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**SEGREGATION IN EDUCATION AND
LABOUR MARKET DISCRIMINATION: THE
ROLE OF PEER BELIEFS**

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***LABOUR ECONOMICS and PUBLIC
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Abstract

In this paper we examine the long term effects of socialization and segregation in schools, on labour market outcomes. We incorporate a model of “informational” peer influence by which beliefs of pupils are affected by exposure to other pupils’ posterior beliefs. Specifically, we focus on the beliefs of private school graduates about the productivity of state school graduates. We incorporate this into a dynamic model of parental school choice (state versus private) and labour market decisions (whether to hire a state or a private school graduate). We provide necessary and sufficient conditions for segregation in education and discrimination in the labour market to hold.

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Segregation in Education and Labour Market Discrimination: The Role of Peer Beliefs

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Abstract: In this paper we examine the long term effects of socialization and segregation in schools, on labour market outcomes. We incorporate a model of “informational” peer influence by which beliefs of pupils are affected by exposure to other pupils’ posterior beliefs. Specifically, we focus on the beliefs of private school graduates about the productivity of state school graduates. We incorporate this into a dynamic model of parental school choice (state versus private) and labour market decisions (whether to hire a state or a private school graduate). We provide necessary and sufficient conditions for segregation in education and discrimination in the labour market to hold.

1 Introduction

There is a large literature focusing on whether and how peer pressure or peer influence are important determinants of individuals’ behaviour. Papers study a wide variety of applications including addictive behaviour among teenagers, productivity among firm workers, or academic achievements in schools and universities.¹ A central issue in the empirical literature is whether these effects have long lasting consequences, so that behaviour in schools for example might be correlated with earning data many years later.

In this paper we suggest another dynamic channel for peer influence effects: Behaviour and outcomes in the future can be a result of the *propagation of beliefs* in earlier stages of life. Specifically, as we show below, peer influence can affect the beliefs of those attending a private school about the future productivity of those graduating from a state school. It will then affect the decisions of employers who have attended a private school whether to employ workers who have graduated from a state school.² We incorporate a model of peer influence and its effect on beliefs, and characterize necessary and sufficient conditions for long term segregation in education and discrimination in employment.

In the UK, while private school graduates are only 7% of the population, the Social Mobility and Poverty Commission report has recently identified that they constitute 71% of senior judges, 62% of senior armed forces officers, 55% of top civil servants, 36% of

¹See Duncan et al (2005) for a study of peer effects in drug use, Sacerdote (2001) for analysis of peer effects on students’ academic and social behaviour, Hoxby (2000), Angrist and Lang (2004) and Burke and Sass (2013) for such analysis in schools. Sacerdote (2011) is an excellent survey of the literature.

²Schools need not necessarily be secondary schools; tertiary education can also fit the model.

the Cabinet and 43% of newspaper columnists. The same commission identified (after tracking 20,000 university graduates) that private school male graduates are up to 10 per cent more likely to land top jobs than those who have the same grades from the same university but went to a state school. A higher share of private school graduates is admitted to top universities such as Oxford and Cambridge despite recent data showing that state school graduates perform better at university everything else equal.³

On the face of it, state school graduates are discriminated against. Among the reasons for such discrimination, is the possibility that many employers believe that state schools graduates are not as able or productive as their private school counterparts.⁴ According to recent research done by the Fabian Society in the UK, the Conservative party's "broken Britain" rhetoric has fuelled middle-class anxieties about state schools.⁵ In a 2013 YouGov survey, in response to the statement "Pupils at private schools are generally brighter than pupils at state schools", 21% answered that they agree and that this is an important factor. Many believe that state schools are worse due to a plethora of reasons, some more justified than others.⁶ Some believe that private schools have a better socio-economic mix of peers, which would influence their own children's attainment. On the other hand, a recent study of Abdulkadiroglu, Angrist and Pathak (2014) shows that the beliefs of parents about schools exhibit an "elitist illusion". Specifically, they show that the presence of pupils with high achievements or the school's racial mix have no effect on other pupils' attainment.⁷

There is also a wide divergence in beliefs about state schools. YouGov surveys show that the responses to questions about state school quality exhibit big differences between

³The Higher Education Funding Council (Hefce) tracked 130,000 students beginning degrees in 2007, looking at schooling, background and ethnicity. Of those students who achieved the same grades at high school (ABB at A-level), some 69% of students from private (independent) schools went on to gain 2:1 or above at university compared with about 77% of students educated at state schools. And at three Bs, 61% of independent students pupils got a 2:1 or above compared with 70% of state school students.

⁴Network effects have also been mentioned as a reason for discrimination. Our analysis essentially endogenises such networks, using beliefs. For example, Granovetter (1974) observes that about half of all jobs are allocated through social network connections rather than formal channels such as classified ads. Marmaros and Sacerdote (2002) show how Dartmouth College seniors use social networks to obtain their first jobs. See also Simon and Warner (1992).

⁵"The Conservatives have massively exaggerated the problems in state schools, linking poor families with educational failure and anti-social behaviour." <http://www.theguardian.com/education/2010/sep/08/broken-britain-rhetoric-fuels-fear>

⁶Among these are larger class size, less resources and worse teachers. On the other hand, there is usually more regulation on teachers' qualifications in state education and the state school year is on average 4 weeks longer in the UK.

⁷Their study contrasts exam-based selection in state schools to those without any such selection mechanisms.

different regions, different political affiliations, and socioeconomic status. For example, when asked: “From what you know, do state secondary schools generally give talented children a good education and allow them to achieve their full potential?”, 64% of labour supporters replied yes compared to only 54% conservatives. In London the yes reply was given by 47% while in the North and Scotland by 59%, despite school graduates in inner London gaining on average better grades.⁸ Among state school parents 58% replied yes compared to only 48% of private school parents. Similar differences occur for the same question regarding primary schools. In the US, surveys show at least 10% differences between state school parents and others for similar questions.⁹

To study the relation between segregation in education, discrimination, and divergent beliefs, we analyze a non-overlapping generations model with infinite periods and three stages at each period. Our focus is on the beliefs about the labour market productivity of graduates from state schools.¹⁰ In the first stage, individuals attend school and their beliefs are shaped by their parents’ beliefs and by peer influence. In the second stage, upon graduation, individuals enter the labour market, some as employers and some as employees. Employers decide whether to hire a randomly assigned employee, given the employee’s school and their own beliefs. We assume that the labour market experience entails learning, so that those who employ state school graduates will observe some information about their true productivity and will update their beliefs. Finally, in the third stage, individuals become parents and transmit their beliefs to their offsprings. Parents also decide on their offsprings’ education path, state or private, given their own beliefs, the schooling decisions of other parents and hence peer influence, and using “partial empathy”. The private school admits a fixed share of the population with the highest willingness to pay for the school.¹¹

