

City of dreams

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ABSTRACT: Bigger cities offer more valuable experience and opportunities in exchange for higher housing costs. While higher-ability workers benefit more from bigger cities, they are not more likely to move to one. Our model of urban sorting by workers with heterogeneous self-confidence and ability suggests flawed self-assessment is partly to blame. Analysis of NLSY79 data shows that, consistent with our model predictions, young workers with high self-confidence are more likely to initially locate in a big city. For more experienced workers, ability plays a stronger role in determining location choices, but the lasting impact of earlier choices dampens their incentives to move.

Key words: cities, sorting, agglomeration, self-confidence, ability, learning

JEL classification: R10, R23

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1. Introduction

Working in a bigger city is associated with higher present and future earnings. Experience is more valuable when accumulated in a bigger city, even if the worker's job is no longer in one; also, prior experience is rewarded more highly in bigger cities (Glaeser and Maré, 2001, De la Roca and Puga, 2017). In exchange for these advantages, workers in bigger cities incur higher housing and congestion costs (Combes, Duranton, and Gobillon, 2019, Duranton and Puga, 2019).

The benefits of bigger cities are significantly larger for workers with higher ability within broad education or occupation categories (De la Roca and Puga, 2017). Given that housing costs there are higher for everyone regardless of ability, one might expect that when workers move, more able ones are more likely to go to a big city. And yet, this is not the case.

Bigger cities have more jobs requiring a college degree and more workers holding one (Moretti, 2012, Davis and Dingel, 2013) but, within broad occupation or education groups, there appears to be little sorting on ability. This finding holds regardless of whether one measures ability through cognitive test results (Bacolod, Blum, and Strange, 2009), individual fixed-effects in a wage regression (De la Roca and Puga, 2017), measures of ability derived from a structural estimation setting (Baum-Snow and Pavan, 2012), or individual residuals from a spatial equilibrium condition (Eeckhout, Pinheiro, and Schmidheiny, 2014).

A lack of sorting on ability is not entirely surprising, given that many people are not mobile. In the United States, according to our data, 56% of people (and 40% of college-educated workers) live in the same city at age 40 as at age 14. However, given that many people do move, one would expect them to consider how they would fare in different cities depending on their ability.

Our starting point is that it is difficult for individuals to assess their own ability, and thus also how much they would benefit from working in a big city. An extensive literature in psychology documents that individuals' assessment of their ability generally has little resemblance to their actual ability (see Dunning, Heath, and Suls, 2004, for a survey). Our data shows a low correlation of 0.21 between ability and self-confidence (our measure of ability self-assessment). Among college graduates, this correlation falls to 0.03.

We formalise the idea that flawed self-assessment can help explain the limited impact of ability on location decisions through a model of urban sorting. Relative to the overlapping generations model of learning in cities in Glaeser (1999), we have heterogeneous workers in self-confidence and ability. Relative to recent models of urban sorting where workers make a single location choice (Behrens, Duranton, and Robert-Nicoud, 2014, Eeckhout, Pinheiro, and Schmidheiny, 2014, Davis and Dingel, 2019), in our framework, workers choose their location in each period. Further, we introduce a role for workers' self-confidence so that the interplay between self-confidence, ability, and experience shapes the incentives to relocate.

The model predicts various patterns of bilateral sorting between big and small cities during workers' life cycles. When young migrants choose a location, they may be fooled by an imperfect assessment of their own ability. Thus, location decisions by young workers are driven mostly by self-confidence. For senior workers, ability plays a stronger role in determining location, but the lasting impact of earlier choices dampens their incentives to move.

We test the main predictions of our model on panel data from the National Longitudinal Survey of Youth 1979 (NLSY79), which contain measures of ability and self-assessment, and individuals' location and job history. We first examine the raw relationship between the location choices of individuals and their levels of self-confidence and ability upon completing education (corresponding to the junior period of our model) and ten years later (the senior period). We find that the data closely match our theoretical predictions.

We then estimate logit models to look at the determinants of locating in a small or a big city when junior, while controlling for other drivers of mobility. Our findings confirm that individuals with higher levels of self-confidence are more likely to locate in a big city upon entering the job market. Instead, high-ability young individuals are not significantly more likely to start their career in a big city.

Finally, we estimate multinomial logit models to examine relocations later in life. We find that it is ability rather than self-confidence that significantly determines the decision to relocate from small to big cities for more experienced workers. While corrections to flawed self-assessment are an essential driver of relocations from small to big cities, workers who initially located in a big city tend to stay there even if their ability is low.

2. The model

Every worker lives two periods, junior and senior. In each period, each worker chooses whether to locate in a big or small city. Subscript B denotes big city and subscript S small city variables.

Ability differs across workers. During her junior period, each worker engages in a continuum of simple tasks with finite measure 1. A worker's ability, α , is the share of simple tasks she can complete successfully as a junior worker. However, junior workers may have an inaccurate assessment of their own ability. A junior worker's self-confidence, σ , is her assessment of what her ability is (i.e. her belief about α). Looking back at what share of simple tasks she completed while junior, a senior worker knows her actual ability α .

Completing a simple task when junior yields an immediate return and also experience that will be valuable when senior. The advantage of locating in a big city for junior workers is that it allows them to accumulate more valuable experience, consistent with the evidence in De la Roca and Puga (2017). Specifically, completion of a simple task yields experience e_B in the big city and e_S in the small city, where $0 < e_S < e_B < 1$.

The advantage of locating in a big city for senior workers is the increased opportunities to exploit previously acquired experience, again consistent with De la Roca and Puga (2017). In particular, during her senior period, each worker may be presented with an opportunity to perform a more complex task and obtain an additional return. Such an opportunity arises with probability Ω_B in the big city compared with Ω_S in the small city, where $0 < \Omega_S < \Omega_B < 1$. The probability of completing this complex task when presented with such an opportunity equals the experience the worker acquired during her junior period.

