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Better Schools for Better O-Level Results in Sri Lanka

ASHANI ABAYASEKARA AND NISHA ARUNATILAKE

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Please address orders to:
Institute of Policy Studies of Sri Lanka
100/20, Independence Avenue, Colombo 7, Sri Lanka
Tel: +94 11 2143100 Fax: +94 11 2665065
Email: ips@ips.lk
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Ashani Abayasekara is an Economist with research interests in labour economics, economics of education, development economics, and micro econometrics. She holds a BA in Economics with First Class Honours from the University of Peradeniya and a Masters in International and Development Economics from the Australian National University (ANU).
ashani@ips.lk

Nisha Arunatilake is an Economist with over 16 years of research experience. Her research and publications have covered especially the areas of education, labour, employment, health, public finance and social protection.

She has been a consultant to the World Bank; United Nations Development Programme (UNDP); Asian Development Bank (ADB); Asian Development Bank Institute (ADBI); International Labour Organization (ILO), in numerous research studies. She was the lead author of the second National Human Development Report (2012) for Sri Lanka.

she holds a BSc in Computer Science and Mathematics with summa cum laude from the University of the South, USA and an MA and PhD in Economics from Duke University, USA.
nisha@ips.lk

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Abbreviations

DCS - Department of Census and Statistics

EQI - Education Quality Inputs

GCE - General Certificate in Education

GOL - Generalized Ordered Logit

HLM - Hierarchical Linear Modeling

ICC - Intra-Class Correlation

MI - Multiple Imputation

MOE - Ministry of Education

NEC - National Education Commission

NEREC - National Education Research and Evaluation Center

NGOs - Non-governmental Organizations

OLS - Ordinary Least Squares

ORL - Ordered Logit Model

SLEAS - Sri Lanka Education Administration Service

SLPS - Sri Lanka Principals Service

SLTS - Sri Lanka Teachers Service

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Executive Summary

It is a well-established fact that a highly educated and skilled workforce is essential for Sri Lanka to remain competitive. Good performance at the O-Levels is a pre-requisite for further education including the A-Levels—which also serves as the university entrance examination—and many vocational training programs. In 2015, close to half the students who sat for the O-Levels either failed or only conditionally passed due to failing mathematics. Given the strong emphasis placed by successive governments in providing free education, examining the effect of publicly funded school resources on student performance is of substantial interest and policy relevance. Identifying school-level factors that have a strong bearing on educational outcomes is also important in ensuring that scarce state funds are utilized efficiently. Further, examining the significance of school resources takes on added significance in the present-day context, where the rising emergence of private tutoring holds potential implications for the effect that school-level factors have on student performance.

In this backdrop, in this study we investigate the impact of school-level resources—including student socioeconomic, school, teacher, principal, and provincial characteristics—on student performance at the O-Level examination. We estimate three econometric models: (1) a standard ordinary least squares regression; (2) a hierarchical linear modelling technique; and (3) an ordered logit model. We obtain data from the annual School Census of government schools conducted by the Ministry of Education of Sri Lanka for the year 2016.

Descriptive analysis of the data indicates wide disparities in educational outcomes among schools. The average rate of students qualifying from the O-Levels to proceed to A-Level classes in national schools is 70%, almost double the average of 39% for provincial schools. Among provincial schools, those in the Southern province outperform schools in other provinces, although the differences are less pronounced. A distinction between national and provincial schools is also evident in the allocation of school-level resources.

The econometric estimations are largely consistent across the three modelling techniques. Across the pooled sample of schools, several school- and provincial-level factors have a significant impact on O-Level examination performance, although the magnitudes of these impacts are not large. The shares of qualified mathematics and first language teachers, grade six scholarship holders, and funds received from external sources positively influence student performance. Teacher leave, on the other hand, has a sizeable negative effect. Additionally, a school's ranking based on status, type, size, and principal service category has a significant bearing on achievement, with increasingly lower O-Level scores being observed for inferior schools and those managed by principals with lower levels of qualifications and experience. A distinction among different school categorizations reveals differential impacts of several variables including school status, type, school-level funds, teacher quality, and principal service grade.

Our findings point to several policy implications for improving O-Level performance rates of students in Sri Lanka. The finding that O-Level performance is lower in both smaller schools and 1C and Type 2 schools holds even after controlling for the share of scholarship holders, indicating that lower performance is not only due to differences in ability. These schools—which are predominantly provincial schools—thus require special attention. The significant positive relationship observed between high quality teachers and student achievement highlights the need for developing policies to ensure that schools attract qualified and experienced staff members. The systematic training and recruitment of teachers into Teacher Service is important in this regard. Also essential is a reallocation of existing qualified and experienced teachers from better performing schools to schools reporting poor examination results. The negative relationship observed between teacher leave and educational outcomes calls for the implementation of incentive schemes that encourage teacher commitment. Lastly, the better O-Level results recorded in schools managed by better qualified and experienced principals suggest the need to enhance the quality of principals' training programmes, and to carry out recruitment to Principal Service in a systematic and merit-based manner.

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ශ්‍රී ලංකාවේ තරගකාරී තත්වය පවත්වා ගැනීමටනම් හොඳින් අධ්‍යාපනය ලත් නිපුණතාවයෙන් යුත් ශ්‍රම බලකායන් අත්‍යවශ්‍ය බව හොඳින් තහවුරු වූ කරුණකි. සාමාන්‍ය පෙළ සඳහා හොඳ සාමාර්ථයක් තිබීම, උසස් පෙළ, උසස් පෙළ තුලින් විශ්ව විද්‍යාල ප්‍රවේශය සහ නොයෙකුත් වෘත්තීය පුහුණු වැඩ සටහන් සඳහා අනිවාර්ය ය. 2015 වසරේ සා. පෙළ සඳහා පෙනී සිටි සිසුන්ගෙන් අඩකට ආසන්න ප්‍රමාණයක් අසමත් වූහ. නැතිනම් ගණිතය අසමත්වීමෙන් අඩ සුදුසුකමක් ලබා ගත්හ. සෑම ආණ්ඩුවක්ම නිදහස් අධ්‍යාපනය පිළිබඳව දක්වන උනන්දුව නිසා සිසුන්ගේ කාර්ය සාධනය කෙරේ රාජ්‍ය අරමුදල් ලබන පාසල්වල බලපෑම පරික්ෂා කිරීම බලවත් අවශ්‍යතාවයක් මෙන්ම ප්‍රතිපත්ති හා අදාල කිරීමක් ද වේ. අධ්‍යාපන ප්‍රතිඵල කෙරේ ප්‍රබල බලපෑමක් වන පාසල් මට්ටමේ සාධක හඳුනා ගැනීම හිඟ වූ රාජ්‍ය අරමුදල් කාර්යක්ෂමව යොදා ගැනීම තහවුරු කිරීමට ද වැදගත් ය. තව දුරටත් ශිෂ්‍ය කාර්ය සාධනය කෙරේ බලපාන පෞද්ගලික ටියුෂන් ලබා දීම ඉහළ යමින් ඇති තත්වයක් තුළ පාසල් සම්පත් වලින් ශිෂ්‍ය ප්‍රතිඵල මත ඇති කරන බලපෑම අධ්‍යයනය කිරීම වැදගත් ය.

මෙවැනි පසුබිමක අපි සා. පෙළ විභාගයේ දී ශිෂ්‍ය කාර්ය සාධනය කෙරේ ශිෂ්‍ය සමාජ ආර්ථික, පාසල, ගුරුවරු, විද්‍යාලාධිපති සහ පළාත් ලක්ෂණ ඇතුළත් පාසල් මට්ටමේ සම්පත්වල බලපෑම විමර්ශනය කෙළෙමු. අපි ආර්ථික මිතික ආදර්ශ තුනක් ඇස්තමේන්තු කෙළෙමු: (1) සම්මත සාමාන්‍ය අඩුතම වර්ග නිමානකය (2) අනුපිළියෙළ රේඛීය ආදර්ශක ක්‍රමය (3) පටිපාටිගත ලඝුක ආදර්ශකය. අප දත්ත ලබා ගත්තේ 2016 වසර සඳහා අධ්‍යාපන අමාත්‍යාංශය මගින් වාර්ෂිකව පවත්වන ලද ආණ්ඩුවේ පාසල් සංගණනයෙනි.

දත්ත විස්තරාත්මක විශ්ලේෂණයට ලක් කිරීමේ දී පාසල් අතර අධ්‍යාපන ප්‍රතිඵලවල පුළුල් විසරණයන් දක්වයි. ජාතික පාසල්වලින් උ. පෙළ පංතිවලට ඇතුළුවීමට සා. පෙළ සුදුසුකම් ලබන ශිෂ්‍යයන්ගේ සාමාන්‍ය අනුපාතය සියයට 70ක් වන අතර එය පළාත් පාසල්වල සාමාන්‍යය වන සියයට 39 මෙන් දෙගුණයකට ආසන්න වේ. පළාත් පාසල් අතුරෙන් දකුණු පළාතේ පාසල් කැපී පෙනෙන ආකාරයෙන් නොවන නමුත් අනෙක් පළාත්වලට ඉදිරියෙන් සිටී. පාසල් මට්ටමේ සම්පත් සම්බන්ධයෙන් ද ජාතික සහ පළාත් පාසල් අතර වෙනසක් දැකිය හැකිය.

ආර්ථික මිතික නිමානකය ආදර්ශන ක්‍රම තුනේ දීම බොහෝ දුරට නොවෙනස්ව පවතී. යොදා ගත් පාසල් නියැදිය පුරාම සා. පෙළ විභාගයේ කාර්ය සාධනය කෙරේ පාසල් සහ පළාත් මට්ටමේ සාධක ගණනාවක් එම බලපෑමේ පරිමාව විශාල නොවන නමුත් සැලකිය යුතු බලපෑමක් ඇති කරවයි. සුදුසුකම් ලත් ගණිත සහ පළමු භාෂා ගුරුවරු, හය වසර ශිෂ්‍යත්වලාභීන් සහ බාහිර මූලාශ්‍රවලින් පාසලට ලැබුණ අරමුදල් ප්‍රමාණය ශිෂ්‍ය කාර්ය සාධනය කෙරේ සාධනීය බලපෑමක් ඇති කරයි. අනෙක් අතට ගුරුවරුන්ගේ නිවාඩු ගැනීම සැලකිය යුතු නිෂේධාත්මක බලපෑමක් ඇති කරයි. අමතරව පාසල් තරාතිරම, වර්ගය, ප්‍රමාණය සහ විදුහල්පති සේවා කාණ්ඩය මත පදනම්ව පාසලක් ශ්‍රේණිගත කිරීමේ දී සාර්ථකත්වය කෙරේ සැලකිය යුතු බලපෑමක් දැකිය හැකිය. දුර්වල පාසල් සහ අඩු සුදුසුකම් සහ අත්දැකීම් ඇති විදුහල්පතීන් පාලනය කරන පාසල්වල සා. පෙළ ලකුණු මට්ටමේ පහත් තත්වයක් නිරීක්ෂණය වේ. විවිධ පාසල් වර්ගීකරණයන් දෙස බලන විට, පාසලේ තරාතිරම, වර්ගය, පාසලේ අරමුදල්, ගුරුවරුන්ගේ ගුණාත්මක භාවය සහ විදුහල්පති සේවා ශ්‍රේණිය ඇතුළත් සාදක මගින් පාසල් විභාග ප්‍රතිඵල මත විවිධාකාර බලපෑම් ඇති කරයි.

අපගේ සොයා ගැනීම් ශ්‍රී ලංකාවේ ශිෂ්‍යයන්ගේ සා. පෙළ කාර්ය සාධනය වැඩි දියුණු කිරීම සඳහා ප්‍රතිපත්ති ඇඟවීම් ගණනාවක් දක්වයි. කුඩා පාසල් සහ 1c සහ 2 වර්ගයේ පාසල් යන කාණ්ඩ දෙකේම සා. පෙළ කාර්ය සාධනය අඩුය යන අපගේ සොයා ගැනීම ශිෂ්‍යත්ව ලාභීන්ගේ ප්‍රමාණය පාලනය කිරීමෙන් පසුව ද දැකිය හැකිය. ඉන් අනාවරණය වන්නේ, කාර්ය සාධන වෙනසට සිසුන්ගේ හැකියාවන් පමණක් බල නොපාන බවයි. වැඩි වශයෙන්ම පළාත්බද පාසල් වන මෙම පාසල් කෙරේ විශේෂ අවධානය යොමු විය යුතුය. උසස් ගුණාත්මක ගුරුවරු සහ ශිෂ්‍ය සාර්ථකත්වය අතර කැපී පෙනෙන සාධනීය සම්බන්ධතාවයෙන් පාසල්වලට සුදුසකම් සහ පළපුරුදු ගුරුවරු ආකර්ෂණය කර ගැනීමේ ප්‍රතිපත්ති ගොඩ නැගීමේ අවශ්‍යතාවය ඉස්මතු කරයි. මේ සම්බන්ධයෙන් ගුරු සේවයට ගුරුවරුන් ක්‍රමානුකූලව බඳවා ගැනීම සහ පුහුණු කිරීම වැදගත් ය. එමෙන්ම වඩාත් හොඳ කාර්ය සාධනයක් ඇති පාසල්වල සිටින සුදුසුකම්ලත් සහ පළපුරුදු ගුරුවරුන් දුර්වල විභාග ප්‍රතිඵල ඇති පාසල්වලට යොමු කිරීම අත්‍යවශ්‍ය ය. ගුරුවරුන්ගේ නිවාඩු සහ අධ්‍යාපන ප්‍රතිඵල අතර නිරීක්ෂණය කළ නිෂේධාත්මක සම්බන්ධතාවය නිසා ගුරුවරුන්ගේ කැපවීම ධෛර්යමත් කෙරෙන දිරිගැන්වීමේ ක්‍රමයක් ක්‍රියාත්මක කිරීමේ අවශ්‍යතාවයක් දක්වයි. අවසාන වශයෙන් වඩාත් හොඳ සුදුසුකම් ලත් සහ පළපුරුදු විදුහල්පතිවරුන් පාලනය කරන පාසල්වල වඩාත් හොඳ සා. පෙළ ප්‍රතිඵල වාර්තාවීමෙන් විදුහල්පති පුහුණු වැඩ සටහන්වල ගුණාත්මක භාවය වැඩි කිරීමේ සහ විදුහල්පති සේවයට ක්‍රමානුකූලව සහ කුසලතා මත බඳවා ගැනීමේත් අවශ්‍යතාවය පෙන්නුම් කරයි.