Note that a school fulfills two roles in our model. First, it creates an observable signal about one’s productivity. Second, schooling involves intense social interactions that influences pupils’ beliefs. The relative benefit of sending one’s offspring to a private school is therefore potentially two-fold. The first benefit is that a private school graduate might have a higher probability of employment (as employers who went to a private school might hire her with a higher probability). The second potential benefit depends on the parents’ beliefs and arises when her child becomes an employer herself. Peer influence implies that the beliefs of the offspring change. Parents might be concerned about this as a strong

⁸<http://www.ofsted.gov.uk/news/ofsted-too-many-of-englands-poorest-children-continue-be-let-down-education-system>

⁹See <http://pdkintl.org/programs-resources/poll/> for the Annual PDK/Gallup Poll of the Public’s Attitudes Toward the Public Schools.

¹⁰For simplicity we assume that everyone knows the productivity of the private school graduates.

¹¹We discuss other potential admission criteria, including interviews, in Section 5.3.

peer influence in the private school may lead their offspring to excessively forgo hiring state school graduates.

Our model of peer influence is a model of group communication, in which individuals communicate their beliefs (posteriors) to each other. Applied to the current set up, it is characterized by a polarization property: When beliefs are strong enough that state school graduates are unproductive, group communication will make them even more extreme in this direction.¹² There is therefore a tension in the model between learning the true information (from hiring a state school graduate), and peer influence, which might push in the opposite direction.

We characterise a simple necessary and sufficient condition for long-term segregation between schools and discrimination in the labour market. The condition is a function of the accuracy of learning from true observations, the initial range of beliefs in the private school, and the strength of peer influence. It identifies environments in which peer influence can outweigh true learning and enable individuals to form extreme beliefs about state school graduates. This, in the long run, will lead them to discriminate against such graduates in the labour market and to send their offsprings to private schools.¹³ We therefore show how incorrect beliefs that create discrimination persist through segregation in education, while segregation in education, through parental school choice, is in itself motivated in equilibrium by labour market discrimination. Thus, in our model, the “old boys” network is endogenously formed.

But peer influence has its limits too. In particular, there might be a misalignment between the parents’ relative benefit from private schools (or their willingness to pay) and their beliefs. Parents with moderate convictions who worry about strong peer influence, may have low willingness to pay for the private school. Other parents with high convictions that state school graduates are as productive as private school graduates, may worry less about peer influence because it will be harder to influence their offsprings. This will imply entry of pupils with these beliefs to the school, which might unravel the “school ethos” and as a result end segregation in the long run.

The model delivers several policy implications. First, discrimination is inefficient in the model as employers forgo employment opportunities and state school graduates are not always employed. While private school graduates enjoy better positions in the em-

¹²Such polarization accords with both experiments of group decision making as well as recent theoretical models of groupthink. See for example Glazer and Sunstein (2009) and experiments referenced there. For another model of groupthink, see Benabou (2013).

¹³Individuals may end up with incorrect beliefs. This arises not because they stop “experimenting”, but because their peers’ beliefs are pessimistic enough and thus peer influence outweighs any positive learning. In that sense we differ from Piketty (1995) or Fudenberg and Levine (1993) where agents maintain wrong beliefs as they do not experiment.

ployment market, they also pay private school fees which extract their willingness to pay. Moreover, their willingness to pay is in part based on wrong beliefs which is therefore not recuperated in the market later on, and indeed recent data in the UK supports the observation that private schools might not be economically beneficial.¹⁴ We then consider how school integration and anti-discrimination policies fare in our model. Specifically, in our environment, anti-discrimination policies can reduce discrimination but not necessarily segregation in education (as they do not affect beliefs sufficiently), while policies which increase the ability of employers to learn the true productivity of their workers (through perhaps a prolonged period of employment) will affect beliefs and hence allow the complete break up of discrimination and segregation.

The model also sheds light on other school selection methods. As we show, when private schools admit pupils only according to their willingness to pay, segregation and hence such schools will not necessarily survive. Selection according to beliefs on the other hand will allow such schools to increase their long term survival. This accords with a common practice of many schools in the UK which hold interviews, not only to the children, but also to their parents. From the point of view of general welfare though, banning such interviews will facilitate the break up of segregation.

Our paper is related to several strands of the literature. First, it is related to the literatures of segregation and discrimination. Several models of discrimination in the labour market assume that individuals have some (sometimes wrong) beliefs which induce them to discriminate, while others analyze models in which discrimination arises as a self-fulfilling equilibrium without any beliefs.¹⁵ Our contribution to this literature is to endogenize how wrong beliefs can evolve and persist through endogenous segregation in education.

In the literature on segregation, Benabou (1993) shows how stratification inefficiently arises due to complementarities in education whereas Benabou (1996) allows for endogenous community formation. In the context of social learning in networks, Calvo-Armengol

¹⁴The report by the Social Market Foundation calculated that the higher educational achievement and university degrees accrued by private school pupils translated to £193,000 in higher earnings between the ages of 26 and 42. After adjusting for family background and social circumstances, which also affect employment prospects, the private school pay advantage was £57,000. However, ten years' worth of average private school fees in 1980 would be around £56,000 in today's prices, roughly equal to the subsequent boost in earnings. See <http://www.theguardian.com/education/2014/jul/03/subsidy-independent-school-fees>.

¹⁵See Black (1995), and Lang, Manove and Dickens (2005). For a survey on models of statistical discrimination see Fang and Moro (2010). Coate and Loury (1993) show how discrimination or segregation arises without negative beliefs, but due to self fulfilling asymmetric equilibria, following Arrow (1973), and as in Eeckhout (2006), Moro and Norman (2004), and Chaundhuri and Sethi (2008). Peski and Szentes (2013) analyze "spontaneous" discrimination which arises from repeated game considerations.

and Jackson (2004) consider how better information and status create segregation in employment. In the context of schools, Epple and Romano (2008) also use complementarities in education and income to derive segregation between state and private schools.

Both these literatures, on discrimination and on segregation, have relatively little to say in terms of how effective are policies that inform the public about possibly wrong beliefs about others (while such policies are widely used). Our model, which is based on beliefs, can allow us to analyse the effect of such policies which we do in Section 5.