The disadvantage of locating in a big city for both junior and senior workers is the higher costs of housing and commuting, which we refer to as urban costs, a widely-documented fact (Duranton

and Puga, 2020). These urban costs are γ_B in the big city and γ_S in the small city, with $0 < \gamma_S < \gamma_B$.¹

Junior period location

Every worker has four possible lifetime trajectories, each consisting of a junior period location choice i and a senior period location choice j : $(i, j) = \{(S, S), (S, B), (B, S), (B, B)\}$. As a junior worker, she chooses among these trajectories on the basis of her self-assessed ability σ . Afterwards, once her true ability α is revealed, the worker can choose whether to stick to her previously selected trajectory or to alter her senior period location choice.

In her junior period, the worker solves the problem

$$\max_{i, j \in \{B, S\}} U_{ij}^{\text{JR}}(\sigma) = -\gamma_i + \sigma\pi_1 - \gamma_j + \Omega_j\sigma e_i\pi_2. \quad (1)$$

$U_{ij}^{\text{JR}}(\sigma)$ denotes the the lifetime net return that a junior worker with self-confidence σ expects to obtain from residing in city i when junior and in city j when senior. By locating in city $i \in \{B, S\}$ during her junior period, the worker incurs an urban cost γ_i . She also completes a share of simple tasks equal to her ability, which she believes to be σ , obtaining an expected return $\sigma\pi_1$. By locating in city $j \in \{B, S\}$ as a senior worker, she incurs an urban cost γ_j . She also faces with probability Ω_j an opportunity to perform a complex task. She succeeds with probability equal to the experience acquired as a junior worker in city i —an experience that, when making her initial choice, she expects to be σe_i — and then obtains a return π_2 .

The key elements of equation (1) are that a big city provides junior workers with both disadvantages (higher urban costs $\gamma_B > \gamma_S$) and advantages (more valuable experience $e_B > e_S$), and the advantages are larger for workers with higher ability (which at this point workers believe to be σ). A big city also provides senior workers with both disadvantages (again, higher urban costs) and advantages (more opportunities to use previously acquired experience, $\Omega_B > \Omega_S$). Such advantages are larger for workers with higher ability or more experience ($\sigma e_B > \sigma e_S$).

The big city has an ‘absolute advantage’ in both experience ($e_B > e_S$) and opportunities ($\Omega_B > \Omega_S$), but to rank location trajectories we must think of ‘comparative advantage.’ If $\frac{e_B}{e_S} > \frac{\Omega_B}{\Omega_S}$, the big city has a comparative advantage in experience. From equation (1), when $\frac{e_B}{e_S} > \frac{\Omega_B}{\Omega_S}$, $U_{BS}(\sigma) > U_{SB}(\sigma)$ holds for all values of σ and trajectory (S, B) can be ruled out. While trajectory (B, S) dominates (S, B) , it will only be selected if it also dominates the other two trajectories. From equation (1), $U_{BS}(\sigma) > U_{SS}(\sigma)$ and $U_{BS}(\sigma) \geq U_{BB}(\sigma)$ jointly hold if and only if²

$$\sigma > \alpha_{BS>SS} \equiv \frac{\Delta\gamma}{\Delta e \Omega_S \pi_2} \quad (2)$$

and

$$\sigma \leq \alpha_{BB>BS} \equiv \frac{\Delta\gamma}{e_B \Delta\Omega \pi_2} \quad (3)$$

¹Here, we treat γ_B and γ_S as parameters. In an online appendix, we model city structure to make γ_B and γ_S a function of the population of each city, with city populations derived in turn as an equilibrium outcome of the location decisions of all agents. We prove equilibrium existence and uniqueness.

²We arbitrarily break ties between location trajectories in favour of the small city, hence the strong inequality $U_{BS}(\sigma) > U_{SS}(\sigma)$ and the weak inequality $U_{BS}(\sigma) \geq U_{BB}(\sigma)$.

are simultaneously satisfied, where

$$\Delta\gamma \equiv \gamma_B - \gamma_S, \quad (4)$$

$$\Delta e \equiv e_B - e_S, \quad (5)$$

$$\Delta\Omega \equiv \Omega_B - \Omega_S. \quad (6)$$

The ability threshold defined by equation (2), $\alpha_{BS \succ SS}$, is such that anyone with ability above this threshold gets a higher expected return by locating in B as a junior worker and relocating to S as a senior worker than by locating in S in both periods (hence the subscript $BS \succ SS$). We use this same notation for all thresholds that follow. Thus, a junior worker will choose trajectory (B, S) if and only if $\alpha_{BS \succ SS} < \sigma$ and $\sigma \leq \alpha_{BB \succ BS}$. These two inequalities can only hold simultaneously if $\alpha_{BS \succ SS} < \alpha_{BB \succ BS}$. Using equations (2) and (3), this requires $\frac{e_B}{\Omega_S} < \frac{\Delta e}{\Delta\Omega}$. The condition that the big city has a comparative advantage in experience, $\frac{e_B}{e_S} > \frac{\Omega_B}{\Omega_S}$, can be rewritten as $\frac{e_S}{\Omega_S} < \frac{\Delta e}{\Delta\Omega}$. Since $e_S < e_B$, the new condition is more stringent. Thus, for some workers to choose trajectory (B, S) , it is not enough that the big city has a comparative advantage in experience, the comparative advantage has to be large enough. Then, when $\frac{e_B}{\Omega_S} < \frac{\Delta e}{\Delta\Omega}$, workers with self-confidence $\alpha_{BS \succ SS} < \sigma < \alpha_{BB \succ BS}$ locate in the big city when junior in order to acquire valuable experience. They do so with the intention of relocating to the small city in their senior period, since in this case the advantage of the big city in terms of opportunities is comparatively small and they believe their ability is not high enough to compensate the extra urban cost. Workers with higher self-confidence, $\alpha_{BB \succ BS} < \sigma$ also locate in the big city when junior, but with the intention of remaining there. Finally, workers with low self-confidence $\sigma < \alpha_{BS \succ SS}$ locate in the small city when junior, and anticipate to remain there.

