THE EDUCATIONAL 'ARMS RACE': ALL FOR ONE, LOSS FOR ALL

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Abstract

The 'arms race' that is playing out in Singapore's education sector can deepen inequality and widen social divisions. Most of the academic literature highlights the premium attributable to greater years of schooling and education and higher rates of return for those with higher levels of education, but there is less research on the societal costs of education if it is desired as a positional good. Apart from some studies on intergenerational income mobility, there is limited literature and empirical data on the societal costs of an escalating educational arms race. This paper provides a stylised model that illustrates how the education system can be a transmission mechanism as well as a multiplier of inequality, and how societal costs can escalate when there is excessive competition for scarce educational resources. We look at Household Expenditure Surveys in Singapore for evidence of an educational arms race and consider the public policy framework in Singapore on education in the light of this analysis and make some policy recommendations to avert costly, persistent arms races that reduce societal well-being. In particular, we suggest significantly adjusting the structure of recurrent public expenditure on education on a per student basis for the primary and secondary schooling levels to reduce regressive effects, and the elimination of streaming and fast-tracking mechanisms, especially early on in students' lives.

1.   Introduction and literature review

Education can be a levelling or main counterweight force against inequality, especially in a society that prides itself on meritocratic principles. Much academic literature has shown a linkage between investments in human capital and societal development, and a positive correlation in the number of years of schooling with lifetime earnings of a worker.

However, Frank (2007) points out that investment in children by parents is a positional good, with such expenditures taking on many of the characteristics of an arms race where it is the relative amounts spent compared to the other contestants that determine ranking. A positional good[1] is a product or service whose value (and hence its consumption) is primarily a function of its relative desirability or scarcity in a social context. Examples of such positional goods are luxury consumption goods such as Ferraris or country club memberships, and also extend to services that signal social status or rank, such as education.

In Singapore and in many other parts of the developed world, one of the most significant investments that parents can make for the benefit of their children is to buy a house proximate to a good school. A study by Addae-Dapaah and Tan (2003) found a measurable premium on "good schools" in housing prices. Successive generations of parents seeking to send their children to these schools may trigger bidding wars for property within the one- and two-kilometre radius of the schools, and prevent less wealthy families from the

1. The concept of positional goods was developed by Fred Hirsch in his 1976 book, *Social Limits to Growth*, Cambridge, Massachusetts: Harvard University Press.

staying in the same neighbourhood. These house pricing and income differentials are sources of inequality and can dampen social mobility over generations, as enclaves of wealthy residents cluster near the schools and around specific locations and neighbourhoods.

Educational qualifications or selection for educational distinction such as the Gifted Education Programme, are very visible measures of academic merit. These measures can become the primary and oftentimes only determinant of merit, leading to the securing of places in the most prestigious and elite higher education institutions. Graduation from these elite higher education institutions may in turn be read as a signal of ability that can draw the attention of employers offering the best-paying jobs. Because of this, educational qualifications can become a positional good. In Singapore however, where education is extensively funded by the government, the educational 'arms race' manifests itself in a considerable shadow education market: a largely unregulated market for private tuition.

As Bray and Lykins (2012) point out, the development of a shadow education market has positional drivers. If private tutoring is received by a part of the cohort and is perceived to be effective, others will feel that they need to follow until almost everyone is receiving it.

This is similar to the analogy of seated spectators in a sports stadium where all can see the action comfortably. If some in the front row were to stand to get an even better view, then others behind them will have to stand in order to

see, up to the point when all of the spectators are forced to stand to preserve their relative view of the game. If the chances for qualifying in the Gifted Education Programme are increased because a child (gifted or not) has obtained private tutoring, then those who are not privately tutored are at a relative disadvantage. All parents wishing to give their children the best opportunities are then forced into paying for such tuition. Once all the children receive private tutoring, the next stage in this arms race would be to differentiate amongst the tutors on quality and track record, which in turn could lead to tutors selecting the most able students to receive tuition, resulting in escalating costs with little aggregate benefit.

A study by Ng (2007) found a significant positive correlation between parental education and their children's education, and suggested that education is a factor of persistence in the intergenerational transmission of income. Wealthier families are better able to invest in their children's education, whether by way of purchasing houses proximate to good schools or by hiring private tutors.

This paper develops a theoretical model that illustrates how, in the presence of positional motivations, the education system can magnify economic inequality and increase societal costs. We evaluate publicly available data from Singapore's Household Expenditure Surveys for evidence of the emergence of arms races in educational expenditure, and whether there are any income-based inequalities in educational expenditure, especially in the shadow education market. Finally, we consider the public policy framework in

Singapore on education in the light of this analysis and make some recommendations.