To the large literature on peer effects or peer pressure mentioned above we add the study of dynamic effects of peer influence of beliefs. Peer influence is also endogenous in the sense that parents decide with whom their offsprings will interact with. Our model is also related then to the literature on cultural transmission, which considers transmission of preferences by means of both inheritance and socialization (Bisin and Verdier 2001). In our model parents transmit beliefs to their children (whereas in their paper parents transmit preferences) and also make a decision about their socialization process which influences these beliefs.

The remainder of the paper is as follows. The next Section presents the model. Section 3 characterizes the relative benefit function from private versus state school education and defines long-term segregation. In Section 4 we present our main result, a simple necessary and sufficient condition for long-term segregation. Section 5 discusses various policy implications and extensions, while the conclusion considers other applications of our model.

2 The model

We assume a continuum of dynasties, each indexed by $i \in [0, 1]$. Each dynasty consists of one individual at any period $t \in \{0, 1, \dots, \infty\}$, which at the end of the period is replaced by one offspring. Each dynasty holds a belief about the productivity of school graduates. Beliefs can change within periods as specified below. At any period t , individuals participate in three stages:

Stage 1: *Schooling*. Pupils start school with the beliefs of their parent. Pupils interact with peers and update their beliefs according to a heuristic we specify below.

Stage 2: *Labour market*. In this stage individuals become employees or employers and are randomly matched. Experience in the labour market is (imperfectly) informative about the productivity of state school graduates.

Stage 3: *Parental school choice*. In this stage individuals become parents and have one offspring each. Depending on their beliefs, they choose to send their offsprings to a private or a state school in the next period. The parents transmit their beliefs to their offsprings.

There are two kinds of schools, state and private. We assume that whatever the school an individual goes to, his eventual productivity is equal to 1. There is, however, heterogeneity in the beliefs that dynasties hold about the productivity of state school graduates. We assume that each dynasty, in time t , knows that the productivity of private school graduates is 1 but holds a belief that the productivity of graduates of state schools is 1 with probability q_i^t and 0 otherwise. Our starting point is a population with a continuum of individuals, which constitutes a full support distribution of beliefs $f^0(q)$ on $(0,1]$.¹⁶ We therefore take the initial beliefs as given and analyse under what circumstances segregation and discrimination will arise.

Our analysis can be generalized to allow for different productivities in different schools. Specifically, there is a large literature on sorting via schools on parental income and on innate ability which can potentially affect productivity.¹⁷ Indeed, many private schools are not only costly but also screen individuals according to their ability. In this paper we abstract away from this possibility; for the purpose of our analysis it is not important whether productivity arises through innate ability, standard peer effects, or through quality teaching. Instead, our focus is on the evolution and persistence of wrong beliefs. The key insights of our analysis would hold also if there is a difference in productivities between the schools, as long as those in the private school perceive this difference as larger than it is.

Peer influence in schools: Pupils start school with their parents' beliefs but are influenced by their peers. For simplicity we assume that in the state school all pupils learn their true productivity, which is 1.¹⁸

A pupil in a private school will randomly interact and exchange information with n other pupils in the school. Let \mathbf{q}^t be a vector of length n of beliefs q_j^t of pupils who attend the private school. If the offspring from dynasty i is matched with these individuals, then his belief when graduating, $q_{i,g}^t$, is

$$q_{i,g}^t = \chi(\mathbf{q}^t, q_i^t) = \frac{q_i \prod_{j=1,\dots,n} q_j}{q_i \prod_{j=1,\dots,n} q_j + (1 - q_i) \prod_{j=1,\dots,n} (1 - q_j)}.$$

Note that beliefs upon graduation increase in the parent's beliefs and those of the others in the school.

¹⁶We allow for the possibility that at period 0, there is an atom at 1.

¹⁷See for example Epple and Romano (1998).

¹⁸A similar analysis will arise if the beliefs of state school graduates on themselves will be sufficiently close to one.

We view peer influence as communication in a group. The functional form for the peer influence is microfounded by a simple model of communication, with the following assumptions. Suppose that individuals start with a common uniform prior about a state of the world and then are exposed to some, potentially different, information sources, and form their own posteriors. Assume further that individuals believe that the sources of information they are exposed to are conditionally independent from the others' sources. If individuals communicate their posteriors to others, Bayesian updating takes the functional form above.¹⁹ Still, individuals have a selection bias in that they only learn from those that they interact with, while not taking into account that others (e.g., those in the state school) may have other beliefs.

Moreover, it is easy to show the following useful observations:

Lemma 1: (i) *Persuasion:* If one individual j has extreme beliefs ($q_j = 1$ or 0) then he fully convinces all others. (ii) *Monotonicity:* A player with $q_i > (<)\frac{1}{2}$ increases (decreases) the beliefs of others. (iii) *Polarization:* If $q_1, q_2, \dots, q_n > (<)\frac{1}{2}$, then for all i , $\chi(\mathbf{q}, q_i) > \max q_i$ ($\chi(\mathbf{q}, q_i) < \min q_i$).

The features above are attractive when considering peer influence. Persuasion implies that an individual with strong convictions will completely sway others by his beliefs. Monotonicity is also quite intuitive, whereby individuals influence others in the direction of their beliefs. Finally, a recent literature has focused on how polarization arises in group deliberation.²⁰ In our model individuals who all share the same direction of beliefs (above or below a half) will become more extreme in that direction.

The labour market: We analyze a simple labour market interaction which allows for frictions (the possibility of being unemployed) as the key disadvantage of state vs. private school graduates. Our results would hold more generally as long as the labour market offers some advantage to private school employees (who are more likely to be employed or would get a higher wage upon employment), and some disadvantage to private school employers (who miss opportunities to employ). This arises in many models of job market discrimination.²¹

Specifically, school graduates at time t make up the two sides of the labour market. We assume that any individual (disregarding their education path) becomes an employer with probability γ and an employee with probability $1 - \gamma$. Employers and employees are

¹⁹This has been used in models of social learning in the binary context (see Eyster and Rabin 2014, Smith and Sorenson 2000, and Duffie and Manso 2010). It is also proved in Sobel (2014) and is generalised in Levy and Razin (2014).

²⁰See for example Glaeser and Sunstein (2009).

²¹See for example the wage-posting models of Black (1995), and Lang, Manove and Dickens (2005).

then matched randomly. To fix ideas, let $\gamma < \frac{1}{2}$, so an employer is matched for sure with an employee, while an employee is matched with probability $\frac{\gamma}{1-\gamma} < 1$.