நிறைவேற்றுச் சுருக்கம்

இலங்கை போட்டித் தன்மையான சந்தையில் நிலைத்திருப்பதற்கு உயர் கற்கைகளை மேற்கொண்ட மற்றும் திறமையான தொழில் படையையும் கொண்டிருத்தல் வேண்டும் என்பது நன்கு உறுதிப்படுத்தப்பட்ட விடயமொன்றாகும். சாதாரண தரப் பரீட்சையில் சிறந்த பெறுபேறுகளைப் பெறுதல் மேலதிக கற்கைகள் அதாவது உயர்தரப் பரீட்சை உள்ளடங்கலான உயர்கல்விக்கான ஆரம்பத் தேவையாக உள்ளது. அதாவது, இப் பரீட்சையில் சித்தியடைவதானது பல்கலைக் கழக நுழைவுப் பரீட்சை மற்றும் பல தொழில்பயிற்சி நிகழ்ச்சித்திட்டங்களுக்கு நுழைவதற்கும் ஒரு தகைமையாகக் கருதப்படுகின்னது. 2015 ஆம் ஆண்டில், சாதாரண தரப் பரீட்சைக்குத் தோற்றிய மாணவர்களில் ஏறக் குறைய அரைவாசி மாணவர்கள் சாதாரண தரப்பரீட்சையில் சித்தியடையவில்லை அல்லது கணிதப் பாடத்தில் சித்தியடையாது நிபந்தனையின் அடிப்படையில் சித்தியடைந்தவர்களாக இருந்தனர். தொடர்ச்சியாக பதவிக்கு வந்த அரசாங்கங்கள் இலவசக் கல்விக்கு மிக வலுவான முக்கியத்துவத்தை வழங்கி, மாணவர்களின் செயலாற்றுகையில் கனிசமான ஆர்வம் மற்றும் கொள்கை தொடர்புத் தன்மை தொடர்பில் அரச நிதியளிப்பில் இயங்குகின்ற பாடாசலைகளின் வளங்களின் தாக்கம் பரீட்சிக்கப்பட்டன. கல்விப் பெறுபேறுகள் தொடர்பில் மிக வலுவானதொரு விடயமாக இருக்கின்ற பாடசாலை மட்ட காரணிகளை அடையாளம் கண்டு கொள்ளல், பற்றாக்குறையான அரச நிதியங்களின் பயன்பாட்டு வினைத்திறனை உறுதிப்படுத்திக் கொள்வதற்கு மிக முக்கியமான விடயமாக உள்ளது. மேலும், தற்பொழுதைய நிலைமையில் பாடாசலை வளங்களின் முக்கியத்துவத்தை பரீட்சித்தல் சிறப்பு முக்கியத்துவ விடயமாக இருப்பதுடன், மாணவர்களின் செயலாற்றுகையில் பாடசாலை மட்ட காரணிகள் கொண்டுள்ள தாக்கத்திற்கு எதிராக மிக முக்கியமான பிரயோகச் செயற்பாடுகளை தனியார் வகுப்புக்கள் தொடர்பான துரித தேவைப்பாடுகள் கொண்டுள்ளன.

இதன் பின்னணியில், இந்த ஆய்வில், சாதாரண தர பரீட்சையில் மாணவர்களின் செயலாற்றுகை தொடர்பில் சமூக பொருளாதாரம், பாடசாலை, ஆசிரியர், அதிபர் மற்றும் மாகாண பண்புகள் - உள்ளடங்கலாக பாடசாலை மட்ட வளங்களின் தாக்கத்தை நாங்கள் ஆய்வு செய்கின்றோம். நாங்கள் மூன்று பொருளாதார மாதிரிகளை மதிப்பீடு செய்கின்றோம்: (1) நியம சாதாரண ஆகக் குறைந்த சமநிலையான மதிப்பீடு: (2) தரவரிசை நேரடி மாதிரி முறைமை: மற்றும் (3) கட்டளையான தர்க்க மாதிரி. 2016 ஆண்டு தொடர்பாக இலங்கை கல்வி அமைச்சினால் நடாத்தப்பட்ட அரச பாடசாலைகளின் வருடாந்த புள்ளி விபரங்களிலிருந்து நாங்கள் தரவுகளைப் பெற்றுள்ளோம்.

பாடசாலைகளுக்கு மத்தியில் கல்விசார் பெறுபேறுகளில் பாரிய சமநிலையற்ற தன்மைகள் இருப்பதை இந்த விளக்கமான பகுப்பாய்வுத் தரவுகள் வெளிப்படுத்துகின்றன. சாதாரண தரப் பரீட்சையிலிருந்து உயர் தர வகுப்புகளில் கல்வி கற்பதற்கு தேசிய பாடசாலைகளிலிருந்து 70 சதவீதமானவர்கள் தெரிவு செய்யப்படுவதுடன் இந்த சதவீதமானது மாகாணப் பாடசாலைகளின் சதவீதமான 39 சதவீதத்தின் ஏறக்குறைய இரண்டு மடங்காகும். மாகாணப் பாடசாலைகளுக்கு மத்தியில், தென் மாகாண பாடசாலைகளின் பெறுபேறுகள் ஏனைய மாகாணங்களிலும் பார்க்க முன்னிலையில் உள்ளதுடன் இந்த வேறுபாடுகள் குறைவாக வெளிப்படுத்தப்படுகின்றன. பாடசாலை மட்டத்திலான வளங்களின் ஒதுக்கீட்டில் தேசிய மற்றும் மாகாணப் பாடசாலைகளுக்கிடையேயான சிறப்புத் பண்புகள் தீர்க்கமான விடயமாக உள்ளது.

இந்த மூன்று மாதிரி தொழில் நுட்ப்பங்களில் பொருளாதார மதிப்பீடுகள் பெருவாரியாக நிலையாக காணப்படுகின்றது. பாடசாலைகளின் மாதிரித் தொகுதியின் ஊடாக, பல பாடசாலைகள் - மற்றும் மாகாண மட்டத்திலான காரணிகள் சாதாரண தரப்பரீட்சை செயலாற்றுகையில் முக்கியமானதொரு தாக்கத்தை கொண்டுள்ளதுடன், இந்தத் தாக்கங்களின் நுண் விடயங்கள் பாரியதன்று. தகைமை பெற்ற கணித மற்றும் தாய் மொழி ஆசிரியர்களின் பங்கு, ஐந்தாம் ஆண்டு புலமைப் பரிசில் பரீட்சையில் சித்தியடைந்தோர் மற்றும் வெளியக ரீதியாக கிடைக்கின்ற நிதிகள் என்பன மாணவர்களின் செயலாற்றுகையில் சாதகமான தாக்கத்தை ஏற்படுத்துகின்றன. ஆசிரியர்களின் விடுமுறை, மறுபுறமாக, பாதமான தாக்கமொன்றை ஏற்படுத்துகின்றன. மேலதிகமாக, தரம், வகை, பருமன் மற்றும் அதிபர் சேவை வகையின் படி பாடசாலையொன்றின் தர வரிசை பாடசாலைகளின் அடைவு, உள்ளகப் பாடசாலைகளில் அவதானிக்கப்பட்ட அதிகரித்து வருகின்ற சாதாரண தர புள்ளிகள் மற்றும் இந்த குறைவான தரங்கள் குறைந்த மட்டத்திலான தகமைகளையும் அனுபவத்தையும் கொண்ட அதிபர்களினால் முகாமை செய்யப்பட்டு வருகின்றன. பாடசாலைத் தரம், வகை, பாடசாலை மட்ட நிதிகள், ஆசிரியர் தகமை மற்றும் அதிபர் சேவை தரம் உள்ளடங்கலான பல மாறிகளில் வித்தியாசமான தாக்கத்தை மாறுபட்ட பாடசாலை வகைப்படுத்தல்கள் வெளிப்படுத்துகின்றன.

இலங்கையில் மாணவர்களின் சாதாரண தர செயலாற்றுகை மட்டங்களை மேம்படுத்துவதற்கு பல கொள்கை அமுல்படுத்தல்களை எங்களுடைய கண்டுபிடிப்புக்கள் சுட்டிக் காட்டுகின்றன. புலமைப் பரிசில் சித்தியடைந்தவர்களின் பங்கின் கட்டுப்பாட்டின் பின்னரும் கூட சிறிய பாடசாலைகள் மற்றும் 1 சி மற்றும் 2 ஆம் வகுதி பாடசாலைகளில் சதாரண தர செயலாற்றுகை குறைவாக இருக்கின்றமை பற்றிய கண்டறிதலானது வெறுமனே திறமைகளின் வேறுபாட்டின் காரணமாக மாத்திரமன்று மாறாக வேறு பல காரணங்களினாலும் ஆகும். இப் பாடசாலைகள், மாகாணப் பாடசாலைகளாக இருப்பதுடன், இவ்வாறான பாடசாலைகள் தொடர்பாக விசேட கவனம் செலுத்தப்படுதல் வேண்டும். அதியுயர் தரமுடைய ஆசிரியர்கள் மற்றும் மாணவர்களின் அடைவு வெளிப்படுத்தல்களுக்கிடையில் மிக முக்கியமான தொடர்பு அவதானிக்கப்பட்டதுடன் இவை தகமைபெற்ற மற்றும் அனுபவம் உடைய பதவியணி அங்கத்தவர்களை பாடசாலைகளுக்கு கவர்ந்து கொள்வதனை உறுதிப்படுத்தும் வகையில் கொள்கைகளை அபிவிருத்தி செய்து கொள்வற்கான தேவைகளை வெளிப்படுத்துகின்றன. இவ் விடயம் தொடர்பில் ஆசிரியர் சேவைக்கு முறைமையான வகையில் ஆசிரியர்களை பயிற்சியளித்தலும் ஆட்சேர்ப்புச் செய்தலும் மிக முக்கியமாகும். தற்பொழுது உள்ள தகமை பெற்ற மற்றும் அனுபவம் வாய்ந்த ஆசியர்களை நன்கு திறமைகளை வெளிப்படுத்தும் பாடசாலைகளிலிருந்து மோசமான பெறுபேறுகளை வெளிப்படுத்தும் பாடசாலைகளுக்கு மீள ஒதுக்கீடு செய்தல் அத்தியவசியமாகும். ஆசிரியர்களின் விடுமுறை மற்றும் கல்விப் பெறுபேறுகளுக்கிடையில் நேர் மாறான தொடர்பு அவதானிக்கப்பட்டதுடன் இதன் ஊடாக ஆசிரியர்களின் அர்பணிப்பை மேம்படுத்தும் ஊக்கத் திட்டங்களை அமுல்படுத்த இந் நிலைமை அறை கூவுகின்றது. இறுதியாக, சிறந்த தகமை பெற்ற மற்றும் அனுபவமான அதிபர்களினால் முகாமை செய்யப்படுகின்ற பாடசாலைகளில் சிறந்த பெறுபேறுகள் பதிவு செய்யப்பட்டுள்ளதுடன் இந் நிலைமையானது அதிபர் பயிற்சி நிகழ்ச்சித்திட்டங்களின் தரத்தை மேம்படுத்துவதற்கும் அதிபர் சேவைக்கு ஆட்சேர்ப்புக்கான முறையான ஒழுங்குமுறை மற்றும் உயர் தேர்ச்சி அடிப்படை முறையின் தேவையையும் வேண்டுகின்றது.

1. Introduction

It is now well accepted that a highly-skilled well-educated workforce is essential for Sri Lanka to remain competitive. Under the education structure of the country, successful performance at the General Certificate in Education (GCE) Ordinary Level (O-Level) examination—undertaken by students completing lower secondary schooling—is a pre-requisite for most further education courses, including the GCE Advanced Level (A-Level) examination and many vocational training programs. In 2015, 69% of those who sat five or more subjects of the O-Level exam qualified to sit for the A-Levels (Ministry of Education of Sri Lanka (MOE), 2016a). To qualify for the A-Levels, a student needs to obtain 6 ordinary passes[1] and at least three special passes with a pass for the first language (Sinhala or Tamil) and mathematics (MOE, 2008). Given the high level of failures in mathematics, the requirement for a pass in mathematics was relaxed in 2014. According to the new conditionality, students meeting all other requirements but with a failure in mathematics can pursue A-Level studies, subject to obtaining a pass in mathematics within two years (MOE, 2014a). In 2015, close to half the students (45%) either failed or only conditionally passed O-Levels due to failing mathematics (MOE, 2016a). In the same year, 11% of Sinhala medium students and 19% of Tamil medium students failed O-Levels due to not obtaining a pass in their first language (Ibid).

The effect of school resources, among other factors, on student performance is a subject of substantial interest and policy relevance. Despite the well documented central role played by education in reducing economic and social inequalities and promoting inclusive economic growth, less is known about the specific types of educational investments that should be pursued. In maximizing the efficiency of government educational budget allocations, it is important that scarce state funds are directed towards resources that have a strong bearing on educational outcomes. Examining the significance of school resources takes on added importance in the present-day context, where the rising emergence of private supplementary tutoring in many parts of the world holds potential implications for the relationship between school-level factors and student performance.

In this study we examine the impact of school-level resources on student performance at the O-Level examination in Sri Lanka. Our analysis begins with standard ordinary least squares (OLS) estimation. We control for several school, teacher, principal, and provincial characteristics that potentially affect student performance. We then proceed to hierarchical linear modelling (HLM) techniques to account for hierarchical levels of grouped data. This is a commonly occurring phenomenon in many contexts including the education sector, where observations are often structured at student, classroom, school, and school district and province levels (Woltman et al., 2012). Our final estimation technique is an ordered logit model (ORL), where we allow for multiple ordered response categories of our dependent variable.

Our results are largely consistent across the three estimation techniques. Of the school characteristics considered, school status, school type, school size, school-generated funds from external sources, and the share of scholarship-holding students have significant—albeit modest—impacts on O-Level performance. Teacher and principal qualifications and experience also matter, as well as the commitment of teachers, measured by teacher absence. Higher provincial unemployment rates raise performance scores, whereas the other provincial variables do not have notable effects on educational outcomes. Disaggregation of the sample based on school categories

[1] Students with at least 5 ordinary passes are allowed to enter A-Level classes under the condition that they obtain a pass in one other subject in O-Levels in the subsequent year.

indicates some notable differences in the effects of school, teacher, and principal characteristics across different school classifications.