2. Review of literature on the link between human capital investment and development

Academic literature on the subject of human capital investment and the links to development has focused on the effect of education (measured by way of mean years of schooling and educational attainment) on income growth. In Singapore, Low et al. (2004) report a 13.2% increase in earnings attributable to a worker who invests in an additional year of education. Yeo et al. (2007) found a similar increase of 13.7% in a worker's earnings for an extra year of schooling, with a higher rate of return for tertiary education as compared with non-tertiary education.

Internationally, a substantial body of research has been carried out from the work of Mincer (1974) that highlights the positive link between human capital investments in education on individual, cohort and societal development (see Barro 1991; Haddad et al. 1990; and Hall 2002). Psacharopoulos and Patrinos (2002) found the international average rate of return for an extra year of schooling is about 10%, with the highest returns recorded for low and middle-income countries.

The intuition that more schooling leads to better earnings capacity for individuals through better-paying jobs is thus well entrenched, both in the academic literature as well as in Singapore society. The notion that more education is always better runs deep in societal values, and it is little surprise

therefore to observe very significant increases in the mean years of schooling in Singapore (see

Figure 1). However, it is also appropriate to take into account societal costs, particularly when education goes beyond knowledge accumulation and takes on positional aspects — where the investment in education becomes a positional good. In particular, there are costs (direct, indirect and opportunity costs) associated with additional years of schooling, particularly if the pursuit of the additional years of schooling is highly competitive.

Figure 1: Singapore mean years of schooling
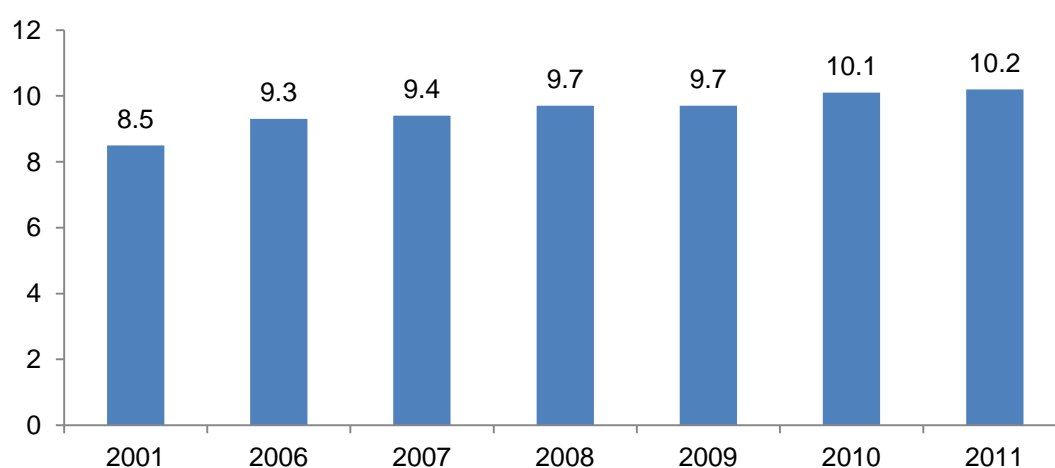
Source: Yearbook of Statistics Singapore, 2012, Department of Statistics, Singapore.

Psacharopoulos and Patrinos (2002) find that the private returns from education to be greater than those to society, where the societal returns are defined as the private benefits less the total private and external costs of education. There may be social benefits from having a highly educated population, but these are difficult to quantify, and there is likely to be a diminishing marginal rate of return in such investments, as argued by Bils and

Klenow (2001). Interestingly, Cheo and Quah (2005) have found such diminishing returns from private tutoring investments in the Singapore context.

Given the government expenditure on education, the education system can have a tendency to be regressive, with those staying longer in the publicly funded education system enjoying larger subsidies, such that they receive more of the public expenditure on education (see Table 1).