We assume that an employee always prefers to work, while the employer has to decide whether to employ the individual he is matched with, conditional on both the wage rate and his beliefs about the productivity of the employee. Specifically, the gain from employing is the productivity of the employee. The cost is a wage w paid to the employee, drawn independently for each match according to a uniform distribution on $[0, 1]$.²² This implies that a state school graduate employer, or a private school employer who is matched with a private school graduate, will employ anyone, as $w \leq 1$ for any w . On the other hand, a private school graduate employer from dynasty i will employ a state school graduate employee at time t only if $w < q_{i,g}^t$, which arises with probability $q_{i,g}^t$.

We assume that following the employment phase, the private-school employer who had employed a state school graduate receives a signal about his productivity. The signal indicates that the productivity of the employee is 1, and is correct with probability $p \in (0.5, 1)$.²³ The private employer updates his beliefs to $q_{i,e}^t$, which is given by,

$$q_{i,e}^t = \begin{bmatrix} \frac{q_{i,g}^t p}{q_{i,g}^t p + (1 - q_{i,g}^t)(1 - p)} & \text{if employed a state school graduate} \\ q_{i,g}^t & \text{otherwise} \end{bmatrix}$$

For simplicity we assume that learning only arises for employers (while private school employees do not learn about the productivity of state school graduates they are employed by). Also, for simplicity, we assume that no peer influence arises in the labour market among employers; labour market experience could filter to other dynasties only through peer influence in schools in the next period (we extend the analysis to allow for communication in the labour market in Section 5.2). Recall that state school graduates, employees and employers, all have beliefs $q_{i,g}^t = 1$ and hence their dynasty will not update its beliefs anymore.

Belief transmission and school choice: Parents transmit their beliefs to their children, i.e., $q_i^{t+1} = q_{i,e}^t$, and decide which school to send them to. We model the schooling decision in the following way. Let Δ_i^t be the relative benefit from sending a child to a private school rather than to a state school, *as perceived by the parent* from dynasty i , with beliefs $q_{i,e}^t$. We compute this in the next section, but two remarks are due. First, the parent will view her offspring's utility given her own beliefs (that is, we are using “partial

²²The uniform distribution over w is not important for our qualitative results.

²³To give an example, assume that the employer believes that if the productivity is 1 then he receives the signal $s = 1$ for sure and if it is 0 he receives the signal $s = 1$ with probability $\alpha \in (0, 1)$, and that he receives $s = 0$ otherwise. Then, $p = \frac{1}{1+\alpha}$ is the precision of the signal $s = 1$. Given that the true productivity is 1 he will receive $s = 1$ and the updating above represents his posterior beliefs.

empathy”). Second, we assume that once individuals become parents, they do not update their beliefs anymore and consider $q_{i,e}^t$ to be the correct beliefs.

We assume that at any time t , the private school admits a share ρ of individuals with the largest Δ_i^t , conditional on $\Delta_i^t > 0$. Thus, the school admits all those with the largest willingness to pay, subject to the school’s capacity constraint. In Section 5.3 we discuss other school admission policies and their impact on segregation.

Equilibria: In equilibrium, at each period t , the decisions of employers are optimal given their beliefs (as described above), and parents correctly compute Δ_i^t to optimally choose a school, given the current distribution of beliefs, the equilibrium decisions of other parents, and future behaviour of employers.

3 Private school versus state school

In this Section we characterize the relative benefit from sending an offspring to a private versus a state school. Specifically, we compute Δ_i^t , the relative benefit from sending a child to a private school vis a vis a state school, as perceived by a parent with beliefs $q_{i,e}^t$.

Note that with probability $\gamma\rho$ an individual becomes an employer and is matched with a private school graduate. In this case no matter what is her own education path, she would employ the graduate and pay w . Also, with probability $\gamma(1 - \rho)$, an individual becomes an employee, and is matched with a state school employer who does not discriminate. These two events do not depend on the individual’s education path.

There are therefore two events in which the education path is relevant. First, with probability $(1 - \gamma)\frac{\gamma}{1-\gamma}\rho = \gamma\rho$ the individual becomes an employee and is matched with an employer who is a private-school graduate. In this case, if she herself went to a private school she is employed for sure (and receives an expected wage of a half), but if she went to a state school she will only be employed with some probability. Specifically, she is employed by an individual from dynasty j only if $w < q_{j,g}^{t+1}$. Thus, given some distribution of employers from dynasties j with beliefs $q_{j,g}^{t+1}$, the relative benefit for attending a private school in this case is:

$$\frac{1}{2} - \bar{w}^{t+1} \geq 0$$

where $\bar{w}^{t+1} \equiv E_{q_{j,g}^{t+1}}(E(w|w < q_{j,g}^{t+1}))$

The second case in which a benefit or a loss from attending a private school arises, is where an individual becomes an employer and is matched with an employee who is a state school graduate (which happens with probability $\gamma(1 - \rho)$). If she is a state school graduate herself, she would employ him for sure, gaining -in the eyes of her parent-expected productivity of $q_{i,e}^t$ while paying in expectations $\frac{1}{2}$. On the other hand, if she

is a private school graduate, she would employ only with an expected probability of $q_{i,g}^{t+1} = \chi(\mathbf{q}^{t+1}, q_{i,e}^t)$ (which takes into account expected peer influence). She would then pay in expectation $E(w|w < q_{i,g}^{t+1})$, and gain productivity of $q_{i,e}^t$. Thus we have that in this event the gain/loss from attending a private school, is:

$$\hat{\Delta}_i^t \equiv \pi_i^t - (q_{i,e}^t - \frac{1}{2}) \quad (1)$$

where π_i^t is the expected gain, in the eyes of the parent, from the offspring being a private school graduate employer, which is:

$$\pi_i^t \equiv E_{\chi(\mathbf{q}^{t+1}, q_{i,e}^t)}(\chi(\mathbf{q}^{t+1}, q_{i,e}^t)q_{i,e}^t - E(w|w < \chi(\mathbf{q}^{t+1}, q_{i,e}^t)))$$

Putting these two together, we have that for a parent with partial empathy and a belief $q_{i,e}^t$, the benefit from a private school vis a vis state school is:

$$\Delta_i^t = \gamma(\rho(\frac{1}{2} - \bar{w}^{t+1}) + (1 - \rho)(\pi_i^t - (q_{i,e}^t - \frac{1}{2}))) \quad (2)$$

Note that the first term, which is a gain, does not depend on the parent's beliefs. It only depends on others' beliefs and how they discriminate. Whenever the beliefs in the private school are different from one, then the relative benefit conditional on being an employee, $\rho(\frac{1}{2} - \bar{w}^{t+1})$, is strictly positive. This allows us to define long-term segregation as a situation in which beliefs in the private school do not converge to 1, or formally:

