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The labor market effects of immigration on natives: Evidence from Hong Kong☆

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ABSTRACT

The local labor market in Hong Kong is characterized with two distinct features: the limited geographical mobility of native workers and their ethnic homogeneity to immigrants. Both of these features may exert a greater labor market pressure on native workers to immigrant inflows in Hong Kong compared to other local markets. Moreover, over the past three decades, new immigrants in Hong Kong are disproportionately less educated youths from Mainland China who are admitted through the one-way permit scheme for family reunion. In this paper, we introduce an immigrant exposure measure capturing the extent of exposure of natives in a given skill group to immigrants in terms of occupational competition, and identify the effects of immigration on natives' employment and earnings by relating the changes in natives' employment and earnings across skill groups to their changes in the immigrant exposure measure. To address the potentially endogenous responses of workers to occupational demand shocks, we further construct the projected immigrant exposure measure applying the lagged skill-group specific occupational employment structure to the contemporary skill distribution and employ it as a Bartik-style instrument. We find that competition from immigrants reduces the employment prospect of native females but not that of native males. However, for native males competition from immigrants yields significant adverse earnings effects, whereas for native females such earnings effects – though still negative – are smaller in magnitude and less often statistically significant.

1. Introduction

The effects of immigration on the labor market outcomes of an economy have long been a controversial issue among policy makers and academics. The early strand of literature on the labor market impact of immigration uses differences in either the geographical or occupational dispersions of immigrants to identify the impact of immigration on natives. Card (1990) and Friedberg (2001) are two notable examples of this literature.[1] Using the Mariel Boatlift as a natural experiment for a sudden and unexpected immigrant influx, Card (1990) finds no discernible effect on wages and unemployment rates in the Miami labor market. Using information on immigrants' former occupations abroad, Friedberg (2001) conducts an occupation-level analysis of the effect of the massive migration from the former Soviet Union on the Israeli labor market and also find no adverse effect of Russian immigrants on

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[1] Other examples include Altonji and Card (1991), Butcher and Card (1991), and Orrenius and Zavodny (2007).

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the wages and unemployment of Israeli natives. While studies in this strand of literature generally tend to find a negligible or very weak spatial or occupational correlation between immigrant inflows and native wages, some limitations of the spatial or occupation approach may prevent measuring the labor market impact of immigration effectively. First, areas and occupations with better economic performances are likely to attract more immigrants to settle in, yielding a spurious positive correlation between wage levels and immigrant inflows. Second, natives may move across localities or occupations in response to a large inflow of immigrants until wages are equalized, net of moving costs.[2] Both problems may attenuate the adverse correlations (if any) between native wages and immigrant inflows across localities or occupations.

To mitigate the potential problems of the endogenous spatial/occupational selections and the factor price equalization, a skill group approach is developed to examine the correlation between native wages and the penetration of immigrants on the dimension of skills, which are usually defined by educational attainment and work experience (e.g., Borjas, 2003, Section IV; Steinhardt, 2011). On the one hand, measuring native labor market outcomes along the skill dimension has the advantage over the occupation or spatial approach as it is far more difficult for workers to change their skills than occupations or residences. On the other hand, relating the labor market outcomes of natives in a skill group solely to the share of immigrants with the same educational attainment and work experience implicitly assumes the non-existence of substitution between immigrants and natives pertaining to different skill groups, which is likely to be an overly restrictive assumption especially if one takes into account the *skill downgrading*[3] of immigrant workers in the host economy (Dustmann, Fabbri, & Preston, 2013). In viewing the limitations of the conventional skill group approach, the nested-CES approach is developed allowing for imperfect substitutability between workers of different skill groups in the aggregate production function (e.g., Borjas, 2003, Section VII; Aydemir & Borjas, 2007; Borjas & Katz, 2007; Peri, 2011). While this nested-CES approach provides a structural interpretation of the native labor market responses to immigrant shocks through cross-group substitutions, this merit also comes at the cost of imposing restrictions on the form of labor aggregation and cross-group elasticities of substitutions.[4]