If instead $\frac{e_B}{e_S} < \frac{\Omega_B}{\Omega_S}$, the big city has a comparative advantage in opportunities. From equation (1), when $\frac{e_B}{e_S} < \frac{\Omega_B}{\Omega_S}$, $U_{BS}(\sigma) < U_{SB}(\sigma)$ holds for all values of σ and trajectory (B, S) can be ruled out. While trajectory (S, B) dominates (B, S) , it will only be selected if it also dominates the other two trajectories. From equation (1), $U_{SB}(\sigma) > U_{SS}(\sigma)$ and $U_{SB}(\sigma) \geq U_{BB}(\sigma)$ jointly hold if and only if

$$\sigma > \alpha_{SB \succ SS} \equiv \frac{\Delta\gamma}{e_S \Delta\Omega \pi_2} \quad (7)$$

and

$$\sigma \leq \alpha_{BB \succ SB} \equiv \frac{\Delta\gamma}{\Omega_B \pi_2 \Delta e} \quad (8)$$

are simultaneously satisfied. These two inequalities can only hold simultaneously if $\alpha_{SB \succ SS} < \alpha_{BB \succ SB}$. Using equations (7) and (8), this requires $\frac{\Delta e}{\Delta\Omega} < \frac{e_S}{\Omega_B}$. This condition is more stringent than $\frac{e_B}{e_S} < \frac{\Omega_B}{\Omega_S}$, so for some workers to choose (S, B) , the big city must have a large-enough comparative advantage in opportunities. Then, when $\frac{\Delta e}{\Delta\Omega} < \frac{e_S}{\Omega_B}$, workers with self-confidence $\alpha_{SB \succ SS} < \sigma < \alpha_{BB \succ SB}$ locate in a small city when junior with the intention of relocating to the big city in their senior period, since the dominant advantage of the big city is now the greater opportunities it provides to use previous experience. Workers with low self-confidence $\sigma < \alpha_{SB \succ SS}$ also locate in a small city when junior, and anticipate to remain there. Workers with high self-confidence, $\alpha_{BB \succ SB} < \sigma$ locate in the big city when junior not planning to relocate either.

We have seen that for any worker to choose trajectory (B, S) we must have $\frac{e_B}{\Omega_S} < \frac{\Delta e}{\Delta \Omega}$ and for any worker to choose trajectory (S, B) we must have $\frac{\Delta e}{\Delta \Omega} < \frac{e_S}{\Omega_B}$. Thus, when $\frac{e_S}{\Omega_B} \leq \frac{\Delta e}{\Delta \Omega} \leq \frac{e_B}{\Omega_S}$ only trajectories (B, B) and (S, S) are chosen. From equation (1), a junior worker chooses (B, B) over (S, S) if and only if her self-confidence is high enough:

$$\sigma > \alpha_{BB \succ SS} \equiv \frac{2\Delta\gamma}{(\Omega_B e_B - \Omega_S e_S) \pi_2}. \quad (9)$$

Senior period location

After her actual ability is revealed by the share of tasks successfully completed when junior, a worker decides whether to stick to her previously planned senior period location or not. If the worker's revealed ability does not match her initial self-assessment ($\alpha \neq \sigma$), the worker will reoptimize by maximizing her senior period utility

$$\max_{j \in \{B, S\}} U_{ij}^{\text{SR}}(\alpha) = -\gamma_j + \Omega_j \alpha e_i \pi_2, \quad (10)$$

where i has already been determined by her junior choice. This new decision is driven by a combination of the worker's actual ability and the choice she made when junior based on her (possibly flawed) self-assessment, where this junior choice has a lasting effect through its impact on experience. Workers whose junior location choice was $i = S$ relocate to B if and only if $U_{SB}^{\text{SR}}(\alpha) > U_{SS}^{\text{SR}}(\alpha)$, i.e. for $\alpha > \alpha_{SB \succ SS}$. Workers whose junior location choice was $i = B$ remain in B if and only if $U_{BB}^{\text{SR}}(\alpha) > U_{BS}^{\text{SR}}(\alpha)$, i.e. for $\alpha > \alpha_{BB \succ BS}$.

The optimal junior and senior location choices as a function of self-confidence σ and ability α are summarised in the following proposition.

Proposition 1. Define low self-confidence as

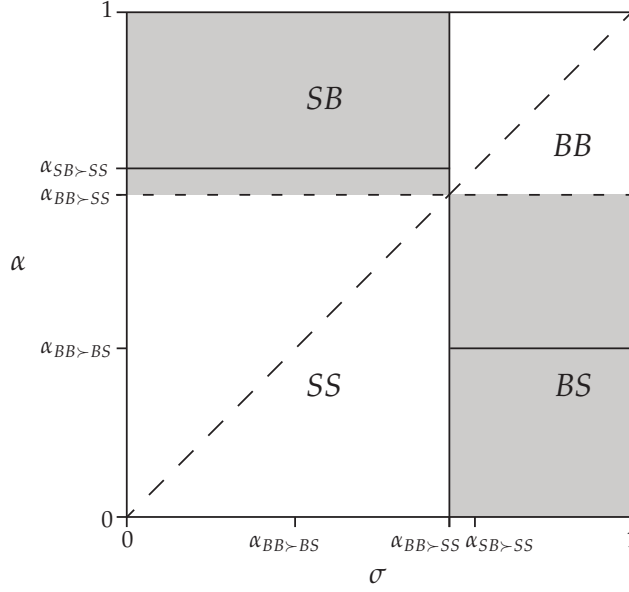
- $\sigma \leq \alpha_{BB \succ SB} \equiv \frac{\Delta\gamma}{\Omega_B \pi_2 \Delta e}$ if $\frac{\Delta e}{\Delta \Omega} < \frac{e_S}{\Omega_B}$,
- $\sigma \leq \alpha_{BB \succ SS} \equiv \frac{2\Delta\gamma}{(\Omega_B e_B - \Omega_S e_S) \pi_2}$ if $\frac{e_S}{\Omega_B} \leq \frac{\Delta e}{\Delta \Omega} \leq \frac{e_B}{\Omega_S}$,
- $\sigma \leq \alpha_{BS \succ SS} \equiv \frac{\Delta\gamma}{\Omega_S \Delta e \pi_2}$ if $\frac{e_B}{\Omega_S} < \frac{\Delta e}{\Delta \Omega}$.