Definition 1: *Long-term segregation exists iff there is a $\delta > 0$ such that $\lim_{t \rightarrow \infty} (\frac{1}{2} - \bar{w}^t) > \delta$.*

The second term in (2) on the other hand, depends on the parent's beliefs in two ways. First, the eventual beliefs of the offspring, following peer influence, are a function of the parent's beliefs. Second, the parent assesses the value from employing according to her own beliefs ("partial empathy"). For example, if the beliefs of the parent are relatively high, sending the child to a private school might represent a larger loss as peer influence might substantially decrease the offspring's beliefs. On the other hand, if the beliefs of the parent are very low, the induced behaviour of the offspring if he goes to the state school must be worse than that induced by the private school, implying a positive first term. Note that for state school parents, with beliefs at 1, the second term is 0. That is, the relative benefit conditional on becoming an employer is zero. This arises as $\chi(\mathbf{q}^{t+1}, 1) = 1$ for any \mathbf{q}^{t+1} and thus no matter which school the offspring goes to, his beliefs will remain at one. This implies that the overall relative benefit of state school parents, which with some abuse of notation we denote by Δ_s^t , is always non-negative, and strictly positive in the case of long term segregation.

In the next Section we provide our main result characterizing the environments for which long-term segregation arises. These would depend on the accuracy of learning, the initial intake of beliefs in the private school, and the strength of peer influence. The potential trade-off between the first and second term in (2), and how the second term is affected by parents' beliefs and peer influence, will constitute the key insight behind the main result.

4 Peer influence and long-term segregation

We now analyse under what conditions long term segregation will hold. Note that to sustain segregation, beliefs in the private school at any point in time have to be sufficiently pessimistic. To see why, suppose for example that at some point in time, all those that attend the private school have beliefs above a half. Thus, the beliefs in the private school can only increase. Peer influence, by Lemma 1, will induce a first order stochastic shift in beliefs and labour market experience will only exacerbate this.

Long term segregation can also fail when the pool of beliefs is “contaminated”. Suppose that at some point in time there are private school dynasties i with $\Delta_i^t < \Delta_s^t$, i.e., their relative benefit from attending the private school is lower than that of a state school dynasty. As a result of such misalignment between beliefs and the willingness to pay for the private school, there might be an influx of children into the private school with very extreme beliefs. These new entrants will affect the beliefs of others within the school and may cause an irreversible shift of beliefs in the school.

Our main result below characterizes initial conditions such that long term segregation will be sustained. We show that the requirements above are strongly related: When beliefs remain pessimistic for all such private school dynasties i , then also the benefits of private schools are aligned with beliefs, i.e., $\Delta_i^t > \Delta_s^t$ for all t . Moreover, this also holds the other way around: If the beliefs of even a small measure of dynasties i become sufficiently optimistic, then eventually there would be a time t where $\Delta_i^t < \Delta_s^t$ and segregation will break up.

Proposition 1:²⁴ *Assume that the initial distribution of beliefs of individuals in the private school is $[0, \bar{q}]$ such that $\rho = F^0(\bar{q})$. Then, (i) long term segregation arises if and only if*

$$\left[\frac{\bar{q}}{1 - \bar{q}}\right]^{n-1} \leq \frac{1 - p}{p},$$

(ii) when it arises, the set of dynasties in the private school is constant and beliefs converge to a degenerate distribution on 0, leading to maximal discrimination.

²⁴The formal proof is relegated to the appendix.

The result provides a well-defined and simple condition for the existence of long term segregation. It depends negatively on the accuracy of information in the labour market, p , negatively on the upper bound of beliefs in the private school \bar{q} and positively on the intensity of peer influence in the school, n . Naturally, the higher is p (the effectiveness of true learning), the lower \bar{q} needs to be, but this is mitigated by n so that a higher intensity of peer pressure could allow for potentially a relatively large set of beliefs in the school. Finally, for any given ρ , if the initial distribution of beliefs puts sufficient weight on low beliefs, segregation is more likely to arise.

The condition is calculated for dynasties at the upper bound of the beliefs in the private school. It insures that those dynasties, following peer influence and labour market experience, will end up with lower beliefs than they had started with. At the same time this also implies that these dynasties still want to send their children to private schools more than state school parents do. Specifically, we show that when the beliefs of all dynasties i in the private school are all below a half, then $\Delta_i^t > \Delta_s^t$. Thus, the set of dynasties whose children attend the school at any period are those with initial beliefs below $\bar{q} < \frac{1}{2}$, and their beliefs converge to 0, leading to maximal discrimination.

We therefore endogenize the environments under which an “old boys” network is created and maintained, where we identify a set of dynasties which will remain in private education and also as discriminating employers. Specifically, segregation in education (which influences beliefs and behaviour in the labour market) and discrimination in the labour market (which affects parental school choices) reinforce one another in equilibrium.

The above condition is also necessary for long term segregation to arise. To see why, note that if it is not satisfied, then there would be a small share of individuals (those with the highest beliefs) for whom peer influence with like-minded dynasties, along with labour market experience, will further increase their beliefs. In the proof we show that as some of these dynasties’ beliefs keep on increasing and get closer to one, their relative benefit from the private school will become lower compared with the relative benefit of state school parents. The reason is that under the supposed segregation, beliefs of most in the private school must converge to zero. Hence for this small measure of dynasties whose beliefs keep increasing, peer influence in the private school means a large swing in beliefs (and thus suboptimal labour market behaviour). This however is not a concern for state school parents whose beliefs are strong enough so that their offsprings are not influenced in the private school. Therefore, given this misalignment of beliefs and willingness to pay, some state school parents send their offsprings to the private school and a process of contamination of beliefs starts, resulting in no long term segregation.

5 Discussion: policy implications

In our model, segregation in the education market interacts with discrimination in the labour market to create inefficiencies. Discrimination is distortionary as state school graduates miss employment opportunities, while private school employers miss opportunities to employ. Note that discrimination due to wrong beliefs is inefficient even if there are some asymmetries in the model, for example if the true productivity of state school graduates is somewhat lower than that of private school graduates.²⁵

Note also that segregation and its harmful consequences may be “underestimated” in our model. First, other network effects which may increase segregation may play a role. For example, private school graduates may have an advantage in becoming employers, which is typically associated with higher gains. This may imply that overtime state school dynasties will be poorer, and thus would not be able to afford the fees up-front, even if their willingness to pay is higher. Second, in terms of instilling beliefs, we have only considered peer influence. One can also extend this to consider how teachers or schools actively affect beliefs. Naturally, a strong ethos of a private school advocated by teachers will strengthen segregation even more.