**Table 1: Government recurrent expenditure on education
per enrolled student, 2001 and 2011**

	2001	2011
Government recurrent expenditure on Education, $ '000		
Primary schools	1,044,461	1,853,250
Secondary schools and Junior Colleges	1,262,302	2,529,659
Institutes of Technical Education	162,648	347,338
Universities	1,114,554	2,944,796
National Institute of Education	87,000	118,558
Polytechnics	592,733	1,179,125
Enrolment in educational institutions		
Primary schools	302,566	258,293
Secondary schools and Junior Colleges	211,457	240,270
Institutes of Technical Education	16,176	25,279
Universities	52,422	75,655
National Institute of Education	3,883	4,452
Polytechnics	59,806	85,111
Government recurrent expenditure on education per enrolled student S$		
Primary schools	3,363	6,850
Secondary schools	5,304	9,095
Junior Colleges	7,879	12,309
Institutes of Technical Education	7,829	11,914
Polytechnics	9,668	14,608
Universities	15,262	20,805

Source: Yearbook of Statistics Singapore, 2012, Department of Statistics, Singapore

3. The model and assumptions

We set up a model of a stylised educational system with two components distinguished into elite and non-elite universities.[2] In this model, there are sufficient spaces at both elite and non-elite universities for the entire cohort of prospective students. There is an entrance examination, and the investments required to prepare a student to pass the entrance examination for the elite universities are significantly greater than that for entry into non-elite universities. In this model, graduates from an elite university can expect to earn a significantly higher annual income than those graduating from non-elite universities.

Table 2: A stylised educational market and its rewards

	Number of available places	Annual earnings of graduates (units)
Elite universities	10	10
Non-elite universities	90	1
Other basic assumptions		
It costs 10 units to pay for all the prep/cram classes and family investment in the student to qualify to get into the elite university.		
It costs 1 unit to pay for all the family investment in the student to qualify for a non-elite university place.		
Top 10% of the students compete for the elite universities		

To begin, we assume there is a ratio of 10:90 between elite university places and non-elite university places, and that the annual earnings of graduates from elite universities is 10 times that of those from non-elite universities. It

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2. They could be at any level of education, but we have used universities as it is the educational attainment level most connected to well-paying jobs, and where the greatest academic research has been conducted on wage differentials from education.

however costs 10 times more to prepare the student to get into the elite university (these are the sum of all the family's investments in bringing the student to the point of entry to university, including opportunity costs of time) than for a non-elite university.

In a meritocratic system, entrance examinations have the objective of singling out the most able and academically qualified students into the best and therefore elite educational institutions. In a perfect world of where full information about all students' ability and aptitude is available, the assessment role of entrance examinations is unnecessary as all participants (students and the universities) would know exactly where they belong or who to enrol, with the most able and academically qualified students allocated to the elite universities, and the rest going into the non-elite universities.

In such a world of perfect and transparent information about students' abilities, and under the assumptions set out above, we would find an initial equilibrium in which the return on education for all students is equal. The additional costs incurred by elite students in preparing for entry and graduation from an elite university would be offset by the additional earnings achieved from employment, whilst the lower earnings of graduates from non-elite universities would be reflected in the lower costs of education. There would also not be any competition, as students would all know their relative abilities, with the top students destined for the elite universities, whilst those with lesser ability need not spend unnecessary amounts seeking to qualify for an elite university.

Table 3: Initial equilibrium results of stylised educational market model

with perfect information

Payback period for elite students	1.00 year
Payback period for non-elite students	1.00 year
Payback period for unsuccessful students seeking to qualify for elite university	N/A
Total cohort earnings (each year, units)	190
Total cohort expenses on education (units)	190
Cohort payback period	1.00 year

In such a world, the outcomes would be as set out in **Table 3** above. The payback period for education would be one year for both elite and non-elite university graduates. Total cohort earnings, calculated by multiplying the annual earnings of all the students in the cohort would be 190 units, the same as the cohort's expenses on education.

In the real world however, there is imperfect information on student ability and thus entrance examinations are necessary to allow for students in the cohort to be grouped by ability. Whilst students may have some idea from prior assessments of their ranking within their existing groupings, they may not know their position relative to all the other students in their cohort, nor will they know who amongst their cohort would be applying for limited places in the various universities. They may also be affected by over-confidence[3], an heuristic bias in which the subjective assessment of their own ability is systematically greater than the objective reality. Schools and universities

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3. Overconfidence bias has been studied extensively — see Harvey (1997) and Pallier et al. (2002) amongst others.

would also be uncertain of any standardisation in the applying students' academic track records, and therefore tend to insist on their own standardised entrance examinations.

In such a world of imperfect information and potential over-confidence bias, it is likely that more students apply than there are available places at the elite universities. Table 4 shows the cohort earnings and expenses (and thus the payback period) in a scenario of our stylised educational market where 20% of the cohort compete for the limited places at elite universities (twice as many applicants as there are places), all of whom pay the costs of preparing the student for entry into the elite university.