The remainder of the paper proceeds as follows. Section 2 briefly reviews the existing literature. Section 3 provides an overview of Sri Lanka's school education system. Section 4 presents our methods. Section 5 describes our data and choice of independent variables. The results are presented and discussed in Section 6. The final section concludes and offers policy implications.

2. Review of Existing Literature

Reflecting its policy significance, a vast amount of research has focused on the relationship between resources devoted to schools and educational outcomes, spanning several decades. In a meta-analysis of close to 400 studies of student achievement in the Unites States over a three-decade period, Hanushek (1997) concludes that there is no strong or consistent relationship between school resources and student performance. More recent studies find strong and positive relationships between teacher qualifications and educational outcomes in the state of North Carolina at the high school level (Clotfelter et al., 2010), between teachers' pedagogical skill and primary student achievement in mathematics in Hong Kong (Fung et al., 2017), and negative effects of higher class sizes on student performance in Greece and Iceland (Wößmann and West, 2006).

Glewwe et al. (2010) conduct a meta-analysis of studies that assess the extent to which school and teacher characteristics have a causal impact on student learning and enrollment rates in developing countries. They find a statistically insignificant impact of most school and teacher characteristics on time in school and learning, with the exception of the availability of desks, teacher knowledge of the subjects they teach, and teacher absence. A recent study focusing on China—home to the world's largest education system—employs a student-fixed effects model and concludes that having a teacher with high credentials positively influences student achievement (Chu et al., 2015). Our results also confirm the importance of teacher qualifications, experience, and teacher absence for student performance.

Some scholars argue that school-level characteristics, rather than directly influencing educational outcomes, operate through their interactions with student-level individual characteristics. For instance, Lee et al. (2005) show that for a sample of 14 Sub-Saharan African countries, school and teacher resources have varying influences on student outcomes that depend on students' socioeconomic characteristics. Lekholm (2011) utilizes structural equation modelling and presents evidence of school characteristics accounting for considerable amounts of variance in student grades in Sweden; however, this relationship becomes mostly non-significant when parental education is accounted for. In a study on Ghana, Chowa et al. (2013), using hierarchical linear modeling, find that student-level characteristics are consistent predictors of mathematics and English scores of Ghanaian youth, while school-level attributes only affect English performance.

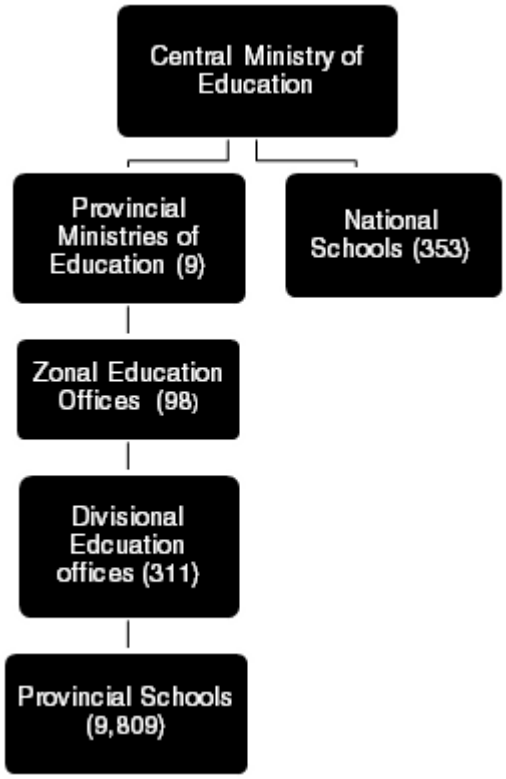
Despite widespread attention, systematic investigations of the relationship between school resources and student performance in Sri Lanka are limited. A prior study is that of Aturupane et al. (2013), which investigates the determinants of learning among fourth grade students using the National Education Research and Evaluation Center (NEREC) survey conducted by the University of Colombo. In line with our results, they find principals' and teachers' years of experience to be important determinants of learning outcomes, in addition to child and household level variables such as educated parents, better nutrition, high daily attendance, and enrollment in private tutoring classes. However, this analysis is limited to primary-level student achievement, and its main focus is on student-level

factors as opposed to school characteristics. It also fails to account for potential dependencies among different hierarchical levels in the education system. To our knowledge, ours is the first study to examine the impact of school resources on O-Level performance rates in Sri Lanka.

3. Sri Lanka's School Education System

Education in Sri Lanka is provided through an extensive network of schools, which stood at 11,021 in 2016 (Central Bank of Sri Lanka, 2016). Our study focuses on public schools, which, at 10,162, account for 92% of total schools (MOE, 2016b).[2] Since 1987, education administration in Sri Lanka has been decentralized, with more powers being given to provinces in the administration and management of education services. Under this new framework, schools are categorized into 'national' schools and 'provincial' schools (Arunatilake and Jayawardena, 2010). National schools come directly under the purview of the Central MOE, a majority of which are elite and central colleges that were established during the colonial period and retained by the central government. Several criteria for listing a school as a national school were established in 1985, which are reflective of schools with superior educational and other related facilities.[3] Provincial schools come under the purview of the respective provincial ministries of education. There are nine provincial ministries of education, one per each province. As such, schools come under 10 different administrative units—the Central MOE and the nine provincial ministries of education. Within a province, schools are also grouped into education zones, and zones are in-turn grouped into education divisions (see Figure1). The ministries of education are responsible for the planning, implementation, and

Figure 1
School Education Administrative Structure of Sri Lanka



Source: Own construction based on MOE (2016b) data.

[2] Other types of schools include assisted and autonomous Private Schools which offer both the local syllabus and the British system, and Pirivenas (monastic colleges, similar to seminaries, where Buddhist priests in Sri Lanka are educated). A separate category of English medium International Schools approved and registered by the Board of Investment of Sri Lanka also operate in the country.

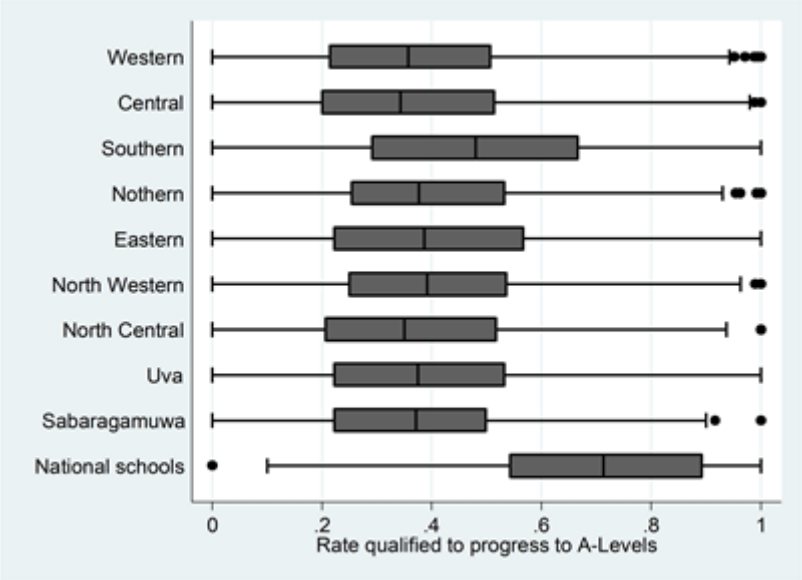
[3] The criteria are: (1) a student population equal to or exceeding 2,000; (2) a student population exceeding 200 in the A-Level Science stream; (3) of the number of students sitting for the A-Levels during the previous three years, a qualification rate of one third for admission to universities each year; (4) adequate buildings, desks and chairs for all students; (5) adequate facilities for teaching technology related subjects; (6) adequate laboratory facilities to meet the requirements of all O-Level and A-Level students; (7) annual income from facilities and services' fees exceeding Rs.15,000; (8) considered by residents as a leading school in the locality; (9) presence of an effective school development society; and (10) presence of an active past pupils' association.

management of all education programs (De Silva, 2003). The education zones are responsible for supervision, monitoring, and implementing education programs, while the education divisions are in charge of implementing education programs and the general administration of schools (Ibid). In 2016, there were 353 national schools, 9,809 provincial schools, 98 educational zones, and 311 education divisions in the country (MOE, 2016b). Given this administrative structure, the performance of schools can be affected, not only by school- and community-level characteristics, but also by the administrative capacity of the different ministries of education and the subunits coming within them.

Sri Lanka's school education system commences at the age of 5, and consists of 13 years of schooling, organized into four levels: primary (grades 1–5), junior secondary (grades 6–9), senior secondary (grades 10 and 11), and collegiate (grades 12 and 13). Education is compulsory up to age 14 (grade 9) in the country. Students are subjected to three national-level examinations. The first is the grade five Scholarship examination, faced by children in grade 5. The main objective of this exam is to provide subsidies to economically disadvantaged talented students to pursue further education in better schools (Sedere et al., 2016). This is not a compulsory examination, and is of most importance to students who aspire to move into better quality schools for their secondary- and collegiate-level education. The second is the GCE O-Level examination, undertaken by students upon completion of secondary-level schooling, which is the focus of our study. It includes six compulsory subjects—mathematics, the first language (Sinhala or Tamil), religion, science, English, and history—and three optional clusters spanning a wide range of subjects such as commerce, agriculture, home science, health studies, aesthetics, languages, and information technology. The third is the GCE A-Level examination—available in the Science, Commerce, and Arts streams—faced by students after completing collegiate-level education.[4]

Since the Free Education Act of 1945, education in Sri Lanka is government-funded and offered free of charge at all levels, including the tertiary level. The state funds both investment inputs—such as expenditure on buildings, furniture, and equipment—and recurrent inputs—such as textbooks, uniform material, meals, expenditure on teachers and other staff, consumable supplies, as well as administrative and development related expenditure (Arunatilake, 2006). While the country has achieved commendable school enrollment and literacy rates, there are mounting concerns regarding the quality of education, and wide disparities in academic achievements exist both across and within provinces (Little et al., 2011; Aturupane et al., 2013; Sedere, 2016). As illustrated in Figure 2, national schools outperform provincial schools in O-Level performance rates in all provinces by a large margin. The

Figure 2
O-Level Performance Rates by Province, 2016



Source: Own calculations based on MOE (2016c) School Census data.

Note: The rate indicates the share of children qualifying to do A-Levels of the children sitting for the O-Levels.

[4] An additional A-Level technology stream was introduced in 2014, and the first batch of students sat for the examination in August 2016.

average rate of students qualifying to proceed to the collegiate level in national schools is 70%, almost double the average of 39% for provincial schools. While O-Level performance rates across provinces show less variation, larger disparities exist at the district level.

Compared to developing country standards, expenditure on education in Sri Lanka is low. Current expenditure on education as a percentage of total government expenditure stands at 9%, which is far below the lower-middle income average of 16% (World Bank, 2017). Further, inequitable resource allocation among schools—based on categorizations such as national and provincial, privileged status, and type of school—affects the provision of equitable quality of education (National Education Commission (NEC), 2016). A Education Quality Inputs (EQI) Scheme funded by the World Bank was initiated with the objectives of improving universal access to better quality education and management of education and resource provision, and decentralization of decision-making regarding school finances (Arunatilake and Jayawardena, 2010). However, owing to shortages and delays in funds released, schools often do not receive their entitlements on time, with some schools not receiving any funds (NEC, 2016).

4. Methods

We employ three estimation approaches to examine the impact of school-level resources on performance at the O-Level examination in Sri Lanka. We commence with a standard OLS estimation and then proceed to HLM to account for relationships among observations at a given level. Our third estimation technique is an ORL model, which accounts for both the sequential categorical nature and the zero-one range of our dependent variable. The estimation of three separate models enables us to compare estimates across different modeling approaches, and serves as a robustness check of our results.

4.1 Ordinary Least Squares

We begin by estimating the following model for a cross-section of schools for the year 2016:

$$Y_i = \alpha + \boldsymbol{S}_i'\boldsymbol{\beta} + \boldsymbol{T}_i'\boldsymbol{\gamma} + \boldsymbol{P}_i'\boldsymbol{\delta} + \varepsilon_i \quad (1)$$

where Y is an indicator of educational performance in school i, measured as the share of students qualifying from the O-Levels to proceed to A-Level classes; S is a vector of school characteristics affecting O-Level performance; T is a vector of variables capturing teacher and principal quality; P is a vector of provincial-level socioeconomic characteristics; and ε is an error term.[5]

4.2 Hierarchical Linear Modelling

To account for potential correlation of performance rates within different levels in the education system, we next adopt a HLM approach, which is best suited when dealing with clustered or grouped data (Buxton, 2008). Due to unavailability of student- and classroom-level data, we focus on a two-level hierarchical model, consisting of the school level (level 1) and the national/provincial MOE level (level 2). Given Sri Lanka's education administration structure described above, we postulate that a school's education performance might be determined by the education ministry under which it falls, in addition to school-level factors.[6] There is a high likelihood that the test scores of students within the same school are correlated due to access to the same school resources and teachers/teaching methods. Similarly, average school test scores within a given education ministry might be affected by the administrative capacity of a specific ministry. This phenomenon is known as intra-class correlation (ICC), which

[5] See Section 5 for a detailed discussion of the independent variables.

[6] Although one could also think of increasing the levels to include education zones and education divisions, we restrict our analysis to two levels. The divisional and zonal education offices come directly under the purview of the provincial education offices, and there is also significant overlap in the responsibilities of each level. We thus assume that these additional levels will not individually influence the functioning and performance of schools significantly.

represents the proportion of variance in the dependent variable that is explained by the grouping structure of the hierarchical model.

Failure to account for ICC using conventional OLS regression models can deliver biased standard errors and confidence intervals, leading one to conclude that there are real effects, when what is observed is merely random variation (Raudenbush and Bryk, 2002; Buxton, 2008). The ability to simultaneously investigate relationships within and between ordered levels of grouped data is another advantage of HLM, making it more efficient at accounting for variance among variables at different levels compared to OLS (Woltman et al., 2012). The preference of HLM for nested data also lies in the fewer number of assumptions needed compared to other statistical models. Multilevel modelling does not require independence of observations, and can accommodate missing data, small and/or discrepant group sample sizes, and heterogeneity of variance across repeated measures (Ibid).