We now discuss several policy interventions and extensions of the model that may alleviate the inefficiency of segregation and discrimination.

5.1 Integration

The literature so far has focused on exploring whether there are benefits from integration in schools in terms of increasing academic achievements by means of standard peer effects (see for example Angrist and Lang 2004). Our analysis shows that there is another potential benefit for early integration e.g., in schools, as it may affect the beliefs of individuals through peer influence and later on, their behaviour in the labour market. Integration facilitates exchange of information, which, as shown by a recent paper of La Ferrara et al (2014), affects beliefs on others. Specifically, La Ferrara et al (2014) show that university roommates in a mixed-race housing have decreased their prejudiced beliefs on the other race compared with those in the same-race housing. In our model such change of beliefs -which arises for example by integrating state school pupils into private schools- will have consequences for discrimination in labour markets and hence such intervention can be welfare enhancing.

As with the effect of integration on academic achievement, the actual level of interaction among the different students is important. If for example pupils from state school dynasties are integrated into a private school but interact only with one another, the

²⁵If the productivity of private school graduates is substantially lower, there might be value for eliminating segregation when considering the optimal distribution of productivities in society.

beliefs of the private school dynasties will not be affected. Thus, integration has to be happening in practice. Generally, the success of integration will depend on the strength of peer influence, as described in the following result:

Proposition 2: *Suppose that a positive share of students from state school dynasties, with beliefs 1, are admitted to the private school. Then the level of discrimination becomes lower at any period the higher is the intensity of peer influence (captured by the number of interactions n).*

The intuition is simple; the higher is the intensity of peer influence, the more private school graduates will be affected by state school graduates' beliefs. A larger share of individuals would have beliefs at 1 after the first stage following integration, and hence more will be convinced in the second stage and so on. Note that this is also robust to having state school pupils with beliefs less than 1 as long as they are close enough to 1. Thus, while without intervention a higher intensity of peer influence increases the instances of segregation (as in the condition of Proposition 1), with intervention in the form of integration the opposite arises, and higher intensity of peer influence hastens the break-up of segregation.

5.2 Labour markets interventions

We now consider several interventions in the labour market and explore how they affect discrimination in our model.

First, let us consider a simple anti-discrimination policy which induces private school employers to hire more graduates from state schools. One way to model this is to assume that a private school employer hires a state school graduate if $w < q_{i,g}^t + \delta$, for some $\delta > 0$. This can be thought of as a subsidy given to an employer who hires a state school graduate. Or, it can be rationalized by thinking of a punishment for the employer who does not abide by anti-discrimination laws and is thus induced to hire more often than he sees fit. In any case, the instances of hiring state school graduates by employers would increase. Note however that such a policy will not have as strong an effect in our model as one would think; our necessary and sufficient condition for segregation relies only on the strength of learning from employment (p) as we compute it in the worst case scenario in which a state school graduate is actually employed. Of course such policy will imply that the magnitude and scale of discrimination decreases, but the set of initial beliefs that would lead to segregation will remain the same, and some discrimination will still arise. Specifically, whenever the condition in Proposition 1 is satisfied, beliefs in the private school will converge to zero so that state school graduates will be employed by private employers iff $w < \delta$. As long as δ is not too high, discrimination will remain.

More fruitful policies in terms of affecting beliefs will therefore be those affecting the learning process upon hiring. One such possibility can be labour laws that allow for a longer probation period in which an employee cannot be fired. This implies better opportunities for the true productivity to come out and hence may allow to increase p . This would readily imply in our model that the environments in which segregation arise are reduced, as in the tension between peer influence and true learning, the latter would be more effective.

There is therefore a trade-off between the two policies discussed above. Anti-discrimination policies will maintain the same set of environments in which segregation arises, but will reduce the level of discrimination. Policies that increase learning in the labour market on the other hand will retain the same level of discrimination once it arises, but will reduce the set of parameters for which it will arise at all.

Another possibility is to encourage and foster interaction among employers so that they would also learn from each others' experience of hiring in the market. Formally, suppose that following the employment and updating of beliefs, employers also meet m other employers and exchange their posteriors, as in our school peer influence model. If some of these employers are state school employers, then segregation will easily break up, as desired. However, it might be, as in school choice, that guilds of employers would be segregated and private school employers would only meet each other. Still, even in this case, we can show that the instances for segregation are reduced. Whenever $n \geq 3$ and $m \geq 2$, \bar{q} as identified in Proposition 1 will be modified to be lower. The intuition is as follows. In our base model, the intensity of peer influence was higher than that of true learning which was individualistic, per dynasty. If labour market peer influence arises, it allows for individuals to transmit their true learning at a higher intensity to others, so it propagates faster. Thus, information exchange among employers -even excluding state school employers- would be helpful to tackle segregation. To summarize, we have the following:

Proposition 3 (*Labour market interventions*): (i) *Policies that allow for better learning of true productivity (increase p), such as an increased employment time, decrease the possibility of segregation.* (ii) *Policies which prevent discrimination in the market will not affect the degree of segregation in schools and hence wrong beliefs but will allow for less discrimination;* (iii) *Policies which encourage information exchange among employers will generally decrease segregation.*

5.3 School admissions and school fees

Our main result about the break up of segregation relies on the assumption that admittance to the private school is according to the willingness to pay with fixed capacity. Note

that the fact that the school has a capacity constraint and always admits a fixed share ρ is not important for this result as other (myopic) pricing mechanisms will eventually break up segregation. More generally, if the private school admits those with the highest willingness to pay (as all pricing mechanisms would), those with the “wrong” beliefs for the school might enter and segregation will break up.

It is not surprising then that many UK secondary schools and universities, who may care about their long term profits and survival, actually screen students not only to their willingness to pay but also according to their beliefs, via extensive interviews. In the prism of our model, interviews allow schools to screen also according to beliefs or family values and thus to make sure that only those with the “right” beliefs (that would ensure segregation) are admitted. Indeed, web sites that provide advice for private (independent) schools’ prospective students in the UK, state for example that it is important to mention in an interview that previous generations in the family have attended the school.²⁶ Students are expected to be able to talk about their family.²⁷ Interview advice for the parents themselves includes “expect to talk about yourself..remember to discuss long term values for your child..remember to talk about the things you can bring to the school”.²⁸

In the top UK universities of Oxford and Cambridge, interviews are part of student admission which many believe to bias the process.²⁹ In terms of policy making, according to our model, a policy of banning interviews would be fruitful in order to prevent private schools or top universities such as Oxford and Cambridge, from attracting individuals with specific beliefs or values. It will therefore reduce the circumstances in which segregation arises.