Define high self-confidence as the opposite. Define

- low ability as $\alpha \leq \alpha_{BB \succ BS} \equiv \frac{\Delta\gamma}{e_B \Delta \Omega \pi_2}$,
- intermediate ability as $\alpha_{BB \succ BS} < \alpha \leq \alpha_{SB \succ SS} \equiv \frac{\Delta\gamma}{e_S \Delta \Omega \pi_2}$,
- high ability as $\alpha_{SB \succ SS} < \alpha$.

When junior, workers locate in S if they have low self-confidence and locate in B if they have high self-confidence. When senior, workers locate in S if they either have low ability or they have intermediate ability and low self-confidence; they locate in B if they either have high ability or they have intermediate ability and high self-confidence.

Figure 1: Equilibrium location choices by self-confidence and ability



(Shaded rectangles mark areas where flawed self-assessment alters location choices.)

Figure 1 represents location choices as a function of self-confidence (σ , horizontal axis), and ability (α , vertical axis). The two capital letters in each rectangle denote location choices, the first representing the junior period location and the second the senior period location for workers with combinations of σ and α falling in that rectangle.

The diagonal of the figure captures situations where self-confidence accurately reflects ability ($\sigma = \alpha$). The figure is plotted for parameter values such that $\frac{e_S}{\Omega_B} \leq \frac{\Delta e}{\Delta \Omega} \leq \frac{e_B}{\Omega_S}$ so that, according to proposition 1, workers with accurate self-assessment locate in the same city in both periods.³ With $\frac{e_S}{\Omega_B} \leq \frac{\Delta e}{\Delta \Omega}$ proposition 1 defines low self-confidence as $\sigma \leq \alpha_{BB>SS}$. Thus, the vertical line at $\sigma = \alpha_{BB>SS}$ has workers with low self-confidence to its left, locating in *S* when junior, and workers with high self-confidence to its right, locating in *B* instead.

For the senior period location, we must compare α to $\alpha_{BB>BS}$ and $\alpha_{SB>SS}$. The horizontal line at $\alpha_{BB>BS}$ has workers with low ability below it, who locate in *S* when senior period regardless of their junior period location. The horizontal line at $\alpha_{SB>SS}$ has workers with high ability above it, who locate in *B* when senior regardless of their junior period location. Workers with intermediate ability $\alpha_{BB>BS} < \alpha \leq \alpha_{SB>SS}$ remain where they located when junior, and this is determined by whether their self-confidence was to the left or right of $\sigma = \alpha_{BB>SS}$.

The shaded rectangles in the figure mark areas where workers have sufficiently flawed self-

³There are only two other possibilities, as per proposition 1. If $\frac{\Delta e}{\Delta \Omega} < \frac{e_S}{\Omega_B}$, even some workers who assess their ability accurately relocate from *S* to *B* when they become senior. If $\frac{e_B}{\Omega_S} < \frac{\Delta e}{\Delta \Omega}$, even some workers who assess their ability accurately relocate from *B* to *S* when they become senior. Alternative versions of the figure for such parameter values can be found in an online appendix; the degree of comparative advantage in experience or opportunities for big cities is the only key difference between them. We plot figure 1 using $e_B = 0.50$, $e_S = 0.24$, $\Omega_B = 0.70$, $\Omega_S = 0.04$, $\pi_2 = 2.75$, and $\Delta\gamma = 0.30$.

assessment that they behave differently than if they had known their actual ability from the beginning. Overconfident workers with very low ability locate in B when junior and relocate to S when senior once they realise that their ability is too low to benefit from better opportunities in B . These are workers whose σ and α fall in the bottom right shaded rectangle labelled BS .

Next, overconfident works of intermediate ability also locate in B when junior. However, they end up remaining in B when senior, since their intermediate ability lets them take advantage of the higher experience gained when junior better than low-ability workers. These are workers whose σ and α fall in the middle right shaded rectangle labelled BB (each trajectory label refers to the entire rectangle containing it delimited by a continuous line). The proportions of overconfident workers who stick with their initial decision to locate in B and who instead prefer to relocate to S depend on the magnitude of the threshold $\alpha_{BB>BS}$.

Conversely, underconfident workers with very high ability locate in S when junior and move to B when senior once they realise that their ability is high enough to exploit better opportunities there. These are workers whose σ and α fall in the top left shaded rectangle labelled SB .

Finally, underconfident workers of intermediate ability locate in S when junior not realising their true ability. By locating in S , they accumulate less valuable experience than if they had located in B , and this leads them to remain in S when senior. Had they known their actual ability, they would have located in B in both periods. These are workers whose σ and α fall in the middle left shaded rectangle labelled SS .

3. Data

We use panel data from the “cross-sectional sample” of the National Longitudinal Survey of Youth 1979 (NLSY79). This survey by the US Department of Labor’s Bureau of Labor Statistics (BLS) follows a nationally representative sample of 6,111 men and women who were 14–22 years old in 1979.

Our measure of ability is the individual’s percentile score in the Armed Forces Qualification Test (AFQT). This cognitive ability test was administered to all NLSY79 respondents in 1980, when their median age was 19, regardless of whether they had any interest in the military.

In our model, we use the term self-confidence to refer to individuals’ perception of their own ability. Prior to being provided their results on the AFQT, NLSY79 respondents were subject to a self-evaluation test devised by Rosenberg (1965), which has been found to measure well individuals’ perception of their own ability to perform in a wide variety of tasks, in particular those that are job-related (Judge, Erez, and Bono, 1998, Chen, Gully, and Eden, 2001). We use the percentile rank computed by the BLS for the Rosenberg test, which weighs responses to each question differently depending on how well they help discriminate between individuals with different levels of latent self-esteem and produces an approximately Normal score distribution.

To relate empirical results more closely to our model, we define a junior and a senior period for each individual and classify metropolitan areas into two groups that we can directly relate to big and small cities in the model.

Regarding timing, we set the junior period for all respondents at the year after their highest level of education is completed, excluding educational periods that take place after a spell of more

than two years away from education (median age of 21 for individuals without post-secondary education and 24 for the college-educated). For our descriptive results, to remain as close as possible to our model, we set a senior period for all respondents by adding ten years to their junior period. However, our regression models exploit the full time dimension of our panel by looking at relocations at any point after the junior period.