Each level in a multilevel analysis is represented by its own sub-model, and each sub-model represents the relationship between a set of explanatory variables and the dependent variable at that particular level. In this setting, separate level 1 models (schools) are developed for each level 2 units (education ministries). They take the form of regressions developed for each school i:

$$Y_{ij} = \alpha_j + \boldsymbol{X}'_{ij}\boldsymbol{\beta}_j + \varepsilon_{ij} \qquad (2)$$

where Y_{ij} is the examination qualified rate for school i in education ministry j; X_{ij} is a vector of school, teacher, and principal characteristics potentially affecting the outcome variable; α_j is the intercept of the qualified rate for school / in education ministry j; β_j is the regression coefficient associated with X_{ij} for the j^{th} education ministry; and ε is an error term.

In the level 2 model, the level 1 regression coefficients (α_j and β_j) are used as outcome variables and are related to each of the level 2 predictors, as shown in Equations (3) and (4):

$$\alpha_j = \gamma_0 + \boldsymbol{P}'_j\boldsymbol{\delta}_0 + U_{0j} \qquad (3)$$

$$\beta_j = \gamma_1 + \boldsymbol{P}'_j\boldsymbol{\delta}_1 + U_{1j} \qquad (4)$$

where P_j is the vector of provincial-level characteristics; γ_0 and γ_1 are overall mean intercepts adjusted for P; δ_0 is the regression coefficient associated with P relative to the level 1 intercept; δ_1 is the regression coefficient associated with P relative to the level 1 slope; U_{0j} are random effects of the j^{th} level 2 unit adjusted for P on the intercept; and U_{1j} are random effects of the j^{th} level 2 unit adjusted for P on the slope.

The intercept and regression coefficients of Equation (2) at level 1 are called *fixed effects* because the effect is fixed for a given value of the level 1 predictor variables. The error terms U_{0j} and U_{1j} of the level 2 Equations (3) and (4) are called *random effects* because the values vary by the level 2 unit. These error terms are unique to HLM and differentiate it from a standard OLS regression equation (Woltman et al., 2012).

The final step in the analysis involves combining the two levels of models by substituting Equations (3) and (4) into Equation (2), which allows for the grouping of variables and coefficients in terms of the level of hierarchy they affect:

$$Y_{ij} = \gamma_0 + \boldsymbol{X}'_{ij}\boldsymbol{\gamma}_1 + \boldsymbol{P}'_j\boldsymbol{\delta}_0 + \boldsymbol{P}'_j\boldsymbol{X}'_{ij}\boldsymbol{\delta}_1 + \boldsymbol{X}'_{ij}\boldsymbol{U}_{1j} + U_{0j} + \varepsilon_{ij} \qquad (5)$$

The combined model illustrated in Equation (5) includes the level 1 and level 2 predictors, a cross-level term, and a composite error ($U_{1j}X_{ij} + U_{0j} + \varepsilon_{ij}$). Equation (5) is often referred to as a *mixed model* because it includes both fixed and random effects (Gill, 2003).

Multilevel modelling is warranted when the ICC is of significant magnitude, generally above 10% (Occhipinti, 2012). Estimation of a "null" or "unconditional" multilevel model—an intercept-only model with no explanatory variables—enables calculation of the ICC. The null model can be specified as below, which is a condensed form of Equations (2) and (3):

$$Y_{ij} = \gamma_0 + U_{0j} + \varepsilon_{ij} \qquad (6)$$

where, as before, γ_0 is the overall mean intercept; U_{0j} is a random education ministry-specific effect on the intercept; and ε_{ij} is an error term. Denoting the variance of ε_{ij} as σ^2_ε and the variance of U_{0j} as σ^2_u , the ICC is calculated as a ratio of the level 2 residual variance (σ^2_u) over the total error variance:

$$\text{ICC} = \frac{\sigma^2_u}{\sigma^2_u + \sigma^2_\varepsilon} \qquad (7)$$

The ICC thus reports the amount of variation unexplained by any predictors in the model that can be attributed to the grouping (level 2) variable, as compared to the overall (within and between) unexplained variance.

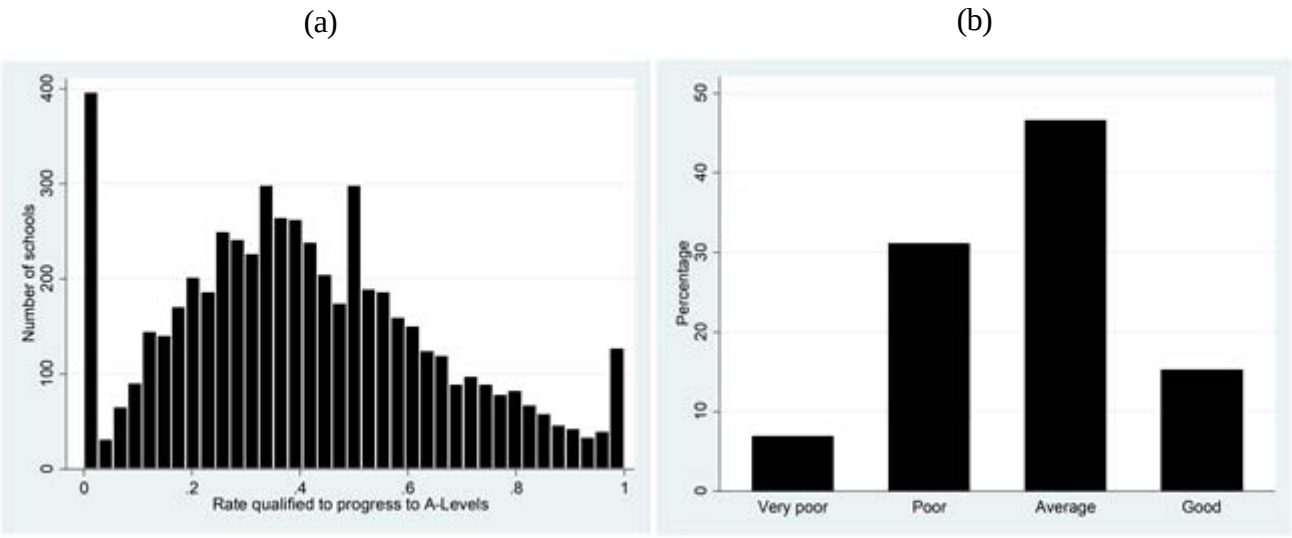
4.3 Ordered Logit Model

When correlation among outcomes at a given level is not large, OLS might produce unbiased results (Occhipinti, 2012). However, the OLS assumption of independent and identically distributed errors can be violated when the dependent variable takes the form of several ordered categories, especially when the probability of the dependent variable varies widely (Pohlman and Leitner, 2003). Using OLS to model such outcomes can also result in the prediction of values beyond the zero-one range (Ibid). The examination performance rates in schools can take values across different categories of a meaningful sequential order, from poor to superior performance. As a further check on the robustness of our results, we therefore estimate an ORL model, which allows for more than two (ordered) response categories of the dependent variable.[7]

The ORL model is often interpreted as having a continuous unmeasured latent variable *Y**, whose values determine what the observed ordinal variable *Y* equals. In our case, *Y** (each school's performance rate) is observed; nevertheless the workings of the model are the same. The variable *Y** has various threshold points, and the value on the observed variable *Y* depends on whether or not a particular threshold has been crossed. *Y* can also be thought of as a collapsed version of *Y**, where *Y** can take numerous values which can be collapsed into a small number of categories of *Y* (Menard, 1997).

Our model consists of four categories of *Y*: "very poor" performance, "poor" performance, "average" performance, and "good" performance. *Y** refers to the actual values taken under each category. We define the threshold points for each grouping based on natural cutoff points observed in the distribution of O-Level performance (see panel (a) of Figure 3). The very poor category consists of schools that fail in producing any students who qualify to progress to A-Level classes, which, at 395 is the highest frequency observed for a single value, and accounts for 7% of schools (panel (b) of Figure 3). The second category of poor performers comprises of schools that record over zero and up to a qualified rate of one-third, after which a spike can be observed. Average performing schools—defined between the range of qualified rates above 0.33 and up to 0.67—amount to close to 50% of our sample. Good performers are schools that record qualified rates above 0.67.

Figure 3
Distribution of Schools by Share of Students Qualifying for A-Levels, 2016



Source: Own construction based on MOE (2016c) School Census data.

Note: The rate indicates the share of children qualifying to do A-Levels of the children sitting for the O-Levels.

[7] It has been argued that the differences between OLS and logit estimations are trivial, and that the simplicity of interpreting OLS results outweighs the technical accuracy of a logit model (Angrist and Pischke, 2009). We choose to estimate both models (in addition to the HLM), and compare estimates across models.

The ORL model takes the form:

$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i\beta - \kappa_j)}{1 + [\exp(\alpha_j + X_i\beta - \kappa_j)]}$$

$$, j = 1, 2, \ldots, M - 1 \qquad (8)$$

where κ are the threshold points defining each category, and *M* are the number of categories in the dependent variable.

An assumption underlying ordered logistic regression is that the relationship between each pair of outcome groups is identical. In other words, the coefficients that describe the relationship between the lowest category (very poor) versus all higher categories (poor, average, and good) of the dependent variable are the same as those that describe the relationship between the combined lower categories (very poor and poor) versus the combined higher categories (average and good), and those between the combined very poor, poor, and average groupings versus the good performance category. This is known as the "proportional odds" or "parallel regression" assumption, where all βs are the same across the levels of *j* (see Equation (8)). If this was not the case, different models are needed to describe the relationship between each pair of outcome groups. In such situations, a generalized ordered logit (GOL) model—which allows for different slopes describing relationships between different outcome categories—is more appropriate than the ORL model (Williams, 2010).

Likelihood ratio tests of whether the coefficients are equal across categories indicate that the parallel lines assumption is violated in the ORL model for several variables in our sample. Consequently, we extend the ORL to a GOL model, where the βs are allowed to vary across the levels of *j*, as shown in Equation (9):

$$P(Y_i > j) = \frac{\exp(\alpha_j + X_i\beta_j - \kappa_j)}{1 + [\exp(\alpha_j + X_i\beta_j - \kappa_j)]}$$

$$, j = 1, 2, \ldots, M - 1 \qquad (9)$$

5. Data and Choice of Independent Variables

5.1 Sample Description

We utilize a cross-section of school-level data from the annual School Census of government schools conducted by the MOE, for the year 2016. The School Census provides detailed data on schools as well as teachers. School information reports all physical and human resources of each school, while teacher information ranges from demographic information of teachers to their academic qualifications and experience. We obtain province-level information from the Department of Census and Statistics of Sri Lanka (DCS).

The 2016 Census covers all 10,162 public schools in the country. Our sample, which focuses on O-Level examination performance, consists of 5,688 schools. We exclude schools which have only primary and lower secondary classes (3,933), and those for which the dependent variable is either missing or takes on unrealistic values (values above one). Our dependent variable is the share of students who sit for the O-Level examination that qualify to continue studies at the A-Levels in each school.

5.2 Independent Variable Descriptions

5.2.1 School Characteristics

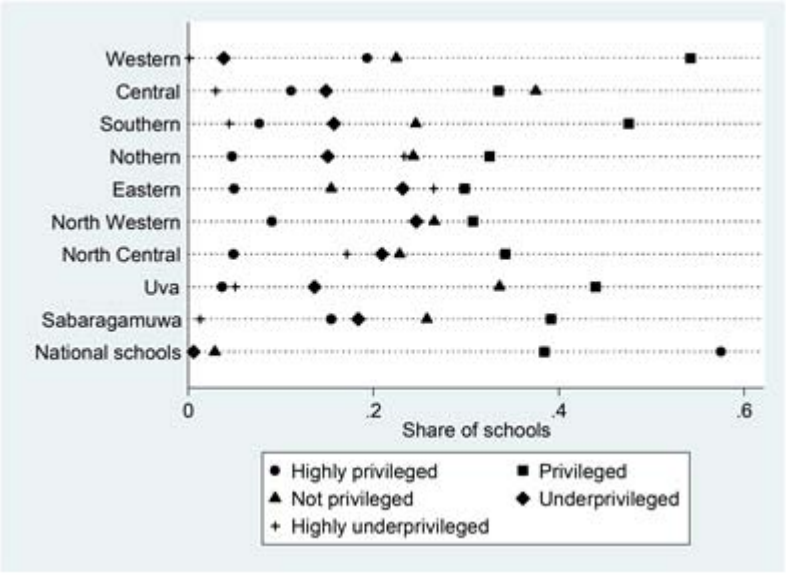
School Status

Our school characteristic variables consist of five dummy variables which serve as indicators of a school's status. Public schools in Sri Lanka are categorized into five distinct groupings based on a list of factors that reflect the availability of school resources, amenities, and ease of access to the school (MOE, 2005). These factors are the availability of basic resources (electricity, water, telephone, and library facilities), the durability of existing equipment such as typewriters, photocopy machines, televisions, and computers, the number of usable toilets, the size of school buildings, availability of a principal's office, teacher common rooms, and storerooms, the number of teachers and shares of those with vocational qualifications, distance from school to the nearest bus stop or train station, the number of available trips by bus or train towards the school between 7-8 am, and distance from school

to zonal and divisional education ministries and the nearest bank, post office, and government hospital. The five status categories are: (1) highly privileged; (2) privileged; (3) not privileged; (4) underprivileged; and (5) highly underprivileged.[8]

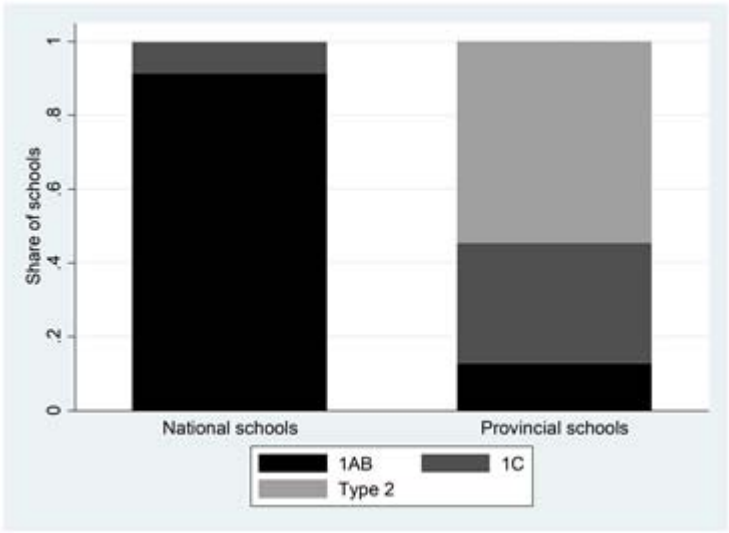
The inequitable distribution of schools by status among national and provincial schools, and among provincial schools in each province, is demonstrated in Figure 4 below. Highly privileged schools are heavily concentrated among national schools, accounting for 58% of the total number of national schools. Underprivileged schools are most prevalent in the Eastern, Northern, and North Western provinces. We expect privileged schools to perform better than underprivileged schools at the O-Levels.