Another element of admission is the level of school fees. In many countries, including the UK and Ireland, private school fees are subsidized by the state as the schools have a charity status. A complete analysis of a tax and subsidy system will have to take into account the taxation cost for those in the state school, but also a potential advantage; lower school fees allow for a wider access, conditional on no other selective methods such as interviews or exams. This, according to our model, will allow to increase integration and the break up cascades of wrong beliefs.

²⁶<http://independenteducationconsultants.co.uk/tips-for-preparing-your-child-for-interview-at-a-top-independent-school/>

²⁷<http://privateschool.about.com/od/visitsandinterviews/a/How-To-Prepare-For-Private-School-Interviews.htm>

²⁸<http://www.kidsinthehouse.com/teenager/education/applying-to-private-school/navigating-the-private-school-parent-interview>

²⁹See for example <https://www.tes.co.uk/article.aspx?storycode=6055970> and <http://www.independent.co.uk/news/education/education-news/blunkett-oxbridge-still-too-exclusive-872815.html>.

6 Conclusion

We have analyzed a model in which labour market discrimination and segregation in education reinforce one another. We have also shown when such belief propagation by peer influence can break-up segregation and have suggested several information-based policy interventions that will alleviate the inefficiencies from wrong beliefs.

We have focused on the distinction between state and private schools. In the context of selective schools, one can also consider selection according to gender or religion. Segregation of schools according to gender might influence beliefs about the opposite gender which may persist in the labour market.

Peer influence and segregation need not arise only in schools. Such “social learning” can take place in other social interactions: Segregation in neighborhoods or communities between rich and poor can create different beliefs, as for example beliefs about the ability and motivation of the poor that has been explored in the literature.

Another example could be segregation through religious affiliation. Religion, as schools in our model, serves a dual role: it allows individuals to distinguish themselves (by its set of rituals, special clothes) as well as affects the beliefs of individuals (not only through peer influence, but also through preaching).³⁰ Some religions may segregate themselves physically and economically and our model can be applied in this context as well.

7 Appendix

Proof of Proposition 1:

Preliminaries: Note that (i) after the first period, all in $[\bar{q}, 1]$ will have beliefs 1; (ii) the condition in the Proposition implies that $\bar{q} < 0.5$; (iii) if an individual \bar{q} attends the private school, and in the worst case scenario mingles with n other individuals with the same beliefs, his beliefs become $\bar{q}_g \equiv \frac{\bar{q}^n}{\bar{q}^n + (1-\bar{q})^n} < \bar{q}$ (as $\bar{q} < 0.5$). If such an individual later on employs a state school graduate, his beliefs become $\bar{q}_e = \frac{\bar{q}_g p}{\bar{q}_g p + (1-\bar{q}_g)(1-p)}$. If $\frac{\bar{q}_g p}{\bar{q}_g p + (1-\bar{q}_g)(1-p)} < \bar{q}$, then the dynasty’s beliefs are still below $\bar{q} < \frac{1}{2}$. The condition in the Proposition insures that $\frac{\bar{q}_g p}{\bar{q}_g p + (1-\bar{q}_g)(1-p)} < \bar{q}$. Moreover, the mapping of q to $\frac{q_g p}{q_g p + (1-q_g)(1-p)}$ has a unique fixed point so that for all $q < \bar{q}$, $\frac{q_g p}{q_g p + (1-q_g)(1-p)} < q$, and for all $q > \bar{q}$, $\frac{q_g p}{q_g p + (1-q_g)(1-p)} > q$.

Sufficiency: We know from the above that beliefs in the private school always remain below $\bar{q} < \frac{1}{2}$. We will now show that for all $q < \frac{1}{2}$, given that beliefs in the private school are below a half for all others as well, then $\Delta_i^t > \Delta_s^t$. This implies that only the original

³⁰See Levy and Razin (2012).

dynasties remain in the school. We therefore need to show that:

$$\hat{\Delta}_i^t = \pi_i^t - (q_{i,e}^t - \frac{1}{2}) = \int_{\mathbf{q}^{t+1}} \left(\int_0^{\chi(\mathbf{q}^{t+1}, q_{i,e}^t)} (q_{i,e}^t - w) dw \right) dF_n^{t+1}(\mathbf{q}^{t+1}) - (q_{i,e}^t - \frac{1}{2}) > 0 = \hat{\Delta}_s^t,$$

where $F_n^{t+1}(\mathbf{q}^{t+1})$ is the distribution over vectors \mathbf{q}^{t+1} of length n which describes the beliefs of children in the school as inherited from their parents (recall that $q_i^{t+1} = q_{i,e}^t$).

A sufficient condition for this is that for any \mathbf{q}^{t+1} :³¹

$$\begin{aligned} \int_0^{\chi(\mathbf{q}^{t+1}, q_{i,e}^t)} (q_{i,e}^t - w) dw - q_{i,e}^t + \int_0^1 w dw > 0 &\Leftrightarrow (3) \\ \int_0^{\chi(\mathbf{q}^{t+1}, q_{i,e}^t)} q_i^t dw - \int_0^{\chi(\mathbf{q}^{t+1}, q_{i,e}^t)} w dw - \int_0^1 q_{i,e}^t dw + \int_0^1 w dw > 0 &\Leftrightarrow \\ \int_{\chi(\mathbf{q}^{t+1}, q_{i,e}^t)}^1 (w - q_{i,e}^t) dw > 0 & \end{aligned}$$

Finally note that the beliefs in the private school converge to the singleton 0 as they are always below a half. This concludes the sufficiency part.

Necessity: Let q^* satisfy $[\frac{q^*}{1-q^*}]^{n-1} = \frac{1-p}{p}$ and suppose that the condition in the proposition is violated so that $[\frac{\bar{q}}{1-\bar{q}}]^{n-1} > \frac{1-p}{p}$. This implies that $\bar{q} > q^*$ and that all those in $(q^*, \bar{q}]$ if they draw only peers from this set, will have new beliefs that are higher than what they started with. In particular, one can find sequences of dynasties whose beliefs will converge to one. We will show that this implies that we can find a positive measure of such dynasties, for whom eventually $\Delta_i^t < \Delta_s^t$.