Unsuccessful applicants to the elite universities would bear the higher costs of preparation, but enjoy reduced earnings applicable to graduates from non-elite universities, and hence their payback period would be 10 years in our model. The cohort payback period rises to 1.47 years, with the increase coming from the expenses of competing of the unsuccessful students.

Table 4. Stylised educational market with competition for elite university spaces (20% of cohort compete for limited spaces at elite universities) – imperfect information

Payback period for the non-elite students	1 year
Payback period for unsuccessful students seeking to qualify for elite university	10 years
Total cohort earnings (each year, units)	190
Total cohort expenses (each year, units)	280
Cohort payback period	1.47 years

Table 5 shows the losers' costs of competing at varying levels of competition under the assumption of imperfect information about students' abilities. These losses represent social costs of competition, which we have quantified blandly in the form of units of annual earnings; but these costs can also manifest themselves in anxiety and stress amongst students and their families and time deficits. In the following section, we look at how the educational arms race can spiral rapidly as positional effects kick in.

Table 5. Losers' costs of competing in stylised educational market, with imperfect information and at varying levels of competition

	Proportion of students in cohort competing for elite universities							
	10%	20%	30%	40%	50%	60%	80%	100%
Cohort expenses (units)	190	280	370	460	550	640	820	1,000
Cohort payback period (years)	1.00	1.47	1.95	2.42	2.89	3.37	4.32	5.26
"Losers'" costs (units)	0	90	180	270	360	450	630	810

3.1　Flexing the costs of the competition

If we set aside general price inflation, the financial costs of competing in the race for limited places at elite universities can rise in our stylised model as a result of an increase in the number of competitors. Positional factors can compound this process of rising costs as in any arms race: relative ascendancy accrues to those who enter the game earliest, perhaps taking private tutoring at earlier ages, or paying the highest prices for the best tutors to crowd out those less able to afford such help.

The concept of a winner's curse[4] that occurs in common value auctions with imperfect information may not apply in such an educational arms race as we have defined it. In such auctions, the winner will have overpaid having submitted the highest bid, when the mean of all the bids would be the best approximation of the perceived value of the auctioned good. However, if the

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4．A concise explanation of the winner's curse concept can be found in Thaler (1988). Common value auctions are those in which the auctioned good is of approximately similar value to all bidders, but the actual value of the good is unknown to the bidders at the time of the auction. The competition for limited places in an elite university may be likened to such a common value auction, as the earnings outcomes post-graduation cannot be known for many years after enrolment.

auctioned good is a positional good, the relative advantage obtained by winning may itself be sufficient to justify overpaying. Rational behaviour by bidders for positional goods in such auctions would thus tend towards bidding ever larger premiums. Hence, parents' desire to give their children an ever earlier head-start can be rationalised.

Table 6 below shows the losers' costs based on the reasons described above. If the costs of competing for places in elite universities double from 10 units to 20, the expenses incurred by the entire cohort rise by 111%, and the payback period would increase. Given the positional drivers inherent in this arms race, cost escalation could continue until sufficient evidence emerges of the negative returns from excessive competition for a good like education, which has positional characteristics. The long-dated horizons over which returns from education are measured make such evidence desperately difficult to disentangle from other general economic and life-cycle effects, and this may be complicated further in the Singapore context by the predominance of Confucian values regarding education.

**Table 6. Losers' costs of competing rise disproportionally
if costs of competing rise**

	Proportion of students in cohort competing for elite universities							
	10%	20%	30%	40%	50%	60%	80%	100%
Cohort expenses (units)	290	480	670	860	1050	1240	1620	2,000
Cohort payback period (years)	1.53	2.53	3.53	4.53	5.53	6.53	8.53	10.53
"Losers'" costs (units)	0	190	380	570	760	950	1,330	1,710

3.2 Flexing income inequality

The model can also illustrate how an increase in income inequality can indirectly affect the social costs resulting from excessive competition for an elite education.

If structural changes to the employment market cause the ratio of the annual earnings of graduates from elite universities become 15 times that of those from non-elite universities instead of the 10-times ratio we started with in Table 3, then the payback period for graduates of elite universities would drop to 0.67 years. All other things remaining equal, the natural response to the higher return on investment in pursuing an elite education (in a market with imperfect information) would be to increase the competition for such spaces, potentially triggering an arms race along the lines described in the previous section 3.1 "Flexing the costs of the competition".

