)	(0.48)	(0.50)
Minimum value	0	0	0

Maximum value	1	1	1
Student-teacher ratio			
Mean	15.13	14.94	15.11
Standard deviation	(2.39)	(2.72)	(2.43)
Minimum value	4.97	7.65	4.97
Maximum value	24.67	24.67	24.67
Male principal			
Mean	0.59	0.60	0.59
Standard deviation	(0.49)	(0.49)	(0.49)
Minimum value	0	0	0
Maximum value	1	1	1

Table 2: OLS (Nationality as Measure of Diversity)

	Coefficient (Standard error)
Proportion of students in school who are foreign nationals	-101.03
	(25.28)
Drumcondra Reading test - percentage correct	1.77
	(0.12)
Drumcondra Maths test - percentage correct	1.35
	(0.11)
Male	-19.00
	(3.92)
Equivalised household annual income	0.0002
	(0.00)
At least one parent has a third level degree	48.92
	(3.86)
Student-teacher ratio	0.08
	(0.77)
Male principal	2.62
	(3.96)
Intercept	198.58
	(14.89)

Table 3: OLS (Language as Measure of Diversity)

	Coefficient (Standard error)
Proportion of students in school with first language other than English/Irish	-34.57
	(56.12)
Drumcondra Reading test - percentage correct	1.80
	(0.12)
Drumcondra Maths test - percentage correct	1.37
	(0.11)
Male	-19.08
	(3.93)
Equivalised household annual income	0.0002
	(0.00)
At least one parent has a third level degree	49.17
	(3.86)
Student-teacher ratio	0.34
	(0.78)
Gender of principal	2.27
	(3.96)
Intercept	184.49
	(14.82)

Table 4: IV (Nationality as Measure of Diversity)

	Coefficient (Standard error)
Proportion of students in school who are foreign nationals	-160.18
	(147.27)
Drumcondra Reading test - percentage correct	1.75
	(0.14)
Drumcondra Maths test - percentage correct	1.34
	(0.12)
Male	-18.98
	(3.96)
Equivalised household annual income	0.0002
	(0.00)
At least one parent has a third level degree	48.80
	(4.02)
Student-teacher ratio	-0.12
	(0.89)
Gender of principal	2.72
	(3.97)
Intercept	208.15
	(27.01)

Table 5: IV (Language as Measure of Diversity)

	Coefficient (Standard error)
Proportion of students in school with first language other than English/Irish	-489.13
	(460.37)
Drumcondra Reading test - percentage correct	1.78
	(0.14)
Drumcondra Maths test - percentage correct	1.34
	(0.13)
Male	-19.77
	(4.10)
Equivalised household annual income	0.0002
	(0.00)
At least one parent has a third level degree	49.80
	(4.07)
Student-teacher ratio	-0.77
	(1.34)
Gender of principal	-0.12
	(4.52)
Intercept	213.89
	(32.08)