Figure 4
Share of Schools by Status, 2016



Source: Own calculations based on MOE (2016c) School Census data.

Figure 5
Share of Schools by Type, 2016



Source: Own construction based on MOE (2016c) School Census data.

School Type

Sri Lankan public schools are also classified based on the number and type of functioning classes. Schools with collegiate level classes are classified as either 1AB or 1C; the former have A-Level Science stream classes, while the latter maintain Commerce and/or Arts streams, but no Science stream. Type 2 schools have classes up to grade 11 which terminate after the O-Levels, and Type 3 schools function only up to grade 8.[9] Similar to the privileged status, Figure 5 indicates that an overwhelming share (91%) of national schools is 1AB, whereas Type 2 schools account for over 50% of provincial schools. We hypothesize that 1AB and 1C schools outperform Type 2 schools at the O-Levels, given the high possibility that schools with collegiate-level classes on average possess better amenities and teacher resources.

School Size

School size—as measured by the total number of students in a school—is a school-level determinant of educational performance commonly used in the literature (Fowler and Walberg,

[8] Since this categorization of schools takes into account several school facilities and resources, we do not include a separate indicator of school-level resources.

[9] In this study we limit our focus to 1AB, 1C, and Type 2 schools, since our objective is to examine O-Level performance.

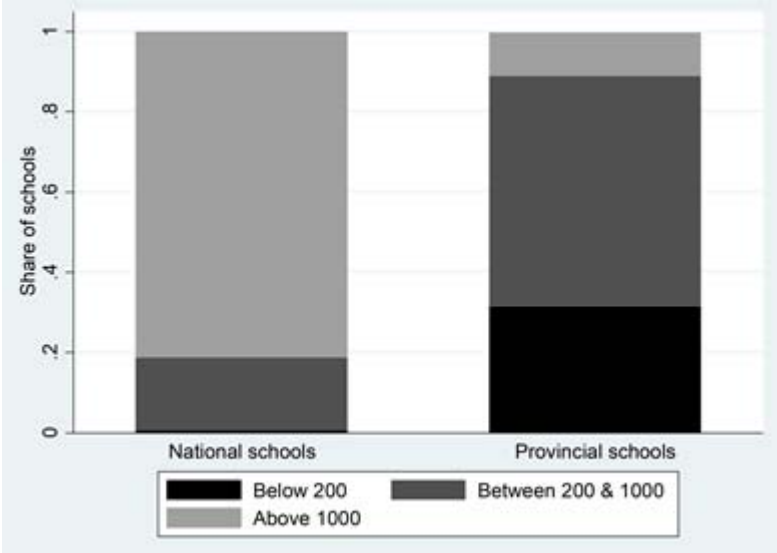
1991; Opdenakker and Dammea, 2007; Lekholm, 2011). In Sri Lanka, parents prefer to send their children to larger and more prestigious schools with superior facilities (Arunatilake, 2006). Consequently, high student numbers are observed in national and 1AB schools. The NEC (2016) notes that the school system is bi-polarized between very small and very large schools, with student populations exceeding manageable levels in large schools, and declining to uneconomical levels in small schools.

We consider three dummy variables capturing school size—schools with student numbers below 200 (low), between 200 and 1,000 (average), and over 1,000 (large).[10] As illustrated in Figure 6, over 80% of national schools have student numbers exceeding 1,000, while close to 90% of provincial schools consist of low or average student populations. We expect large schools to outperform their smaller counterparts, given the large student numbers observed in more prestigious schools. Moreover, it is reported that teachers in small schools are demoralized, thereby adversely affecting the quality of education in such schools (NEC, 2016).

Ethnic Composition

Sri Lanka's provincial distribution of schools shows some variation in terms of ethnic composition, which we account for by including a dummy variable for ethnicity. While there is no marked distinction between national and provincial schools, differences among provinces are more pronounced. School Census data (MOE, 2016c) indicate that the Northern and Eastern provinces are home to 98% and 65% of non-Sinhala (Tamil and Muslim) schools, respectively, whereas the other provinces and national schools have disproportionate shares of Sinhala schools. We do not have a strong prior for this variable.

Figure 6
Share of Schools by Size, 2016



Source: Own construction based on MOE (2016c) School Census data.

5.2.2 Student Socioeconomic Indicators

The unavailability of student-level data prevents us from directly controlling for socioeconomic characteristics of students which could potentially impact educational outcomes. As such, we attempt to capture the general socioeconomic status of students in a given school via three variables. The first is the share of grade five scholarship holders in grade six in a school. This variable could serve as an indicator of the level of affluence of students as well as ability. We use this variable as a proxy for the proportion of scholarship holders who sit for the O-Levels.[11] The second and third are the shares of funds a school receives from the school community (past pupil associations and non-governmental organizations (NGOs)) and from other external sources.[12] The level of funds received is also indicative of the socio-economic background of students: schools attended by

[10] This categorization is based on the recommended number of five classes of 30 students for each grade. For the six grades of secondary education (grades 6-11), this implies a total of 900 students. A student size of 200 would indicate that the entire secondary section just marginally exceeds the 150 recommended for one grade, hence translating into "low". The "large" category above 1,000 reflects schools with student numbers that exceed the recommended average of 900.

[11] The shares of scholarship holders as well as the share that pass the O-Level exam are both for the year 2015 in our sample. As such, we use the share of scholarship holders as a proxy for the scholarship holders sitting for O-Levels, assuming that this proportion remains roughly constant over the years in a given school.

[12] A third category of funding from the central and provincial MOEs exists. We exclude this source of funding from our analysis since it is highly correlated with both school community funds and funds generated through other activities.

children with more affluent parents or from richer communities are likely to receive more funds.

Suggestive of the high demand for national schools, Figure 7 shows that national schools attract a sizable share of grade six scholarship holders (15%), compared to a mere 1% among provincial schools. National schools also outperform provincial schools in the generation of school-level funds, although the difference is less stark than for scholarship holders. We expect positive impacts of these variables: it is likely that schools with a higher number of scholarship awardees would perform better in subsequent assessments, while a supportive community and a school's success in fund-raising are also important for a school's performance.

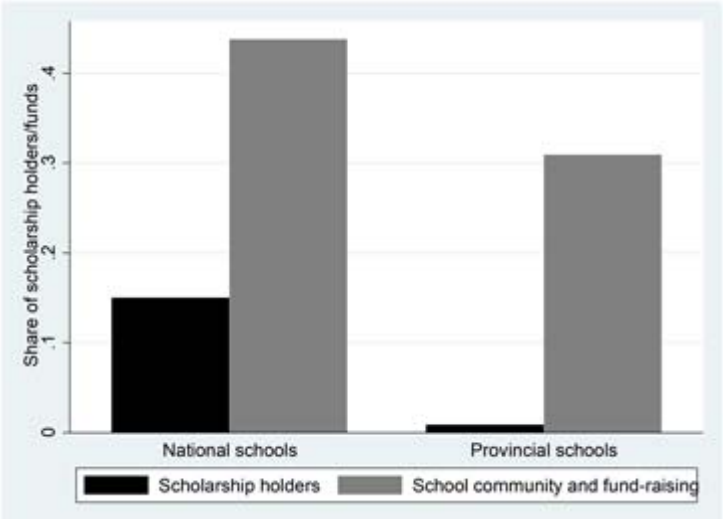
5.2.3 Teacher and Principal Characteristics

Teacher/Principal Quality

Teacher quality variables are consistently used in the literature as determinants of student performance (Clotfelter et al., 2010; Lekholm, 2011; Araujo et al., 2016). Teacher quality is typically assessed based on both qualifications and experience, which capture the knowledge and mastery of content, as well as the ability to teach (pedagogical skill) (Ingersoll, 2002; Peske and Haycock, 2006). Teachers in Sri Lanka are recruited to Teacher Service under four criteria: (1) graduate teachers; (2) trained teachers; (3) untrained teachers with two to three year diplomas; and (4) novice teachers who are not yet absorbed into teacher service (MOE, 2014b). Each of these different types of teacher recruits is also categorized according to subject knowledge. We consider teachers who have either a degree in a particular subject, or have been specially trained to teach a particular subject (criteria 1 and 2), as "in-field" teachers—i.e. teachers with good subject knowledge in the subject they teach. We focus on mathematics, Sinhala, and Tamil subject teachers, since it is mandatory to pass these subjects at the O-Levels to progress to A-Level classes.[13]

Recruitments to Teacher Service are also carried out at different levels, referred to as "Classes" (MOE, 2014b). Teachers who do not hold a degree in education are recruited to Class 3 of teacher service. Depending on their educational qualifications, Class 3 teacher recruits are again categorized into Class 3–Grade I(a) (those with a degree), Class 3-Grade I(b) (pedagogy trained teachers), Class 3–Grade I(c) (those with diplomas), and Class 3-Grade II (those with only A-Levels). Teachers with a Bachelor of Education are directly recruited to Class 2–Grade II. Conditional on their initial recruitment, those who have been recruited to Class 3 need to obtain three to five years' experience in teaching and pass an efficiency bar exam to be promoted to Class 2–Grade II. This recruitment structure suggests that all Class 2 teachers hold subject and pedagogical knowledge, as well as at least three years of experience. We therefore consider teachers of Class 2–Grade II and higher to be "experienced" teachers.

Figure 7
Shares of Grade 6 Scholarship Holders and School Funds, 2016



Source: Own calculations based on MOE (2016c) School Census data.

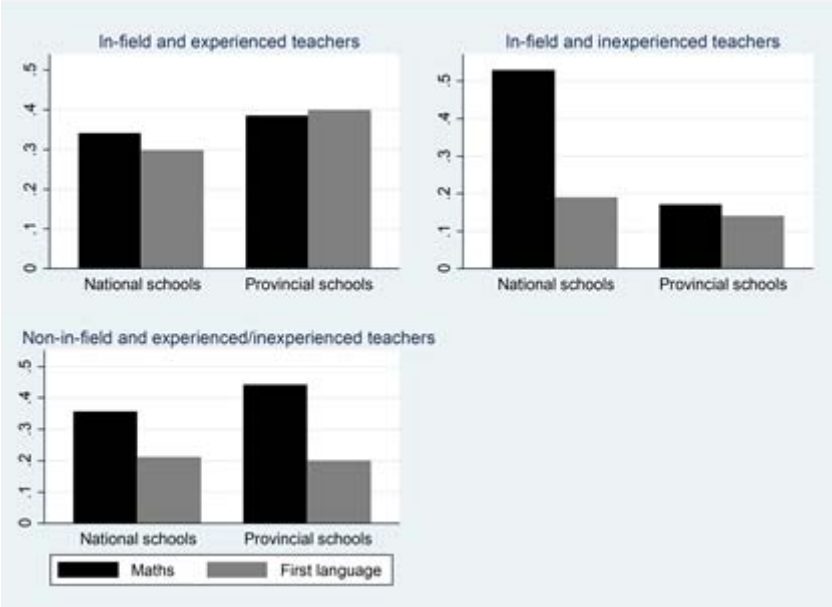
Note: The share of scholarship holders refers to the share of grade six students who gained admission to a school based on results obtained at the grade five scholarship exam. The share of school community funds and other fund raising refers to the share of total funds a school receives from the school community and from other external sources.

[13] The School Census groups Sinhala and Tamil teachers into one category (termed mother language) in questions relating to teacher qualifications and the subject taught. Accordingly, we include a common category (termed first language) for teachers of both languages.

We use three variables to measure teacher quality: (1) the share of in-field and experienced teachers; (2) the share of in-field and inexperienced teachers[14]; and (3) the share of other teachers (teachers who are not in-field, and either experienced or inexperienced). These are shares out of the number of *recommended* teachers for each school—which we believe provides a more accurate measure of teacher quality—as opposed to the *existing* number of teachers. We obtain recommended teacher numbers from the MOE (2016d), where the number of required secondary-level teachers for each subject is determined based on class sizes.

Figure 8 suggests that the share of in-field and experienced teachers is higher in provincial schools. This is a somewhat surprising observation, as one would expect national schools to have a larger share of qualified and experienced teachers. Given the large student numbers and class sizes in national schools, the number of recommended teachers (which is based on class size) is likely to be high on average, hence causing downward pressure on the share of high quality teachers. Nevertheless, Figure 8 also indicates that national schools account for a larger share of qualified and inexperienced teachers and a lower share of unqualified mathematics teachers. We expect the share of in-field and experienced teachers to have a positive influence on student performance, and the share of unqualified teachers to have a negative impact.

Figure 8
Shares of Teachers by Qualifications and Experience, 2016



Source: Own calculations based on MOE (2016c) School Census data.

Note: These shares refer to the respective numbers of existing teachers under each category out of the number of recommended teachers for each school.

The Teacher Service categorization based on Classes also applies to principals, which takes into account educational and professional qualifications, experience in administration and teaching, as well as problem-solving, logical thinking, and communication skills (MOE, 2014c; MOE, 2015).[15] Based on such criteria, the Classes are, in descending order of ranking: (1) Sri Lanka Education Administration Service (SLEAS); (2) Sri Lanka Principals Service (SLPS); (3) Sri Lanka Teachers Service (SLTS)[16]; and (4) those not absorbed into Teacher Service. We combine categories (3) and (4) in our analysis, which both account for a low number of observations.[17] Subsequently we include three dummy variables for the SLEAS, SLPS, and the combined SLTS and non-Teacher Service grades.

Figure 9 depicts a clear demarcation in principal service grades among national and provincial schools. Principals of the highest ranking SLEAS grade account for over 40% of principals of national schools, while provincial schools are overwhelmingly headed by principals of the SLPS. We

[14] This share could represent recent graduates, who have the necessary qualifications but are yet to accumulate experience.

[15] The specific criteria for each category form an extensive list, and are outlined in Appendix A.

[16] This category is the same as the Teacher Service class categorization discussed above for teachers.