The investment required to prepare a student to compete for the limited number of (now more valuable) places in an elite university would rise, but because of the long lag in the emergence of evidence about declining negative returns, a socially costly arms race could persist for a considerable period. Similar effects with respect to rising income inequality would follow with a drop in the earnings of graduates from non-elite universities. The sharply lower returns on investment from education in a non-elite university would likely also increase the competition for elite university places, at the same time reducing demand for places in the non-elite universities. It is also likely in this scenario that the investments that non-elite students make to pursue a university education would drop, so as to restore parity in the relative returns from elite and non-elite university education.

The model can also be used to assess the effects of an improvement in income equality (if only within the university graduate cohort). If the annual earnings of graduates of non-elite universities doubled from one unit to two whilst those accruing to graduates of elite universities remained unchanged, the total cohort earnings would stay at a level similar to the scenario above (280 units, that is, 100 units from elite university graduates and 90 x 2 = 180 units from graduates from non-elite universities). The payback period for graduates of non-elite universities, however, has halved to 0.5 years. In such a scenario, the higher returns on investment from a non-elite university education would likely increase the demand, with the potential cohort size enlarging with those who had never considered pursuing a university education now attracted by the higher returns. Given increased competition

for non-elite university places, it is likely that the costs of the investment to obtain a non-elite university education would rise commensurately over time such that the excess returns drop. Positional effects and behaviour could also appear amongst a broader pool of aspiring students beyond the scope of the initial cohort considered by this model, but this time for non-elite university places.

3.3 Flexing supply of places at elite universities

Adjusting the number of spaces available at elite universities would demonstrate the effects of increasing or reducing social scarcity, and in turn raise or reduce the costs of competition once positional effects are incorporated. A reduced number of elite university places for the same number of students in the cohort aspiring to enrol in universities would intensify the competition for the remaining places. This is likely to upset the equilibrium in the market (akin to persons seated in the front row of the stadium standing up), and trigger new rounds of the educational arms race. Assuming the employment market structure remains unchanged, the number of graduates from elite universities would ultimately fall, increasing the scarcity of elite university graduates and increasing their earning power.

An enlarged number of elite university places, whether by increasing the in-take at existing elite universities or by upgrading non-elite universities to elite status, would have a reverse effect (the persons standing in the front row of the stadium sitting down). The larger pool of elite university graduates could have deflationary implications on their earning power in a theoretical case, but

it is possible to argue for the greater productivity and output of the elite university graduates to support the earning power of the greater number of elite university graduates in aggregate. In such a scenario, societal well-being would increase.

4.   Implications for public policy in Singapore

The tendency for education to adopt positional characteristics has significant implications for public policy in a society such as Singapore's, based as it is on meritocratic ideals and the determination of merit-worthiness dependent in large part on academic performance. More, better and earlier education is a mantra that is commonly offered as the panacea to class divides and widening income inequality. Education policies carry a disproportionate weight in the country's efforts to level the playing field, and to give children from all social classes equal opportunities.

Earlier, Table 1 shows the regressive nature of the government's recurrent expenditure on education on a per capita basis, with more being spent per student enrolled at the tertiary level than at the secondary schooling level, which in turn is higher than that for primary schooling. The ratio of the Singapore government's per capita expenditure on tertiary education to primary education is 3.41x (2009), which compares to Finland, where this same ratio stood at 1.70x in 2009. [5] The inference is that Singapore's

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5. Singapore's ratio calculated by the author is based on data from the Yearbook of Statistics Singapore, 2012, Table 19.16. Finland's ratio is calculated by author from the

education system is more regressive than that of Finland. Finland's education system is frequently compared with that of Singapore's, given similar rankings in the OECD's Programme for International Student Assessment (PISA) studies but with significantly different education philosophies, especially in early childhood and primary level education.

Figure 2. Ratio of public expenditure on tertiary education to primary school expenditure (per student), 2009
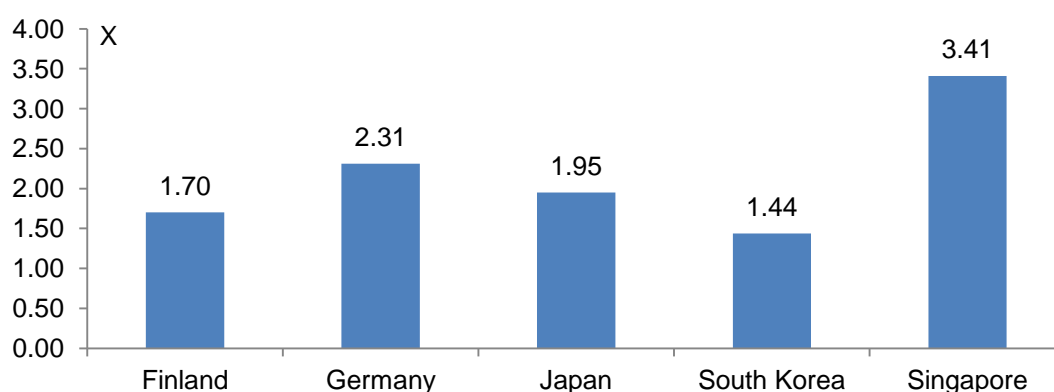
Source: Calculated based on data from Yearbook of Statistics Singapore, 2012, Department of Statistics, Singapore, Table 19.16; ratios for Finland, Germany, Japan and South Korea calculated by the author from the OECD StatExtracts on-line database at http://stats.oecd.org/Index.aspx; data collected on 13 September 2012.