Regarding locations, for each respondent we know location at the county level at birth, at age 14, and at each interview date since 1979. Based on this, we determine whether each respondent lives in a Core Based Statistical Areas (CBSA) with a 2010 population above two million. If so, we classify them as living in a big city, otherwise as living in a small city.⁴

4. Observed location choices by self-confidence and ability

We first examine how the location choices of individuals vary with self-confidence and ability. To relate these choices to the theoretical predictions depicted in figure 1, we divide the self-confidence and the ability measures into terciles. Figure 2 plots in a grid each of the nine possible combinations of self-confidence (horizontal axis) and ability (vertical axis) terciles. Panel (a) shows the frequency of each of these combinations in the NLSY79 sample. Individuals are far from being concentrated on the three diagonal cells, and those in the middle tercile of ability are spread almost uniformly across self-confidence terciles.

In panel (b), we define a junior period (the year after completing education) and a senior period (ten years later) and, using the same labels as in our theoretical figure 1, we assign to each grid cell the most prevalent location trajectory observed in the data for that combination of self-confidence and ability terciles.⁵

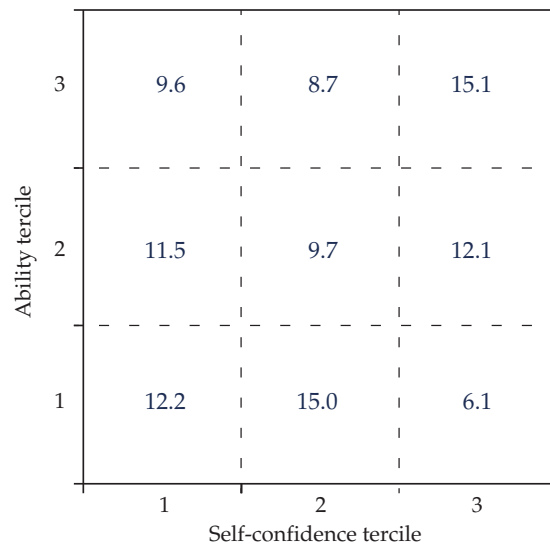
The three cells along the diagonal (representing those with well-aligned self-confidence and ability) show the assortative matching between cities and workers predicted by our model. Workers with accurate self-assessment tend to locate in small cities if they have low ability (bottom-left and centre-centre cells) and in big cities if they have high ability (top-right cell).

Turning to individuals whose self-assessment is less accurate, consider individuals in the top tercile of ability but the bottom or middle tercile of self-confidence (top-left and top-centre cells). Their choices are, again, consistent with our theoretical predictions. Once individuals with low self-confidence find they have high ability, they move away from the small city where their under-confidence led them to locate initially. Had their self-assessment been more accurate, they would have located in the big city from the beginning.

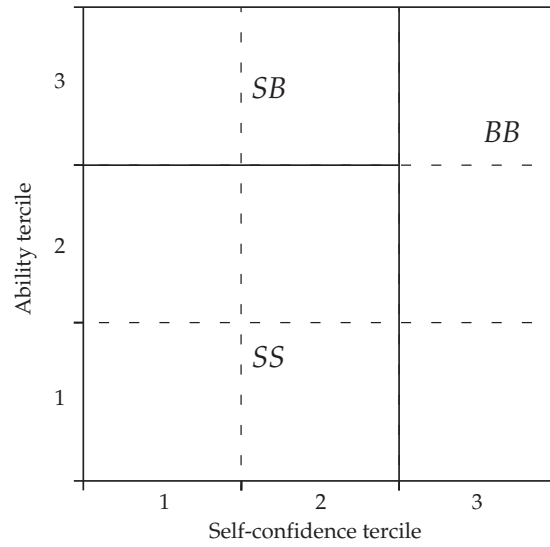
Individuals with intermediate levels of ability and high or low levels of self-confidence also follow the location choices predicted by our model. Those in the top tercile of self-confidence

⁴This is in the middle of the range used by other papers dealing with urban sorting, which typically classify cities as big when their population is above a threshold of between 1.5 million (Baum-Snow and Pavan, 2012) and 2.5 million (Eeckhout, Pinheiro, and Schmidheiny, 2014). The effects of self-confidence and ability are virtually identical to those we report in the tables below when we define big cities as those that exceed 1.5 and 2.5 million instead of 2 million in 2010.

⁵When measuring localisation, the relevant benchmark is not a uniform distribution but the distribution that would arise under random location choices (see, e.g. Ellison and Glaeser, 1997). Thus, we measure the prevalence of each location trajectory relative to a random-location benchmark in which each individual follows each location trajectory with the same probability as the share of that trajectory in the aggregate population regardless of ability and self-confidence.



Panel (a)
Bivariate distribution of self-confidence and ability



Panel (b)
Prevalent location choice

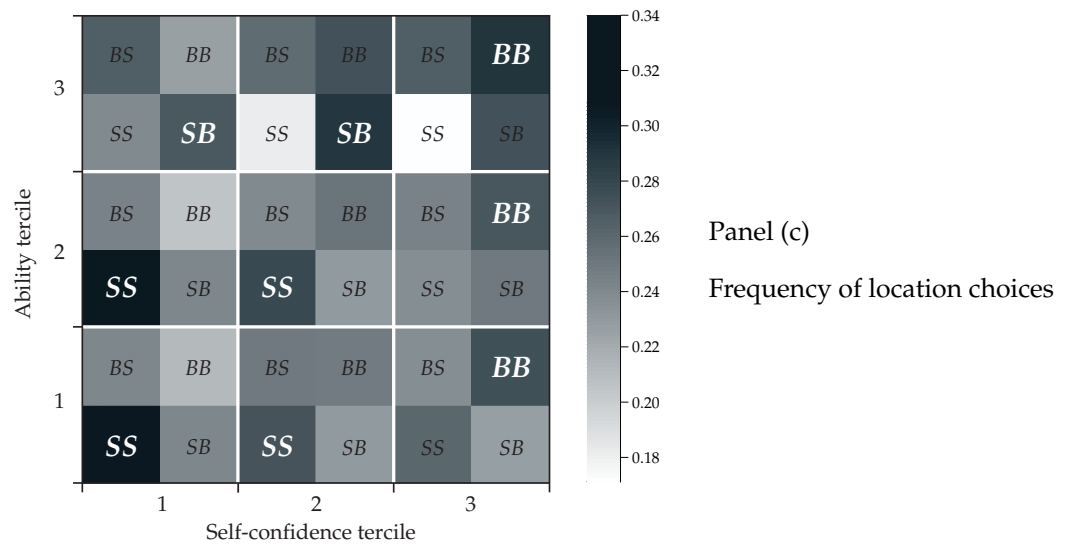


Figure 2: Observed location choices by self-confidence and ability tertiles

(centre-right cell) start in big cities and remain there. According to our model, having invested in locating in a big city when junior led by their high self-confidence and acquiring valuable experience as a result, they remain in a big city to put that experience to use. Those with lower self-confidence (centre-left cell) but similar intermediate ability, instead tend to locate in a small city and remain there.