By Lemma 1, dynasties must converge to have beliefs on zero, one or a half. We next show that long term segregation implies that a strictly positive measure of dynasties will converge to beliefs of zero.

First note that if long term segregation exists, it cannot be that almost all dynasties converge to one. If this is the case the benefit from sending one's child to private school for any parent will converge to that of state school parents.

The next step is to note that if the measure of dynasties whose beliefs converge to zero goes to zero, then it must be that the measure of dynasties whose beliefs go to one, goes to one. To see this note that if there was in the limit a strictly positive measure of

³¹Note that (3) is guaranteed by the wage being distributed uniformly. In fact any distribution that first order stochastically dominates the uniform will satisfy this. For other distributions, one would potentially need to add another condition to insure that no "contamination" arises but there would always be a low enough initial \bar{q} that would satisfy such condition. The necessary part does not depend on the uniform distribution at all.

dynasties going to a half, this would unravel as these would learn from work experience with strictly positive probability and their beliefs would start to drift to one.

The conclusion from the above is that if there is long term segregation, in the limit, there must be a strictly positive measure, α , of dynasties converging to zero. This implies that for any $\varepsilon > 0$ there exist a time T_ε such that there are at least a measure $\frac{\alpha}{2}$ of dynasties with beliefs below ε . We will now look at the strictly positive measure of dynasties at $(q^*, \bar{q}]$ whose beliefs are increasing and show that as a measure $\frac{\alpha}{2}$ of other dynasties have beliefs below ε , then their loss from peer influence in the private school is large.

To do so, we focus on such dynasties in $(q^*, \bar{q}]$ whose beliefs increase sufficiently slow so that others can converge to have beliefs below ε . Specifically, note that by choosing which individuals in the private school members of a dynasty interact with each period and whether they learn in the labour market, we can construct a feasible sequence of beliefs for a dynasty $\{q_i^t\}_{t=1}^\infty$ that lingers as long as we wish below a half, i.e. for any T we can find such a sequence such that $q_i^t \rightarrow 1$ but such that $q_i^t < 0.5$ for any $t < T$. Note further that by continuity of $\chi(\mathbf{q}^{t+1}, q_{i,e}^t)$ and full support we can also construct a whole set of such sequences all going to one in a similar rate.

Note now that,

$$\begin{aligned} & \hat{\Delta}_i^t - \hat{\Delta}_s^t \\ &= \int_{\mathbf{q}^{t+1}} \left(\int_0^{\chi(\mathbf{q}^{t+1}, \bar{q}_{i,e}^t)} (\bar{q}_{i,e}^t - 1) dw \right) - \int_{\chi(\mathbf{q}^{t+1}, \bar{q}_{i,e}^t)}^1 (1 - w) dw) dF_n^{t+1}(\mathbf{q}^{t+1}) + (1 - \bar{q}_{i,e}^t) \\ &< - \int_{\mathbf{q}^{t+1}} \left(\int_{\chi(\mathbf{q}^{t+1}, \bar{q}_{i,e}^t)}^1 (1 - w) dw \right) dF_n^{t+1}(\mathbf{q}^{t+1}) + (1 - \bar{q}_{i,e}^t) \end{aligned}$$

Now choose ε and T_ε such that a measure $\frac{\alpha}{2}$ of dynasties have beliefs below ε . Note that if i interacts with n of these dynasties, the measure of all such interactions is $(\frac{\alpha}{2})^n$. Choose a sequence of a strictly positive measure of dynasties whose beliefs converge to one slow enough so that at T_ε their distance from one is $\eta > 0$ such that $\chi(\mathbf{q}^{t+1}, q_i^t)$ is at most 2ε . Then we will have:

$$\begin{aligned} \hat{\Delta}_i^t - \hat{\Delta}_1^t &< - \int_{\mathbf{q}^{t+1}} \left(\int_{\chi(\mathbf{q}^{t+1}, \bar{q}_{i,e}^t)}^1 (1 - w) dw \right) dF_n^{t+1}(\mathbf{q}^{t+1}) + (1 - \bar{q}_{i,e}^t) \\ &\quad - \left(\frac{\alpha}{2}\right)^n \left(\int_{2\varepsilon}^1 (1 - w) dw \right) + \eta \\ &< 0 \end{aligned}$$

Note that α does not depend on ε , and hence when ε and η are low enough this expression will be negative and so in the next period a strictly positive measure of state school parents will send their kids to the private school.

Once a strictly positive measure of dynasties with beliefs at 1 enter the school, this will be the case for all future periods (as from that point onwards, the measure of dynasties with beliefs less than 1 is smaller than ρ). They will then “infect” whoever they meet and so all dynasties will converge to beliefs of 1 which is a contradiction to long term segregation. ■

Proof of Proposition 3: Parts (i) and (ii) are explained in the text and follow from the condition and proof in Proposition 1. To see (iii), consider again how we had defined the cutoff \bar{q} in Proposition 1 and let us modify it to the current extension of peer influence in the labour market. Specifically, as in Proposition 1, for segregation to hold we need that the dynasty at the upper bound of beliefs, following interaction in the school, learning in the market, and peer influence in the labour market, will end up with beliefs not higher as those that they had started with. Thus, if there are m interactions among employers in the labour market, we need $\frac{(\bar{q}_e)^m}{(\bar{q}_e)^m + (1 - \bar{q}_e)^m} < \bar{q}$ where $\bar{q}_e = \frac{\bar{q}_g p}{\bar{q}_g p + (1 - \bar{q}_g)(1 - p)}$, and $\bar{q}_g = \frac{\bar{q}^n}{\bar{q}^n + (1 - \bar{q})^n}$. The new condition for the cutoff becomes then

$$\begin{aligned} \left[\frac{\bar{q}}{1 - \bar{q}}\right]^{n+m-1} &\leq \left[\frac{1-p}{p}\right]^m \Leftrightarrow \\ \left[\frac{\bar{q}}{1 - \bar{q}}\right]^{n-1} \left[\frac{\bar{q}}{1 - \bar{q}}\right]^m &\leq \frac{1-p}{p} \left[\frac{1-p}{p}\right]^{m-1} \end{aligned}$$

But note that at the original cutoff as in Proposition 1, we have that $\left[\frac{\bar{q}}{1 - \bar{q}}\right]^{n-1} = \frac{1-p}{p}$ which implies that $\left[\frac{\bar{q}}{1 - \bar{q}}\right]^m < \left[\frac{1-p}{p}\right]^{m-1}$ only if $n \leq 3$ and $m \leq 2$. In all other cases then the condition for the cutoff is more strict, implying fewer instances of segregation. ■

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