[17] It is unusual to expect principals that are only of the Teachers Service grade or who do not belong to a service grade. We note that 68% of those in Teachers Service are from schools with no principal, where the principal's role is carried out by either acting, vice, or assistant principals, sectional heads or teachers. This is also the case for 24% of those who do not belong to a teacher service category. It is possible that schools with principals of either of these categories are political appointees without regard to qualifications or experience.

hypothesize that principals of the SLEAS have a superior impact on student performance compared to the other categories.

Teacher Absenteeism

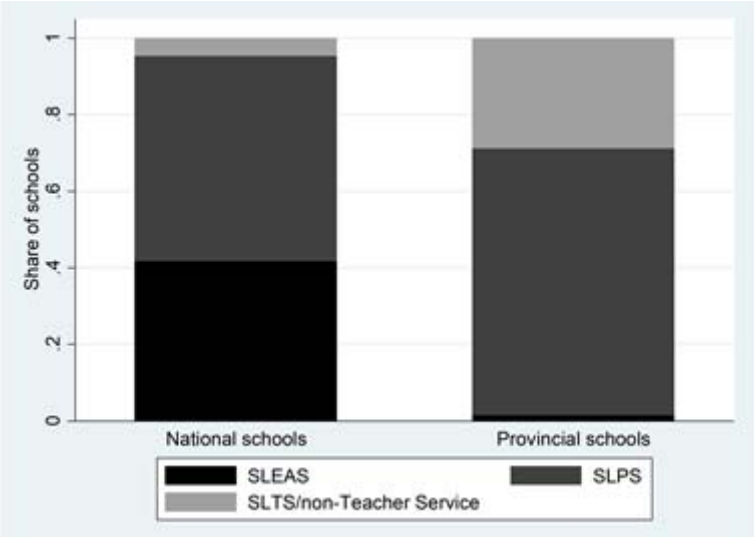
The level of commitment of teachers in performing their tasks is another variable potentially affecting student performance. We consequently include a measure of the average number of days of leave taken by teachers in a school as a proportion of the total number of school days. We predict a negative relationship between teacher absenteeism and educational outcomes.

The student-teacher ratio, class size, and teacher salaries are other frequently used measures of school quality in the existing literature (Fowler and Walberg, 1991; Lekholm, 2011; Aturupane et al., 2013; Chowa et al., 2013). However, these variables are not good indicators of school quality in Sri Lanka. Concerning student-teacher ratios and class sizes, although lower magnitudes are assumed to indicate better quality, as discussed above, the opposite appears to be the case in Sri Lanka. With regard to teacher salaries, the MOE determines teacher salaries at the central level, and, as such, these do not vary much across schools (Arunatilake, 2006).

5.2.4 Provincial Characteristics

Our final set of independent variables consists of provincial-level factors that reflect the socioeconomic status of the province each school belongs to.

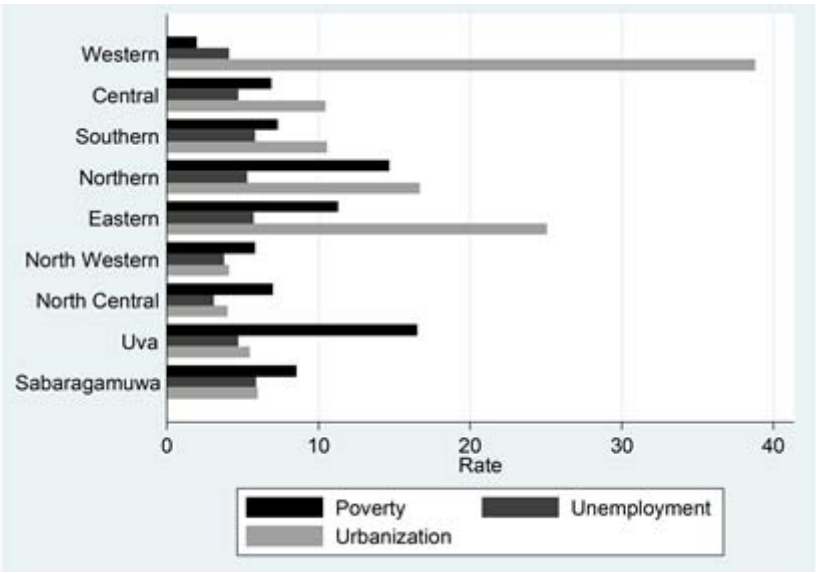
Figure 9
Share of Schools by Principal Service Grades, 2016



Source: Own calculations based on MOE (2016c) School Census data.

We consider the poverty headcount ratio, the unemployment rate, and the urbanization rate in each province as well as among national schools.[18,19] Apart from having potential direct impacts on a school's performance, these characteristics—which also serve as the level 2 explanatory variables in our HLM estimations—can also have a

Figure 10
Socioeconomic Characteristics by Province



Source: DCS (2013; 2015a; 2015b).

Note: Poverty refers to the poverty headcount ratio or the proportion of the population below the poverty line; unemployment refers to the percentage of the labour force that is currently unemployed; urbanization refers to the share of population in the urban sector.

[18] While GDP per capita is a potential important provincial variable, we omit this variable from our analysis due to high correlation between GDP per capita and the poverty headcount ratio and GDP per capita and urbanization rates.

[19] The provincial variables for national schools are calculated by taking the average of each indicator in each of the provinces to which each national school belongs.

bearing on the administrative capacity of each provincial MOE.

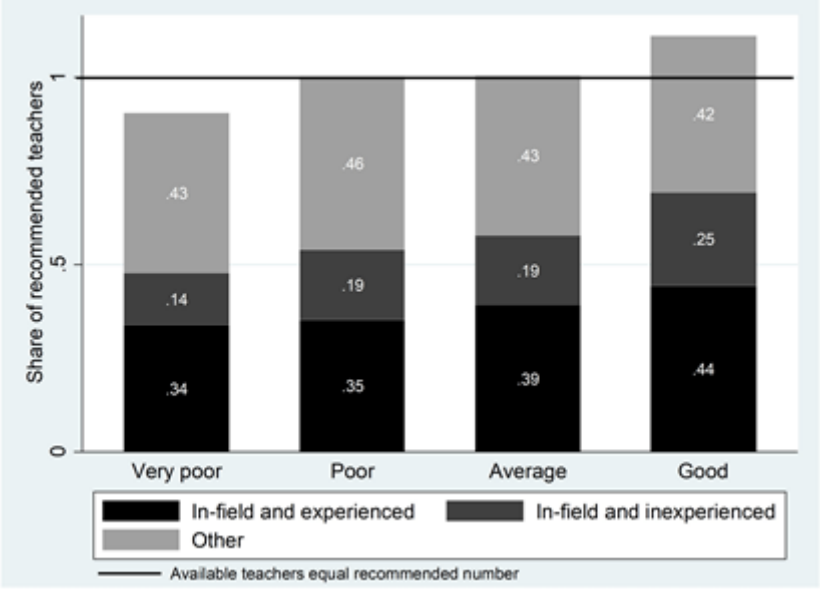
Figure 10 shows considerable variation in these indicators among provinces. The Western province records the lowest poverty rate and highest urbanization rate. Poverty levels are highest in the Uva province, while the North Western and North Central provinces record the lowest urbanization rates. We expect poverty to influence O-Level results negatively, and unemployment and urbanization rates to have a positive impact. It is probable that students are motivated to perform well and compete for limited jobs in provinces with lower employment opportunities.

Table 1 presents the sample means of our dependent and independent variables for the overall sample and for the four groups of O-Level performers—very poor, poor, average, and good schools—identified in the ORL model.[20] It is interesting to note that the mean values for each category of performers show a pattern indicative of our predictions discussed above. For example, the percentage of highly privileged schools is lowest among very poor performing schools, and highest among above average performers. Similarly, the share of 1AB schools ranges from a mere 3% of very poor performers to over 40% of good performing schools. The shares of scholarship holders, funds received from external sources, and teacher and principal quality variables also show an improving trend as one moves from column 2 to column 5.

Figure 11 provides a clear illustration of the differences in the availability and quality of mathematics teachers across the performance categories. As can be seen, schools that report the best O-Level results (good performers) have more than adequate numbers of mathematics teachers (a share of over one), a majority (44%) of whom are both in-field and experienced. In contrast, 'very poor' performing schools have a shortage of mathematics teachers, and a large share of unqualified teachers.

We observe missing values in our sample for the student socioeconomic indicators.[21] Consequently, we adopt multiple imputation (MI) techniques—a simulation-based approach for analyzing incomplete data—to deal with these missing observations.[22] The MI approach is motivated by several factors including higher efficiency than the commonly used list-wise deletion (complete-cases analysis)[23], greater flexibility than fully-parametric methods such as maximum likelihood, and the ability to account for missing data uncertainty, thereby not underestimating the variance of estimates as in the case of single imputation methods (Rubin, 1987; Cameron and Trivedi, 2005).

Figure 11
Available Mathematics Teachers as a Share of Recommended by Performance Categories, 2016



Source: Own calculations based on MOE (2016c) School Census data.

Notes: The four categories are defined based on shares that qualify to proceed to A-Level classes: very poor (0), poor (0-0.33), average (0.34-0.67), and good (>0.67). The line at the value one indicates that the number of available teachers exactly equals the recommended number. A value less than one indicates teacher shortages, while a value exceeding one indicates teacher surpluses.

[20] A full list of variable definitions and sources is provided in Appendix B.

[21] Information on the share of scholarship holders is not available for 165 schools, while 52 schools report missing values for the shares of different sources of funding.

[22] See Rubin (1987) and Cameron and Trivedi (2005) for a detailed explanation of this approach.

[23] This refers to the deletion of observations that have missing values on one or more of the variables in the data set.

Table 1
Sample Means of Variables

Variables	Sample Means				
	Overall (1)	Very poor (2)	Poor (3)	Average (4)	Good (5)
Rate qualified to progress to A-Levels	0.41	0.00	0.21	0.48	0.83
School characteristics					
Highly privileged schools	0.13	0.04	0.06	0.13	0.29
Privileged schools	0.39	0.26	0.37	0.44	0.37
Not privileged schools	0.25	0.35	0.28	0.24	0.18
Underprivileged schools	0.15	0.20	0.18	0.14	0.10
Highly underprivileged schools	0.08	0.15	0.11	0.05	0.06
1AB schools	0.18	0.03	0.04	0.20	0.43
1C schools	0.31	0.07	0.30	0.38	0.25
Type 2 schools	0.51	0.90	0.66	0.42	0.32
Students less than 200	0.30	0.79	0.34	0.23	0.20
Students between 200-1000	0.55	0.20	0.62	0.61	0.38
Students over 1000	0.15	0.01	0.03	0.16	0.42
Non-Sinhala schools	0.26	0.20	0.29	0.26	0.24
Student socioeconomic characteristics					
Scholarship holders	0.02	0.002	0.002	0.008	0.09
School community funds	0.10	0.09	0.10	0.10	0.11
Other external sources of funds	0.22	0.13	0.20	0.23	0.29
Teacher characteristics					
In-field and experienced math teachers	0.38	0.34	0.35	0.39	0.44
In-field and inexperienced math teachers	0.19	0.14	0.19	0.19	0.25
Other math teachers	0.44	0.43	0.46	0.43	0.42
In-field and experienced first-language teachers	0.40	0.36	0.37	0.40	0.42
In-field and inexperienced first-language teachers	0.14	0.11	0.15	0.15	0.12
Other first-language teachers	0.20	0.18	0.22	0.19	0.19
Leave	0.15	0.15	0.15	0.15	0.15
Principal characteristics					
SLEAS	0.04	0.003	0.005	0.02	0.17
SLPS	0.69	0.539	0.693	0.73	0.63
SLTS/Non-Teacher Service	0.27	0.458	0.302	0.25	0.20
Provincial characteristics					
Poverty	8.11	8.22	8.05	8.16	8.01
Unemployment	4.79	4.79	4.73	4.79	4.90
Urbanization	14.53	12.77	15.23	14.32	14.55

Source: Own calculations using MOE (2016c) School Census data.

Note: Teacher shares based on qualifications and experience may not add up to 1.00 for each group, as shares are shown as a percentage of recommended, as opposed to the total, number of teachers.

6. Results

6.1 Pooled Sample Estimates

Table 2 presents estimates depicting the relationship between school resources and O-Level exam performance. Estimation of a null multilevel model produces an ICC of 0.14, implying that 14% of the total variation in performance scores can be accounted for by the province-wise location of each school. As such, we estimate an HLM in addition to OLS and GOL models, to account for correlation among outcomes within a given province.

Our main focus is on the HLM estimates in column 2, which is our preferred model. The estimates are in line with our predictions. They indicate that O-Level performance lags behind that of highly privileged schools in other categorizations of schools, especially in highly underprivileged schools. The rate of qualification to A-Level classes in 1C and Type 2 schools is lower than 1AB schools, by 0.06 and 0.12 points, respectively. A similar trend is reflected in the school size variables, with average- and low-sized schools lagging behind their larger school counterparts. The share of scholarship holders in a school has a notable positive impact on student performance, with a 10 percentage point increase in this share boosting O-Level results by approximately 4 percentage points. The share of funds generated from external sources also raises performance rates, although at a lower magnitude.

In terms of teacher quality variables, having both qualified and experienced teachers is important for student achievement. For instance, increasing the share of in-field and experienced mathematics teachers by 10 percentage points would raise O-Level performance scores by 0.2 percentage points, on average. The amount of leave taken as a proportion of working school days has a large adverse impact on good performance. The qualifications and experience of principals also matter. Compared to the SLEAS category, principals belonging to the other two categories lower students' chances of progressing to A-Levels, by an increasing magnitude for lower ranks of service grades. Of the provincial level variables, higher community-level unemployment rates raise the likelihood of better performance. These HLM estimates are largely similar to the OLS estimates shown in column 1.

Columns 3—5 present estimates of odds ratios[24] from a GOL model. An odds ratio of one indicates that a conditional increase in the independent variable is not associated with any change in the dependent variable, while an odds ratio above (below) one indicates that an increase in the independent variable raises (lowers) the dependent variable.[25] Again, the logit estimates are broadly comparable with the other models. An additionally significant determinant is a school's ethnicity, where the odds of good performance are marginally lower in Tamil and Muslim schools compared to Sinhala schools.

The variables for which the parallel regression assumption is violated are highlighted in gray. The odds of good performance in highly underprivileged schools compared to highly privileged schools is significantly lower in the very poor category versus the combined poor, average, and good performance categories, and the combined very poor and poor versus the combined average and good performance categories, but not significantly different between the good performance category and all other groupings. While there is no significant difference in the odds of performance in schools registering zero qualified rates versus the combined better performing categories between 1AB and 1C schools, the odds of very poor and poor performance versus average and good performance, and that of very poor, poor, and average performance versus good performance is 0.4 and 0.7 points lower, respectively, in schools which do not have an A-Level science stream compared to

[24] Proportional odds ratios for the ordered logit model are obtained by exponentiating the ordered logit coefficients.