Looking finally at individuals in the bottom tercile of ability who self-assess this inaccurately, as per our theoretical predictions, if their overconfidence is not excessive (bottom-centre cell), they tend to locate in a small city and have no strong reason to move later. The only cell out of nine in figure 2 that seemingly differs from the theoretical prediction of figure 1 is the bottom-right cell. The model can still accommodate the empirical result for this cell—the least frequent combination of ability and self-confidence terciles, with only 6.1% of the total— if $\alpha_{BB \rightarrow BS} \equiv \frac{\Delta\gamma}{e_B \Delta\Omega \pi_2}$ is sufficiently low (requiring large values of e_B and $\Delta\Omega$). Then, workers with low ability who are driven to the big city by their overconfidence when junior acquire valuable experience in the big city (large e_B). By remaining there, they take advantage of the much greater opportunities big cities provide (large $\Delta\Omega$).

Panel (b) of figure 2 only shows the most common location choice in each cell. Panel (c) shows the incidence of all choices in each cell. We now split each of the nine cells into four quadrants corresponding to every possible two-period location trajectory, with darker shades representing a higher frequency of that trajectory compared to the overall population. We mark in white the prevalent location choice.⁶ Note how strategy *SS* becomes gradually less prevalent and *BB* gradually more prevalent as we move upwards and rightwards.

Overall, the location choices of individuals vary with self-confidence and ability in a way that closely matches our theoretical predictions. Workers with accurate self-assessment tend to locate in small cities if they have low ability and in big cities if they have high ability. Workers with a flawed self-assessment instead make initial location choices that are related to their self-confidence rather than their ability. For workers with intermediate ability, any errors in self-assessment are necessarily moderate. Thus, their initial location choices become self-perpetuating even if they do not correspond with the worker’s ability (according to the model, because they affect the value of acquired experience). Workers with high or low ability can make more substantial errors in self-assessment. These are more likely to be corrected, at least for underconfident high-ability workers who, despite lacking the self-confidence to initially locate in a big city, tend to move to one eventually. All of these conclusions are so far based on raw data, without taking into account other characteristics and experiences of individuals. We next incorporate these.

5. Determinants of location in big and small cities

A first implication of our model is that junior workers sort on self-confidence rather than ability, with more confident workers more likely to locate in big cities upon entry into the labor market. In column (1) of table 1 we estimate a logit model where the dependent variable takes value one if the individual lives in a big city the year after completing education. All columns report

⁶We are grateful to Jesse Shapiro, our discussant at the NBER Summer Institute, for suggesting this additional panel.

Table 1: Determinants of location in big and small cities

	In a big	In a small city upon		In a big city upon	
	city upon	completed	moved to	moved to	moved to
	completing	education	another	a big	a small
	education	small city	city	city	another
	(1)	(2a)	(2b)	(3a)	(3b)
Self-confidence percentile	1.0039 (0.0015)**	1.0003 (0.0010)	1.0010 (0.0017)	0.9983 (0.0013)	1.0015 (0.0016)
Cognitive ability percentile	1.0008 (0.0023)	1.0016 (0.0015)	1.0056 (0.0022)**	0.9961 (0.0030)	1.0023 (0.0026)
Male	0.9055 (0.0774)	1.0841 (0.0731)	0.9430 (0.0928)	1.1108 (0.1096)	0.9625 (0.1074)
Hispanic	1.9031 (0.6962)*	0.8903 (0.1883)	1.6687 (0.3409)**	0.5186 (0.1250)***	1.1181 (0.2248)
Black	1.4298 (0.3775)	0.6330 (0.0781)***	1.2662 (0.2423)	0.5146 (0.0874)***	0.8273 (0.1581)
High-school graduate	0.9314 (0.1304)	0.8845 (0.0768)	0.7692 (0.1432)	0.9707 (0.1302)	1.2264 (0.3368)
Some college	0.9868 (0.1603)	0.9260 (0.1024)	1.3396 (0.2499)	1.0860 (0.1630)	2.0135 (0.6109)**
College graduate	2.1470 (0.5274)***	0.9621 (0.1190)	1.1562 (0.2767)	1.0624 (0.1998)	2.1857 (0.5784)***
Never married	1.3106 (0.2220)	0.8194 (0.0725)**	0.9122 (0.1075)	0.8006 (0.0954)*	0.9037 (0.1352)
One or more children	0.6395 (0.0808)***	0.7739 (0.0605)***	0.6673 (0.0851)***	0.8586 (0.0930)	0.7360 (0.1138)**
Full-time working spouse	1.0161 (0.1598)	1.0426 (0.0775)	1.3744 (0.2057)**	1.1229 (0.1403)	1.4606 (0.2115)***
In a small city at age 14	0.0184 (0.0038)***				
Experience		0.9977 (0.0126)	1.0152 (0.0228)	1.0015 (0.0186)	1.0384 (0.0338)
Tenure		0.9235 (0.0112)***	0.9226 (0.0214)***	0.9412 (0.0150)***	0.9113 (0.0193)***
Weeks out of work, previous period		1.0022 (0.0020)	1.0027 (0.0028)	1.0071 (0.0029)**	1.0117 (0.0033)***
Same city upon completing education and age 14		0.4572 (0.0292)***	0.5574 (0.0624)***	0.4950 (0.0459)***	0.4699 (0.0814)***
Years since completing education	No	Yes	Yes	Yes	Yes
Birth-year indicators	Yes	Yes	Yes	Yes	Yes
N	5,298		37,582		25,597
Pseudo R^2	0.4619		0.0551		0.0476