The longer a Singaporean student stays in the state-funded education system, the greater the public expenditure on his or her education, such that a university graduate with 12 years of secondary and primary schooling and a three-year degree in Singapore would receive 3.2 times more public funding for their education than someone with only a primary school education.

The creation of conditions of social scarcity, for example by way of streaming or through the establishment of Gifted Education Programme, can accentuate the regressive nature of public funding of a student's education. As discussed earlier, wealthier families are better able to support their children to the latter stages of the education (and being recipients of greater amounts of state funding as they progress). Such families can afford to give their children the best and earliest possible head-starts, allowing them to be streamed into the best classes at the best schools, giving them the greatest opportunities to go up the educational ladder.

The frequency of contests for ranking of students creates more occasions for triggering positional arms races. Primary school students are subject to frequent testing and their positions within the cohort and the class are clearly denoted in end-of-term assessments, culminating in the Primary School Leaving Examination (PSLE) taken in Primary 6, the grades for which are critical in determining which students get into the best secondary schools. Co-curricular activities, through the Direct School Admission system, have now brought into play as yet another arena of contest, and although lauded as creating additional pathways of success, have the effect of creating pockets of social scarcity in which distinct arms races can be conducted.

Household expenditure survey results provide some evidence of income inequality in expenditure on private tuition. The Report on the Household Expenditure Survey 2002/03 shows households with above median income significantly out-spending those below the median income. Households with

monthly income from $6,000 to $6,999 spent on average $95.10 a month on private tuition and other course fees, more than twice what households with monthly income from $2,000 to $2,499. At the extreme end of the income divide, households with monthly income of $10,000 and spent 27 times more on private tuition and other course fees than households with less than $1,000 monthly income.

**Figure 3. Household expenditure on other tuition and course fees by household income group (2002/03)**
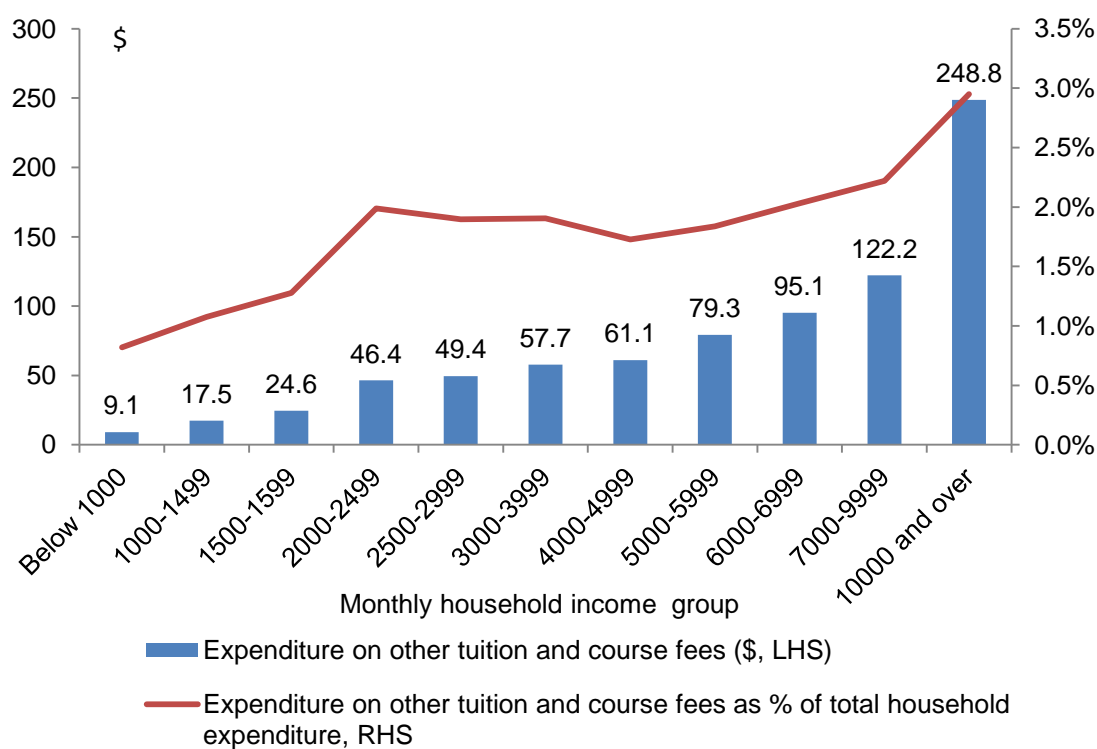
Source: Report On The Household Expenditure Survey, 2002/03, Department of Statistics, Singapore.