In this paper, we propose an alternative skill group approach to study the impact of immigration on native wages that tackles the existence of cross-skill group substitutions using occupational competition instead of the functional form restrictions imposed in the nested-CES approach. In an earlier paper, Altonji and Card (1991) evaluate the effect of immigration on a native group – defined by race and gender in their context – by the average proportional increase in the labor supply experienced by this native group through industry displacement.[5] Following the same spirit as Altonji and Card (1991) but focusing instead on occupational competition, we construct an *immigrant exposure* measure that evaluates the average level of exposure of native workers in a skill group to immigrants as the weighted average of the proportional increase in labor supply due to immigration across all the occupations in which natives in this skill group are employed. Unlike the immigrant ratio used in the conventional skill group approach, which only considers the displacement effect of immigrants from the same skill group, this immigrant exposure measure takes into account competition from immigrants in all skill groups. Besides the overall proportional size of immigrants to natives, this immigrant exposure measure also depends on the overlap of the occupational distribution of a native skill group with that of immigrants. We then identify the effect of immigration on native wages by relating the differences in the changes in native wages across skill groups to their differences in the changes in the immigrant exposures.[6] To further account for the potentially endogenous shifts in the occupational employment structure of both native skill groups and immigrants, we employ a Bartik-style instrument using the projected immigrant exposure measure constructed by applying the lagged skill-group specific occupational employment structure to the contemporary skill distribution for both natives and immigrants.

On the empirical front, we apply the proposed empirical strategy to study the effect of massive immigrant influx on native employment and wages in Hong Kong. One explanation for the lack of an inverse relationship between native labor market outcomes and immigrant inflows is the geographical mobility of native workers (Borjas, Freeman, Katz, DiNardo, & Abowd, 1997). Compared to other local labor markets, the outflow of native workers in Hong Kong is far more limited because of the “one country, two systems” policy. Moreover, the vast majority of immigrants in Hong Kong are Mainland Chinese who share the same ethnicity, culture, and language with local natives, which make immigrants closer substitutes to their native counterparts compared to elsewhere. The limited geographical mobility of native workers together with their ethnic, cultural, and linguistic homogeneity with immigrants thus renders Hong Kong a distinct setting to examine whether immigrant inflows exert effective supply-side pressure to the local labor market. Pooling four waves of Hong Kong Census micro data from 1996 to 2011, we show that competition from Mainland immigrants adversely affects the employment prospect of native females but not that of native males. Moreover, we find that an increase in the number of Mainland immigrants amounting to 1% increase in the effective labor supply of male native workers depresses their earnings by approximately 0.48–0.70%. Compared to those found in the conventional skill group studies, e.g., 0.3–0.4 in Borjas (2003), our estimates of the earnings effects for male native workers are larger in magnitude, which could be attributable to

[2] Kenna and Walker (2011) show that interstate migration decisions in the US are influenced to a substantial extent by income prospects. While they estimate that an average worker faces a very high moving cost (over US$300,000), the average cost of moves that are actually made is substantially lower after taking into account worker heterogeneity.

[3] That is, immigrants have to acquire more education or job market experience than natives in order to be employed in certain occupations.

[4] In addition, researchers usually have only very few observations to use for estimating the elasticity at the highest level of the labor aggregator in the nested-CES approach.

[5] That is, the weighted average proportional increase in labor supply across the industries in which this native group is employed with the weight for each industry equaling to the share of the native group employed in this industry.

[6] This empirical strategy is analogous to a recent a recent study on the impact of international trade on US labor market (Autor, Dorn, & Hanson, 2013), which relates the changes in the labor-market outcomes across US local labor markets to changes in exposure to import competition as the result of regional variation in the importance of different manufacturing industries for local employment.

both our use of a more direct measure of immigrant displacement through occupational competition as well as the aforementioned distinct features of local labor market in Hong Kong. For female native workers, our estimated earnings effects, though always negative, are smaller in magnitude (ranging between − 0.01 and − 0.25) and sometimes statistically insignificant. However, compared to those for males, the estimated earnings effects for females should be interpreted more cautiously as the composition of female native wage workers has also been affected by competition from immigrants.

The remainder of the paper is organized as follows. Section 2 summarizes Hong Kong's immigration policy and some previous studies on the impact of immigration on the local labor market in Hong Kong. Section 3 describes the micro-level census data sets of Hong Kong. Sections 4 and 5 introduce the concept of immigrant exposure and the empirical framework, respectively. Section 6 presents the empirical results and Section 7 concludes.