Notes: Column (1) reports a logit estimation for all individuals in the sample where the dependent variable takes value 1 if the individual lives in a big city one year after completing her highest level of continuous education and value 0 otherwise. Columns (2a) and (2b) report a multinomial logit estimation of a multiple-exit discrete duration model for individuals who lived in a small city upon completing education where the dependent variable takes value 1 if the individual relocates to another small city, value 2 if the individual relocates to a big city, and value 0 for all periods the individual remains in the same city. Columns (3a) and (3b) report a multinomial logit estimation of a multiple-exit discrete duration model for individuals who lived in a big city upon completing education where the dependent variable takes value 1 if the individual relocates to a small city, value 2 if the individual relocates to another big city, and value zero for all periods the individual remains in the same city. Odds ratios are reported; coefficients above one indicate a positive effect and coefficients below one indicate a negative effect. All specifications include a constant. White, female, ever married and high-school dropouts are the omitted categories. Standard errors in parentheses are clustered at the metropolitan area level. ***, **, and * indicate significance at the 1, 5, and 10 percent levels. A 'big city' is defined as a Core Based Statistical Area (CBSA) with population greater than 2,000,000 in 2010.

exponentiated coefficients (odds ratios), so values above one indicate a positive effect and values below one a negative effect. Results show that individuals with higher levels of self-confidence are more likely to locate in a big city when junior: an increase of one standard deviation in the self-confidence percentile (28.9 points) raises the probability of locating in a big city by 11%.⁷ In contrast, conditioning on self-confidence, individuals with higher levels of ability are not any more likely to initially locate in a big city.

Of course, a worker's ability is correlated with higher education, and college-educated workers are more likely to locate in a big city. This is partly because individuals who grow up in a big city have higher college graduation rates and a majority of people start working in the same place where they grew up (Bosquet and Overman, 2019). There is also some sorting of college-educated workers into bigger cities. An individual with a bachelor's degree has a 115% higher probability of locating in a big city when junior than someone with primary education, other characteristics being equal. However, there is substantial heterogeneity in cognitive ability among workers with the same level of education. Importantly, self-assessment of ability relative to people with the same education is so imperfect that there is virtually no correlation (0.03) between self-confidence and ability among college-educated workers. As a result, controlling for education, a higher ability does not make initial location in a big city any more likely. T-tests of differences in means confirm that college-educated workers who start working in big cities are not more able than those who start in small cities, yet they are significantly more self-confident.

We also include a set of demographic controls. Having children lowers the probability of locating in a big city by 36%, while being Hispanic raises it by 90%. Many people are closely attached to the place where they grew up. One year after completing their education, 70% of individuals in our sample are in the same city as at age 14 and 56% remain there by age 40. Thus, we include as a control an indicator variable for living in a small city at age 14. While growing up in a small city notably decreases the probability of entering the job market in a big city, our results regarding the role of ability and self-confidence are quite similar whether we control for location at age 14 or not.

We next study location choices later in life. Our model predicts that ability matters for the location of senior workers, but that junior location choices have long-term consequences. Conditional on location upon entering the labour market, higher-ability workers should be more likely to locate in big cities later in their careers. To test these implications, we exploit the lifetime careers of workers in the NLSY79 to estimate a multiple-exit discrete duration model using a multinomial logit. Each period, individuals choose whether to stay in their city, migrate to a small city or migrate to a big city.⁸

In columns (2a) and (2b), we focus on individuals who were living in a small city upon completing education. The dependent variable takes value one in the last period prior to migration if the individual relocated to another small city, value two if the individual relocated to a big city, and value zero for all periods an individual remained in the same city. Results show that the level

⁷Calculated by subtracting 1 from the regression coefficient for the self-confidence percentile and then multiplying by the standard deviation of the variable: $(1.00391 - 1) \times 28.878 = 0.113$.

⁸We focus only on first-time moves, and thus, an individual can move at most once and then drops from the population at risk of migrating for the first time.

of self-confidence no longer influences the decision to relocate in any direction, whereas the level of ability is a crucial relocation driver from small to big cities, but not to other small cities. The estimated coefficient on ability in column (2b) implies that a one standard deviation increase in the ability percentile raises the probability of moving from a small to a big city by 16%.

Analogously, in columns (3a) and (3b), we focus on individuals who were in a big city upon completing education. Results reveal that neither self-confidence nor ability are key determinants of the relocation decision of senior workers from big cities in any direction. This is consistent with one of our conclusions from figure 1 when e_B and $\Delta\Omega$ are large: if big-city experience is highly valuable and differences in opportunities between small and big cities are large, then workers who located in a big city upon completing education tend to stay even if their ability is low.

Other findings show that being partnered to a full-time working spouse increase the odds of moving to a big city, regardless of the worker's initial location (Costa and Kahn, 2000). Having children discourages workers from moving, and more so to big cities. Looking at time-varying labor market variables, a longer job tenure reduces the odds of migrating in any direction. Unemployment is often a major factor that affects mobility decisions of individuals (Greenwood, 1997). We noted above that workers who initially located in big cities and found good local opportunities to use their previously acquired experience tend to stay put, even if they turn out to have low ability. On the other hand, individuals who find themselves out of work for an extended period of time in a big city, are more likely to move away. Finally, individuals living in the same city upon completing education as at age 14 are also much less likely to move anywhere later in life.

Robustness and alternative explanations

One source of concern is that the sorting by self-confidence that we observe during the junior period is unrelated to an inaccurate assessment of ability, but instead reflects an intrinsic additional value of self-confidence in big cities. To address this concern, we follow De la Roca and Puga (2017). In column (1) of table 2, we replicate their results using our US NLSY79 data (their study uses Spanish Social Security data). We regress log earnings on worker fixed-effects, job characteristics, indicator variables for all individual big cities and for groups of similarly-sized small cities, measures of overall work experience and work experience acquired in big cities, and interactions between these measures of experience and worker fixed-effects. The positive and significant coefficient on big-city experience shows that experience acquired in big cities is significantly more valuable than the experience acquired elsewhere, consistent with what we assume in our model.