The more recent Report on the Household Expenditure Survey 2007/08 did not provide as detailed an analysis by income grouping, instead providing the information in quintiles. However, it is possible to observe an increase in the share of monthly expenditure allocated to private tuition and other course

fees, especially for the lowest quintile of households by monthly income. These households spent $25.0 a month on private tuition and other course fees in the survey conducted in 2007/08, up from $12.8 a month in the survey in 2002/03, equivalent to an average annual increase of 14.4% and considerably higher than general price inflation of 1.2% per annum from 2002 to 2007 (as measured by the Consumer Price Index). In contrast, the amounts spent by the highest quintile of monthly household income fell modestly in the five-year period from $146.3 in 2002/03 to $142.5 in 2007/08.

Figure 4. Household expenditure on private tuition and other educational courses by household income quintile (2007/08)
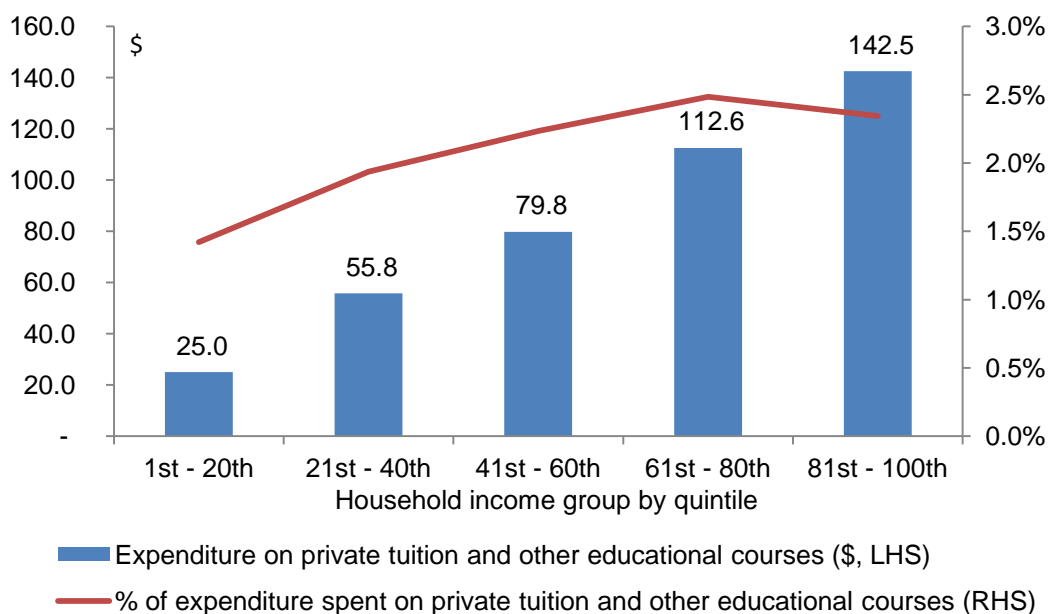
Source: Report On The Household Expenditure Survey, 2007/08, Department of Statistics, Singapore.

5. Limitations of the analysis

Before taking the analysis further into the recommendations and conclusions, it is important to consider the limitations of this study.

Firstly, the model is a wholly theoretical framework around which we attempt to illustrate the impact of excess competition (perhaps due to positional factors) on the cohort's costs of competing in an educational arms race to attend elite universities. The framework does not quantify the possible social benefits and positive externalities that may result from having a more educated workforce beyond allowing for a skill premium in the wage differentials between elite and non-elite university graduates. The framework

also does not focus on the possible individual benefits that may accrue from contesting in these educational arms races. For example, students may learn discipline and hard work are virtues. We are unable to find any real-world studies that quantify such individual and societal benefits and positive externalities, even though this does not allow us to exclude the possibility that our model under-estimates these positive effects.