[25] We report odds ratios due to several reasons. First, they are relatively easier to interpret than logit coefficients. Second, they possess advantages over marginal effect estimates. The significance of marginal effects can be different to those of the coefficients since marginal effects for non-linear models need to be calculated assuming some specific value for each explanatory variable, unlike for a linear model (Wooldridge, 2002). Odds ratios are also simpler to obtain than marginal effects.

Table 2
School-Level Determinants for Pooled Sample

Dependent variable: Rate qualified to progress to A-Levels

Specification	OLS	HLM	GOL		
			Very poor	Poor	Average
	(1)	(2)	(3)	(4)	(5)
Privileged	-0.012	-0.017*	0.871	0.871	0.871
	(0.010)	(0.010)	(0.083)	(0.083)	(0.083)
Not privileged	-0.005	-0.009	0.930	0.930	0.930
	(0.011)	(0.011)	(0.100)	(0.100)	(0.100)
Underprivileged	-0.004	-0.011	0.903	0.903	0.903
	(0.013)	(0.013)	(0.106)	(0.106)	(0.106)
Highly underprivileged	-0.027*	-0.037**	0.617**	0.651***	1.240
	(0.015)	(0.015)	(0.115)	(0.092)	(0.233)
1C	-0.065***	-0.056***	1.212	0.379***	0.676***
	(0.010)	(0.010)	(0.435)	(0.050)	(0.084)
Type 2	-0.129***	-0.118***	0.295***	0.196***	0.586***
	(0.011)	(0.011)	(0.092)	(0.026)	(0.078)
Students between 200-1000	-0.100***	-0.098***	1.697***	0.452***	0.362***
	(0.011)	(0.011)	(0.302)	(0.053)	(0.041)
Students below 200	-0.146***	-0.144***	0.348***	0.348***	0.348***
	(0.013)	(0.013)	(0.045)	(0.045)	(0.045)
Non-Sinhala	-0.010	-0.006	0.890*	0.890*	0.890*
	(0.007)	(0.008)	(0.062)	(0.062)	(0.062)
Share of scholarship holders	0.378***	0.369***	202.16***	202.16***	202.16***
	(0.036)	(0.036)	(139.28)	(139.28)	(139.28)
School community funds	-0.008	-0.014	0.987	0.987	0.987
	(0.016)	(0.016)	(0.149)	(0.149)	(0.149)
Other external funds	0.036***	0.028**	2.767***	1.591***	1.181
	(0.013)	(0.013)	(0.793)	(0.216)	(0.205)
In-field and experienced math teachers	0.027***	0.021***	1.203***	1.203***	1.203***
	(0.008)	(0.008)	(0.084)	(0.084)	(0.084)
In-field and inexperienced math teachers	0.016*	0.007	1.089	1.089	1.089
	(0.009)	(0.009)	(0.092)	(0.092)	(0.092)
Other math teachers	0.008	0.008	1.063	1.063	1.063
	(0.006)	(0.006)	(0.059)	(0.059)	(0.059)
In-field and experienced first-language teachers	0.015**	0.014**	1.150**	1.150**	1.150**
	(0.006)	(0.006)	(0.067)	(0.067)	(0.067)
In-field and inexperienced first-language teachers	-0.002	0.000	0.965	0.965	0.965
	(0.009)	(0.009)	(0.082)	(0.082)	(0.082)
Other first-language teachers	0.002	0.001	1.339**	0.951	1.020
	(0.007)	(0.007)	(0.183)	(0.071)	(0.116)
Leave	-0.375***	-0.377***	0.038***	0.038***	0.038***
	(0.086)	(0.089)	(0.030)	(0.030)	(0.030)
SLPS	-0.101***	-0.088***	0.365***	0.365***	0.365***
	(0.017)	(0.018)	(0.064)	(0.064)	(0.064)
SLTS/Non-Teacher Service	-0.108***	-0.095***	0.357***	0.357***	0.357***
	(0.018)	(0.019)	(0.065)	(0.065)	(0.065)
Poverty	-0.000	-0.001	0.990	0.990	0.990
	(0.001)	(0.002)	(0.008)	(0.008)	(0.008)
Urbanization rate	-0.001***	-0.001	1.004	0.988***	0.986***
	(0.000)	(0.001)	(0.005)	(0.003)	(0.004)
Unemployment rate	0.025***	0.025**	1.240***	1.240***	1.240***
	(0.004)	(0.011)	(0.044)	(0.044)	(0.044)
Observations	5,688	5,688	5,473	5,473	5,473
R^2	0.24	-	-	-	-
Pseudo R^2	-	-	0.13	0.13	0.13
Number of groups	-	10	-	-	-

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10%, respectively. Standard errors are shown in parentheses. Categories of the dependent variable for the GOL model include: (1) very poor (0); (2) poor (0–0.33); (3) average (0.34–0.67); and (4) good (>0.67). Odds ratios are reported for the GOL model. MI techniques not adopted for the GOL model as this estimation procedure is not available in Stata. Coefficients on constants and random effects parameters of the HLM not reported. R^2 and Pseudo R^2 obtained from models that do not use MI techniques.

schools that do. The share of other (unqualified and experienced or inexperienced) first-language teachers significantly raises the odds of qualifying for A-Level classes for the very poor group compared to the other groups, but not for other combinations of groupings. This finding is perhaps suggestive of the importance of teachers—irrespective of their levels of qualifications and experience—for students at the lowest end of the performance scale.

That the majority of our variable coefficients are similar across all models could be partly attributable to the relatively low value of the ICC. This indicates that the correlation in outcomes within provinces is not overly significant so as to invalidate the results of models such as OLS and GOL which do not account for provincial-level variation in outcomes. Our explanatory variables are able to explain approximately 24% of the sample variation in O-Level performance rates across schools. It is possible that student-level characteristics have a larger bearing on examination outcomes. Further, the increasing significance of private tutoring which operates on a large scale in Sri Lanka (Pallegedara, 2011; Sedere et al., 2016) could lower the impact that school-level characteristics have on student performance.[26]

6.2 Estimates by School Categories

In this section we disaggregate our sample and estimate separate regressions based on two categorizations: (1) national and provincial schools; and (2) 1AB, 1C and Type 2 schools. The distinction between national and provincial schools is motivated by the substantial differences that exist in school amenities (and other characteristics) between the two school groups. It is possible that more intelligent students self-select into national schools, which in turn raises examination scores in these schools. If this was indeed the case, our estimates could suffer from endogeneity issues. Estimation of separate regressions enables us to test whether the effects of our explanatory variables on O-Level performance rates still hold as for the pooled estimations, and whether they differ between the two school categories. We use an OLS estimation approach instead of HLM due to two reasons: (1) educational outcomes for the first regression of national schools are all affected by the same level 2 variable—the central MOE—making a HLM redundant in this case; (2) while the nine different provincial education ministries can still influence the variation of O-Level test scores in provincial schools across different provinces, the ICC of a null model is negligible at 2%, suggesting that OLS would suffice.

The objective of differentiating between school types is to test whether school- and provincial-level characteristics have a significant and comparable impact on O-Level performance rates for similar schools. This categorization does not distinguish between national and provincial schools, and hence we stick to HLM, our preferred model.

As can be seen in Table 3, the significance of variables still holds as for the pooled sample, although some marked differences can be observed in impacts across the different school categories. Columns 1 and 2, which compare national and provincial schools, indicate that school status is an important determinant of O-Level performance among national schools, as in the case of the pooled sample; however, academic achievement among provincial schools is not affected by a school's standing. On the other hand, school-generated funds and the qualifications and experience of teachers and principals have a significant bearing on student achievement only in provincial schools. Several potential reasons can be put forward to explain this finding: (1) school-level funds and teacher quality are higher and fairly uniform among national schools, while they could differ significantly across provincial schools based on location and other factors; (2) teacher quality is less important for student performance in national schools, either since intelligent students self-select into these schools, or since students are self-motivated to work hard and/or access private tutoring in larger quantity, given the high competition and pressure to perform well. The provincial variables are also important in explaining provincial school-level variation in examination performance. The positive impacts of 1AB and larger schools and the share of scholarship holders and the negative impact of teacher leave observed for the pooled sample, still hold among both national and provincial schools.

[26] We are unable to directly control for private tutoring due to data unavailability. Our proxies for student socioeconomic characteristics serve as an indirect indicator of trends in additional tutoring consumed by students across schools.

Table 3
School-Level Determinants by School Category

Dependent variable: Rate qualified to progress to A-Levels

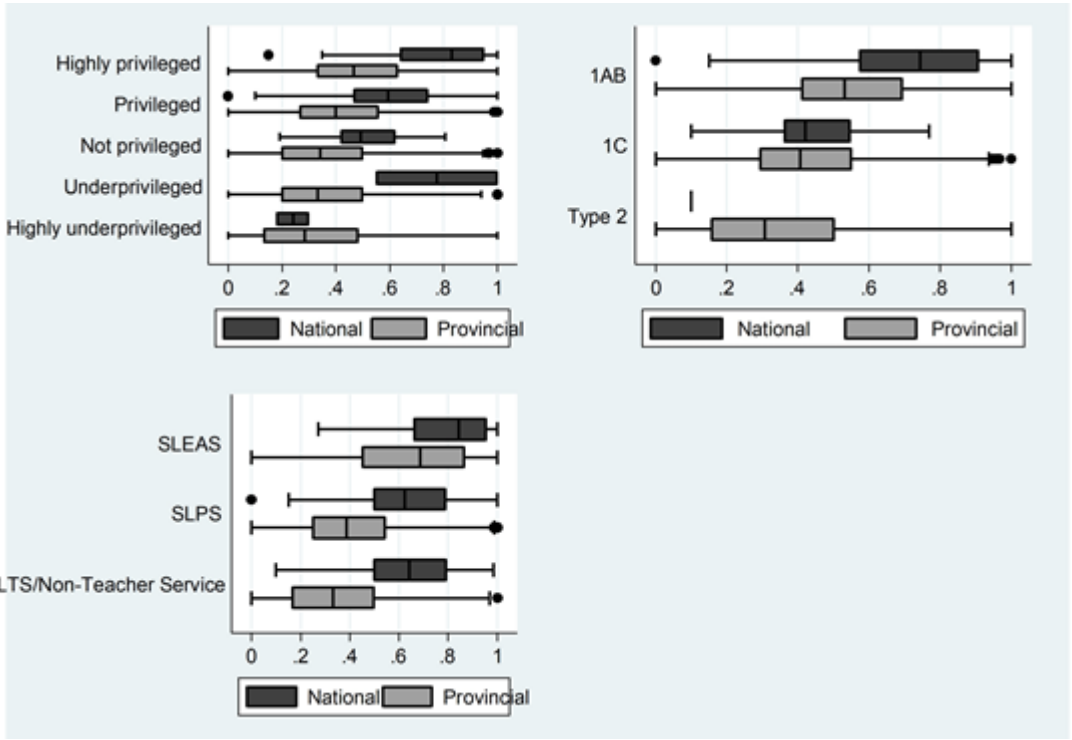
Specification	OLS		HLM		
	National (1)	Provincial (2)	1AB (3)	1C (4)	Type 2 (5)
Privileged	-0.058***	0.003	-0.020	-0.003	-0.003
	(0.019)	(0.011)	(0.012)	(0.016)	(0.022)
Not privileged	-0.098*	0.008	-0.006	0.009	-0.001
	(0.051)	(0.012)	(0.027)	(0.018)	(0.023)
Underprivileged	-0.018	0.009	-0.028	-0.026	0.009
	(0.110)	(0.013)	(0.032)	(0.021)	(0.024)
Highly underprivileged	-0.276***	-0.013	-0.037	0.015	-0.037
	(0.112)	(0.016)	(0.057)	(0.026)	(0.026)
1C	-0.112***	-0.054***	-	-	-
	(0.035)	(0.011)	-	-	-
Type 2	-0.141	-0.120***	-	-	-
	(0.221)	(0.012)	-	-	-
Students between 200-1000	-0.090***	-0.092***	-0.094***	-0.073***	-0.122***
	(0.027)	(0.012)	(0.014)	(0.016)	(0.032)
Students below 200	-0.431***	-0.139***	-0.209**	-0.105***	-0.174***
	(0.168)	(0.014)	(0.101)	(0.023)	(0.033)
Non-Sinhala	-0.031	-0.010	-0.047***	0.009	-0.007
	(0.024)	(0.008)	(0.016)	(0.012)	(0.013)
Share of scholarship holders	0.348***	0.342***	0.328***	0.462***	0.341***
	(0.040)	(0.051)	(0.032)	(0.142)	(0.130)
School community funds	0.016	-0.005	0.011	0.055**	-0.057**
	(0.064)	(0.017)	(0.033)	(0.028)	(0.025)
Other external funds	0.040	0.035***	0.053**	0.011	0.028
	(0.040)	(0.013)	(0.024)	(0.020)	(0.021)
In-field and experienced math teachers	0.040	0.027***	0.035**	0.031**	0.014
	(0.031)	(0.008)	(0.018)	(0.012)	(0.011)
In-field and inexperienced math teachers	-0.027	0.013	0.012	0.008	0.001
	(0.025)	(0.010)	(0.019)	(0.016)	(0.014)
Other math teachers	0.015	0.007	0.017	0.017*	-0.001
	(0.023)	(0.006)	(0.015)	(0.009)	(0.009)
In-field and experienced first-language teachers	-0.016	0.016***	0.009	0.008	0.019**
	(0.029)	(0.006)	(0.015)	(0.011)	(0.009)
In-field and inexperienced first-language teachers	-0.030	-0.003	-0.039*	-0.019	0.014
	(0.036)	(0.010)	(0.023)	(0.016)	(0.013)
Other first-language teachers	-0.058*	0.003	-0.012	-0.011	0.009
	(0.030)	(0.008)	(0.021)	(0.013)	(0.010)
Leave	-0.551*	-0.384***	-0.862***	-0.238	-0.296***
	(0.292)	(0.090)	(0.189)	(0.154)	(0.127)
SLPS	-0.032*	-0.114***	-0.082***	-0.043	0.029
	(0.020)	(0.026)	(0.016)	(0.044)	(0.068)
SLTS/Non-Teacher Service	-0.017	-0.121***	-0.083***	-0.038	0.015
	(0.044)	(0.027)	(0.025)	(0.045)	(0.068)
Poverty	0.000	-0.001	0.003	-0.000	-0.001
	(0.003)	(0.001)	(0.003)	(0.002)	(0.003)
Urbanization rate	-0.000	-0.001***	0.000	-0.001*	-0.002*
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Unemployment rate	0.008	0.025***	0.007	0.013	0.034***
	(0.012)	(0.004)	(0.014)	(0.010)	(0.012)
Observations	346	5,342	999	1,776	2,913
R^2	0.54	0.15	-	-	-
Number of groups	-	-	10	10	10

Notes: ***, **, and * indicate statistical significance at 1%, 5%, and 10%, respectively. Standard errors are shown in parentheses. MI techniques adopted to impute missing values. Coefficients on constants and random effects parameters not reported. R^2 obtained from estimations that do not apply MI techniques.