Further, the significant interaction between big-city experience and worker fixed-effects is evidence of a positive complementarity between ability and the long-term benefits of acquiring work experience in a big city. In column (1) we use worker fixed effects as a measure of ability, directly following De la Roca and Puga (2017). Since the NLSY79 includes the AFQT percentile score as a measure of cognitive ability, which we have been using so far, column (2) provides an alternative version of column (1) measuring ability with the AFQT score instead, and obtains essentially the same results.

The key question is whether self-confidence, like ability, is more highly rewarded in big cities. To answer this, in columns (3) and (4) we add to the specifications of columns (1) and (2), respec-

Table 2: Estimation of the relationship between earnings earnings, ability and self-confidence

	Log earnings			
	(1)	(2)	(3)	(4)
Big-city experience	0.0164 (0.0025)***	0.0159 (0.0025)**	0.0163 (0.0025)***	0.0157 (0.0025)***
Big-city experience \times experience	-0.0004 (0.0001)***	-0.0004 (0.0001)***	-0.0004 (0.0001)***	-0.0004 (0.0001)***
Big-city experience \times worker fixed-effect	0.0168 (0.0051)***		0.0179 (0.0052)***	
Big-city experience \times cognitive ability		0.0065 (0.0036)*		0.0076 (0.0036)**
Big-city experience \times self-confidence			-0.0047 (0.0034)	-0.0052 (0.0034)
Experience	0.0285 (0.0018)***	0.0275 (0.0018)***	0.0286 (0.0018)***	0.0277 (0.0018)***
Experience ²	-0.0004 (0.0001)***	-0.0003 (0.0001)***	-0.0004 (0.0001)***	-0.0003 (0.0001)***
Experience \times worker fixed-effect	0.0528 (0.0077)***		0.0532 (0.0080)***	
Experience ² \times worker fixed-effect	-0.0010 (0.0002)***		-0.0010 (0.0002)***	
Experience \times cognitive ability		0.0310 (0.0050)***		0.0304 (0.0051)***
Experience ² \times cognitive ability		-0.0005 (0.0002)***		-0.0005 (0.0002)***
Experience \times self-confidence			-0.0010 (0.0048)	0.0028 (0.0047)
Experience ² \times self-confidence			0.0001 (0.0002)	0.0000 (0.0002)
Tenure	0.0288 (0.0014)***	0.0290 (0.0014)***	0.0288 (0.0014)***	0.0290 (0.0014)***
Tenure ²	-0.0010 (0.0001)***	-0.0010 (0.0001)***	-0.0010 (0.0001)***	-0.0010 (0.0001)***
City size indicators	Yes	Yes	Yes	Yes
2-digit occupation & sector indicators	Yes	Yes	Yes	Yes
Worker fixed-effects	Yes	Yes	Yes	Yes
Observations	46,736	46,736	46,736	46,736
R ²	0.2656	0.2580	0.2657	0.2581

Notes: All specifications include a constant. Coefficients are reported with robust standard errors in parenthesis, which are clustered by worker. ***, **, and * indicate significance at the 1, 5, and 10 percent levels. A 'big city' is defined as a Core Based Statistical Area (CBSA) with population greater than 2,000,000 in 2010. Worker fixed-effect computation follows De la Roca and Puga (2017).

tively, interactions between both experience types and the self-confidence measure. If anything, the small negative point estimate for the interaction between big-city experience and self-confidence suggests more overconfident workers (higher self-confidence for given ability) may benefit less from big cities, but the coefficient is not statistically significant.

One may also worry that the empirical relationship between self-confidence and living in a big city upon completing education could be driven by other personality traits correlated with

self-confidence.⁹ Since NLSY79 respondents were not administered a personality test, we turn to a related data set, NLSY79 Children and Young Adults, which surveys all offspring of NLSY79 female respondents. As part of this survey, young adults were administered the Ten Item Personality Inventory test, measuring the big-five personality traits: extraversion, agreeableness, conscientiousness, neuroticism and openness. In addition, they were also subjected to the same Rosenberg test measuring self-confidence in our main sample and various cognitive ability tests, specifically the Peabody International Achievement Test for math, reading recognition and reading comprehension. Since this data set follows offspring of women in our main sample, respondents are much younger, so we can only examine the determinants of location upon completing education. When we replicate column (1) of table 1, with and without the big-five personality traits as controls, we find that the effect of self-confidence is significant and slightly larger in magnitude than in table 1, and that the effects of cognitive ability measures are still not significant. More important, the coefficient of self-confidence remains significant and unchanged after controlling for the big-five personality traits.¹⁰

6. Conclusions

Bigger cities offer more valuable experience and opportunities in exchange for higher housing costs. While higher-ability workers benefit more from bigger cities, they are not more likely to move to one. Our model of urban sorting by workers with heterogeneous self-confidence and ability suggests flawed self-assessment is partly to blame. Workers who misjudge their ability at an early career stage make location decisions they would not have made had they known their actual ability. By the time they learn enough about their actual ability, those early decisions have had a lasting impact, reducing their incentives to move and affecting their lifetime earnings.

Analysis of NLSY79 data shows that, in line with our model predictions, the location choices of young workers are guided by self-confidence rather than ability. Thus, some overconfident young workers start their career in a big city, while they would have chosen a small city with better self-assessment. That initial misjudged decision then becomes self-validating: having incurred an excessive cost to gain more valuable experience, they find they might at least take advantage of this by remaining in the big city. Analogously, some underconfident young workers end up spending their whole life in a small city, even though a correct initial ability assessment would have made them self-select into a big city instead. Workers who severely underestimate their ability may nevertheless relocate from a small to a big city, once labour market experience provides them with better information about their true capabilities. Young workers who are confident enough of their abilities locate in bigger cities to pursue their dreams, but those dreams do not come true for everyone.

⁹For example, high self-confidence tends to be positively related to extraversion (Robins, Tracy, Trzesniewski, Potter, and Gosling, 2001) and extravert individuals may be more likely to choose dense locations (Francis and Rutledge, 2004, Jones *et al.*, 2013, suggest this based on data for doctors and clergy).

¹⁰Results are available in an online appendix.

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