Second, there are limitations in the available administrative data that could provide us evidence of the emergence of educational arms races beyond the anecdotal. The Household Expenditure Survey data we refer to above should be used carefully and in context, given that contests for social status and positional arms races generally happen within similar social and income strata, and it is not possible to tease out such intra-strata battles for position and to work out the social costs from there. This is especially true in the most recent dataset in the 2007/08 Household Expenditure Survey, which groups households by monthly income in quintiles.

6.   Conclusions and recommendations

This paper has provided a theoretical framework that shows how society's losses can increase significantly if education becomes a positional good. This can result in escalating 'arms races' waged by families in their educational investments that in turn benefit wealthier families who are better able to bear the costs of competition. Such educational arms races may be one way in which education becomes a factor of persistence in the intergenerational

transmission of income as described by Ng (2005). The mechanisms through which household investments in education can take on positional characteristics appear at points where the system creates conditions of social scarcity, through the establishment of special fast-track programmes for those identified as talented, able or gifted, or by streaming or ranking students and schools, for example via the PSLE or through formal or informal school rankings.

The review of the administrative data on education expenditure (both private and public) yields two major observations:

1. Singapore's recurrent public expenditure on education per student is highly regressive (especially when compared with other developed country educational systems against which Singapore is often benchmarked). The further a student progresses up the levels in the state-funded education system in Singapore, the greater the public subsidy for that student's education.

2. Whilst comprehensive state provision of education provides a levelling effect on the education expenses of Singaporean households, the existence of a private education market can allow for social and income inequalities to be maintained and exacerbated. Singapore's Household Expenditure Survey data unsurprisingly show wealthier families being able to pay significantly more for private tuition than can those in the lower percentiles/quintiles of the household income distribution.

These observations can be combined with our understanding of behaviour when education has become a positional good from the theoretical model, to propose the following recommendations, grouped under two categories.

A.   Reduce the regressive nature of Singapore's public expenditure on education

Singapore's public expenditure on education per student scales up very quickly towards the upper rungs of the education ladder. Addressing this regressive structure of expenditure can be achieved either by reducing the quantum spent on tertiary education, increasing that spent on primary and secondary education, or both. The demands of today's knowledge-based economy would make the first option counter-productive in many senses. Universities and polytechnics are traditionally seen as very important channels of human and social capital, and many of the positive externalities resulting from having a well-educated population are channelled through these institutions.

Raising the amounts spent on primary and secondary schooling without reducing the amounts spent on tertiary education would increase the fiscal burden. However our calculations show that for Singapore to get to similar levels of proportionate spending on the different education levels as Finland on a per student basis whilst keeping its current expenditure on tertiary education unchanged, it would have to increase expenditure on primary schools by S$1.34 billion and that on secondary schools by S$932 million.

The combined additional spending (S$2.722 billion) would amount to 0.7% of Singapore's 2011 Gross Domestic Product (GDP), and would represent an increase of 25% on the government's recurrent expenditure on education in 2011. To get to the same levels of proportionate spending as Germany, the increase in expenditure on primary and secondary schools would be S$1.339 billion, equivalent to 0.4% of 2011 GDP and 15% of the government's recurrent expenditure on education in 2011.

The additional expenditure could be used to level the playing field in the primary and secondary schooling system, with greater allocation towards less desirable schools, and on expenditure focused on addressing those schools' weaknesses and building on their strengths.

B.   Eliminate the various forms of streaming and ranking of students and schools, especially in the early years of education

In order to minimise the creation of pockets of social scarcity, the various forms of streaming, fast-tracking and ranking of both students as well as schools should be eliminated, especially at the earliest stages of education system such as at the primary school level. By reducing or eliminating the early emergence of positional behaviour, a costly arms race will not be triggered in the name of giving one's children a head-start. As has been discussed, such arms races are typically won by wealthier families, thus perpetuating inequality and reducing social mobility.

Whilst some forms of assessment may be necessary in any education system to identify strengths and weaknesses, the imposition of these ranking or streaming programmes before students have built up a foundation of knowledge and life-skills can generate over-investment and over-specialisation in a student's life.

Specifically in Singapore's context, fast-track programmes at the primary school level such as the Gifted Education Programme should be abolished, whilst streaming should only be introduced once students have completed their foundation levels of education.

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