Columns 3—5 show patterns of variation in school-level determinants between 1AC, 1B, and Type 2 schools. School status does not affect student performance in any school type. Ethnicity, external funds, and principal service grade matter only for 1AB schools. The varying impact of principal quality among school types could be owing to the fact that higher quality principals are more important in managing larger and more advanced schools, whereas smaller and less developed schools may not require as competent a principal. Alternatively, school community funds and provincial variables affect O-Level scores in 1AC and Type 2 schools. The teacher quality variables show diverse effects across the three school types—in-field and experienced mathematics teachers are important in schools that have A-Level classes, while qualified first language teachers have an impact on student performance in Type 2 schools. School size and the share of scholarship holders are important determinants of educational outcomes for all school types.

Figure 12 illustrates some of the key findings discussed above. The share of students that qualify from the O-levels to proceed to the collegiate level gradually diminishes, on average, as one moves from higher ranked schools—either in terms of status, type, or principal service grade—to lower order ones. This trend is observed across both national and provincial schools, with the exception of underprivileged national schools, which outperform privileged schools. It is also worth noting that national schools are consistently placed to the right of provincial schools, suggestive of superior performance of national schools across different categorizations.

Figure 12
O-Level Performance Rates by School Status, Type, and Principal Service Grade, 2016



Source: Own calculations based on MOE (2016c) School Census data.

7. Conclusions and Policy Implications

In this study we use cross-sectional school-level data to examine the impact of school resources on educational outcomes at the secondary level in Sri Lanka. Across the pooled sample of schools, several school- and provincial-level factors have a significant impact on O-Level examination performance, although the magnitudes of these impacts are not large. We find positive effects of the shares of qualified mathematics and first language teachers, grade six scholarship holders, and the share of funds received from external sources. Teacher leave, on the other hand, has a sizeable negative effect on student achievement. Additionally, a school's ranking based on status, type, size, and principal service category has a significant bearing on performance, with increasingly lower O-Level scores being observed for inferior schools and those managed by low quality principals. A distinction among different school categorizations points to differential impacts of several variables including school status, type, school-level funds, teacher quality, and principal service grade.

Our explanatory variables are able to explain approximately one-fourth of the variation in O-Level performance scores. Student-level characteristics could be other potential important determinants of academic performance, which we are unable to account for owing to data constraints. Future research might explore the role of student-level characteristics in determining academic performance, subject to data availability.

Our results point to several implications for improving O-Level performance rates of students in Sri Lanka. The finding that O-Level performance is lower in both smaller schools and 1C and Type 2 schools holds even after controlling for the share of scholarship holders, indicating that lower performance is not only due to differences in ability. These schools—the majority of which are provincial schools—thus require special attention if the overall O-Level performance rate is to be increased nationally.

The significant positive relationship observed between high quality teachers and student achievement highlights the need for developing policies to ensure that schools attract qualified and experienced staff members. The systematic training and recruitment of teachers into Teacher Service is important in this regard. Our analysis also indicates that schools that report the best O-Level results have more than adequate numbers of mathematics teachers, while 'very poor' performing schools encounter teacher shortages, particularly teachers of higher quality. A reallocation of qualified and experienced teachers from better performing schools to schools reporting poor examination results is thus important. Relocating teachers is however a challenging task, given that teachers prefer to remain in privileged schools with good administrative and pedagogical support. Under the current recruitment system, teachers are recruited centrally by the ministries of education and allocated to schools. This gives them flexibility in changing schools according to their preferences via the education ministries. Giving schools—especially those with teacher shortages—powers to recruit teachers at the school-level could restrict teacher mobility and address problems of teacher shortages in less privileged schools. Such a system has already been implemented in estate sector schools to remedy serious shortages of Tamil medium teachers.

Our findings also show that student achievement is low in schools when the number of days of leave taken by teachers is high. Descriptive statistics indicate an average share of teacher leave days of 15% of total working school days, which is not an insignificant figure. Providing incentives for teachers to reduce leave is therefore important. One possibility is implementing an incentive scheme for unutilized leave. Developing systems that recognize and appreciate teachers who improve education outcomes of students can also motivate teachers to be more engaged.

Lastly, our results reveal that schools managed by better qualified and experienced principals perform better at the O-Levels. It is disconcerting to note that, on average, 27% of schools in our sample are managed by individuals who are not in either the SLEAS or SLPS grades—a figure which rises to 46% in 'very poor' performing schools. Enhancing the quality of principals' training programmes, and the recruitment to Principal Service in a systematic and merit-based manner, are key in ensuring that the majority of Sri Lankan schools are overseen by competent leaders.

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Appendices

Appendix A
Principal Service Grades in Sri Lanka

A1
Sri Lanka Education Administration Service (SLEAS)

The SLEAS category is the highest ranking category of principal service, for which there are three categories of recruitment—(1) open; (2) limited; and (3) service experience and merit.

- Open recruitment

Open recruitment is made to Grade III of the SLEAS, and requires a degree from a university recognized by the University Grants Commission (UGC). The method of recruitment involves written examinations in four areas—comprehension, intelligence, general knowledge, and essay and precis. A minimum of 40% in all areas is needed to qualify for an oral interview, where knowledge in the process of learning and teaching, and skills in logical reasoning, problem-solving and communication are tested.

- Limited recruitment

This category also recruits to Grade III of the SLEAS and requires both educational qualifications and experience to match the qualifications. These requirements can be one of either the following three options:

Qualifications	Experience
Degree obtained from a university recognized by the UGC or the National Institute of Education (NIE)	Active and satisfactory teaching experience at least during the immediately preceding period of five years
National Diploma in Teaching or Trained Teacher Certificate; or an officer in the SLPS	Active and satisfactory teaching experience at least during the immediately preceding period of seven years
Belonging to the SLPS	Active and satisfactory service during the immediately preceding period of five years in a post of the SLPS

Additionally, every candidate should have passed the first efficiency bar examination of the service for which he/she applies. The method of recruitment consists of three written examinations in general knowledge and intelligence, comparative education, and educational administration and management. A minimum of 40% has to be obtained in these examinations to qualify for an oral interview which, similar to the open recruitment category, tests subject and pedagogy knowledge, and logical reasoning, problem-solving and communication skills.

- Service experience and merit

Recruitments are again made to Grade III of the SLEAS. A period of at least three years of service in Grade I of the SLPS is essential to be considered for this category. In addition, no candidate is permitted to sit for the competitive examination for recruitment on the basis of service experience and merit for more than three sittings, while they also should have passed or been exempted from the efficiency bar examinations applicable to the SLPS. Recruitment is made based on the results of two written examinations—in comparative education and education management and administration—and service experience. Service experience refers to seniority against all periods of active and satisfactory service in Grade I of the SLPS.

The promotion from Grade III to Grade II (Grade II to Grade I) within the SLEAS requires: (1) a minimum of 10 (seven) years of service in Grade III (II) of the SLEAS and the earning of 10 (seven) salary increments; (2) passing the first (second) efficiency bar examination on the prescribed date; (3) successful completion of a capacity building training course in educational management and administration; (4) passing the Post Graduate Diploma in Education (post-graduate degree in a relevant subject); and (5) demonstration of performance at a satisfactory level during the preceding 10 (seven) years.

A2
Sri Lanka Principals Service (SLPS)

Recruitment to the SLPS is available only via the "limited" option, and made to Class 3 of the SLPS. Educational and professional qualifications and experience required are as follows:

Qualifications	Experience
Bachelor of Education degree obtained from a university recognized by the UGC or from the NIE	Completion of five years of satisfactory service in the Sri Lanka Teachers Service
Degree in any area of subject recognized by the UGC with a Post Graduate Diploma in Education	Completion of five years of satisfactory service in the Sri Lanka Teachers Service
National Diploma in Teaching /Trained Teacher Certificate	Completion of six years of satisfactory service in the Sri Lanka Teachers Service

The method of recruitment to the SLPS comprises three written examinations in comprehension, case studies on school administration, and aptitude and general knowledge. A minimum of 40% in each examination is required. Based on the marks obtained at the written examination, candidates are subject to a general and structured interview, which further tests knowledge and competency in the written examinations and the general understanding of the role of a principal.

Promotions from Grade III to Grade II (Grade II to Grade I) of the SLPS are contingent upon: (1) completing an active and satisfactory period of at least six years in Class 3 (Class 2) and being eligible for six salary increments; (2) passing the first (second) efficiency bar examination on the prescribed date; (3) demonstration of satisfactory performance during the period of 6 years preceding the date of promotion; and (4) passing a capacity building training course. Promotion from Grade II to Grade I additionally requires completion of a Post Graduate Diploma in Education or a Bachelor of Education and a Diploma in School Management or Post Graduate Diploma in Education Management.

Sources: MOE (2014b; 2014c; 2015).

Appendix B
Variable Descriptions

Dependent variable

O-Level performance rate: The share of students who qualify to proceed to A-Level classes out of the total number of students who sit for the O-Levels in a school. Source: MOE (2016c).

Independent variables

School characteristics

- School status dummies:
  - *Highly privileged*: A dummy variable, which equals one if the school is categorized as highly privileged
  - *Privileged*: A dummy variable, which equals one if the school is categorized as privileged
  - *Not privileged*: A dummy variable, which equals one if the school is categorized as not privileged
  - *Underprivileged*: A dummy variable, which equals one if the school is categorized as underprivileged
  - *Highly underprivileged*: A dummy variable, which equals one if the school is categorized as highly underprivileged

- School type dummies:
  - *1AB*: A dummy variable, which equals one if the school has A-Level classes in the Science stream in addition to the Commerce and Arts streams
  - *1C*: A dummy variable, which equals one if the school has A-Level classes in the Commerce and Arts streams, but not in the Science stream
  - *Type 2*: A dummy variable, which equals one if the schools has classes only up to O-Levels

- School size dummies:
  - *Students above 1000*: A dummy variable, which equals one if the school has a student population above 1,000
  - *Students between 200-1000*: A dummy variable, which equals one if the school has a student population between 200 and 1,000
  - *Students below 200*: A dummy variable, which equals one if the school has a student population below 200

- *Non-Sinhala:* A dummy variable, which equals one if the school is of Tamil or Muslim ethnicity, and equals zero if of Sinhala ethnicity. Source: MOE (2016c).

Student socioeconomic characteristics

- *Scholarship holders*: The share of grade six students that gained admission to the school based on results obtained at the grade five scholarship examination. Source: MOE (2016c).

- *School community funds*: The share of total funds a school receives from NGOs and past pupil associations. Source: MOE (2016c).

- *Other external funds*: The share of funds a school receives from sources other than the central or provincial MOEs and school community. The specific sources are: (1) funds from school land and buildings; (2) funds from members of School Development Societies; (3) funds obtained from various school activities such as the production of learning equipment; and (4) other forms of funds decided upon by the School Development Society. Source: MOE (2016c).

Teacher and principal characteristics

- *In-field and experienced mathematics teachers*: The share of recommended mathematics teachers teaching mathematics in a school, who hold either a degree or diploma in mathematics and belong to Class 2–Grade II or higher of teacher service. Source: MOE (2016c).

- *In-field and inexperienced mathematics teachers*: The share of recommended mathematics teachers teaching mathematics in a school, who hold either a degree or diploma in mathematics and belong to Class 3 of teacher service. Source: MOE (2016c).

- *Other mathematics teachers*: The share of recommended mathematics teachers teaching mathematics in a school, who are either untrained in mathematics or not absorbed into teacher service, and belong to either Class 2 or Class 3 of teacher service. Source: MOE (2016c).

- *In-field and experienced first language teachers*: The share of recommended first language teachers teaching the first language in a school, who hold either a degree or diploma in Sinhala or Tamil and belong to Class 2–Grade II or higher of teacher service. Source: MOE (2016c).

- *In-field and inexperienced first language teachers*: The share of recommended first language teachers teaching the first language in a school, who hold either a degree or diploma in Sinhala or Tamil and belong to Class 3 of teacher service. Source: MOE (2016c).

- *Other first language teachers*: The share of recommended first language teachers teaching the first language in a school, who are either untrained in the first language or not absorbed into teacher service, and belong to either Class 2 or Class 3 of teacher service. Source: MOE (2016c).

- *Leave*: The average number of days of leave taken by teachers of a given school as a proportion of the total number of working school days. Source: MOE (2016c).

- Principal Service grade dummies:
  - *SLEAS*: A dummy variable, which equals one if the school principal/acting principal belongs to the SLEAS grade
  - *SLPS*: A dummy variable, which equals one if the school principal/acting principal belongs to the SLPS grade
  - *SLTA/ Non-Teacher Service*: A dummy variable, which equals one if the school principal/acting principal belongs to the Teacher Service grade or does not belong to teacher service

Provincial characteristics

- *Poverty*: The poverty headcount ratio—the proportion of the population that exists below the poverty line in each province. Source: DCS (2015a).

- *Unemployment*: The unemployment rate—the percentage of the labour force that is currently looking for, but without jobs in each province. Source: DCS (2015b).

- *Urban*: The urbanization rate—the share of population in the urban sector in each province. Source: DCS (2013).

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Institute of Policy Studies of Sri Lanka
100/20, Independence Avenue, Colombo 7, Sri Lanka
Tel: +94 11 2143100 Fax: +94 11 2665065
Email: ips@ips.lk; Website: www.ips.lk
Blog: 'Talking Economics' - http://ipslk.blogspot.com
Twitter: www.twitter.com/TalkEconomicsSL

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