2. Mainland immigrants to Hong Kong

Hong Kong is a society of immigrants. Historically, all Mainland entrants were admitted and granted residency, regardless of whether they entered legally or not. As an attempt to halt the flooding of immigrants from Mainland China during the Cultural Revolution (1966–1976), the Hong Kong Government enacted in November 1974 the “Touch Base Policy.” Under this new rule, illegal immigrants who evaded capture and reached the urban area were allowed to stay, while those caught in the so called “frontier closed area” near the border would be repatriated. However, the Touch Base Policy still failed to the halt the influx of illegal immigrants from Mainland China and was abolished by the Hong Kong Government in October 1980. In the meantime, the one-way permit (OWP) scheme was introduced for admissions of separated spouses (mostly wives) and children of Hong Kong permanent residents. The OWP quota was first set at 75 per day in 1983, and was then increased to 105 in 1993 and further to 150 in 1995, and remained unchanged thereafter. According to the Census and Statistics Department (2007, 2012), over 780,000 Mainland immigrants entered Hong Kong as OWP holders between 1996 and 2011, amounting for over 11.1% of Hong Kong's population in 2011. Of them, 69.4% are females because of the dominance of the cross-boundary marriages between Hong Kong males and Mainland females. Also as a result of the gender asymmetry in the cross-boundary marriages, child and adolescent entrants admitted before age 19 account for nearly two-thirds of male OWP entrants (64.0%) but only slightly more than a quarter of female OWP entrants (27.0%), for whom the 25–34 year olds are the largest age group (38.3%).

The massive inflow of Mainland immigrants to Hong Kong has been subject of a number of previous studies. In a closely related paper, Suen (2000) employs a nested-CES model to study the effect of immigration by disaggregating labors by age and nativity groups.[7] He finds only very small wage effects of new immigrants on natives and older immigrants who have resided in HK for ten or more years, although the estimated effect is somewhat greater on more recent immigrants. Three other papers have studied the determinants and the changes in the native-immigrant earnings gaps in Hong Kong. Liu, Zhang, and Chong (2004) decompose the mean native-immigrant earnings gap in 1996 into the inter- and intra-occupational components, and find the latter to be slightly more important than the former. Lam and Liu (2002) document a substantial widening of the native-immigrant earnings gap between 1981 and 1991 and attribute it mainly to the divergence between skill prices for immigrants' education and for natives' education. They reason that due to the deindustrialization in Hong Kong in the 1980s, the price of the skills that Mainland immigrants acquired in their home towns were less valuable in the high value-added services in Hong Kong. Applying the same methodology of Lam and Liu (2002), Liu, Lam, and Shui (2016) find the native-immigrant earnings gap grew further during 1991–2001 but began to narrow during 2001–2011. They attribute the improvement in the immigrants' relative earnings position in the second period to a larger increase in their rates of return to schooling than the natives.

3. Data description

The data set used in this study comes the micro data of four waves of Hong Kong Population Censuses/Bi-censuses 1996, 2001, 2006, and 2011.[8] The micro data of each census/bi-census is a 5% random sample of the population, forming a consistent set of data in terms of the definitions of variables relevant to this study. Given the study's focus on the labor market effects of new immigrant inflows on natives and the predominance of immigrants coming from Mainland China, we restrict our attention only to individuals between ages 20 and 64 who were either born in Hong Kong (the native sample) or born in Mainland China and have resided in Hong Kong for less than 20 years (the immigrant sample).[9]

We use the employment status and earnings as two main measures of labor market outcomes. An individual is defined as employed if his/her economic activity status is coded as employee, employer, or self-employed.[10] Since the data set contains no information on working hours, which renders the calculation of hourly wage impossible, we use monthly income from main employment as the earnings measure. We construct separate measures of immigrant exposure and conduct separate empirical analyses for male natives and female natives. Because females are more likely to engage in part-time work than males, it is important to note

[7] The ten age groups are the five-year age cohorts from 15–19 to 60–64. The four nativity groups are natives, Chinese immigrants having stayed in HK for at least 10 years, Chinese immigrants having stayed in HK for 5 to 9 years, and Chinese immigrants having stayed in HK for less than 5 years.

[8] The census data in year 1991 are only used for constructing instrumental variables.

[9] In the Census/Bi-census micro data, the duration of residence in Hong Kong is censored at 20 years, i.e., coded as “20 + years” for those who have resided in Hong Kong for 20 or more years. We exclude individuals who were born in Mainland China but have resided in Hong Kong for 20 or more years because they should have almost fully assimilated into the local labor market.

[10] Here self-employed also includes unpaid family workers.

Table 1
Summary Statistics.

	Natives		Immigrants	
	Males	Females	Males	Females
	(1)	(2)	(3)	(4)
Panel A. Sample size				
A1. All sample	271,979	264,138	36,674	72,312
A2. Non-student sample	248,691	240,032	33,383	68,434
A3. Employed sample	214,579	157,328	28,119	35,211
Employment ratio (A3/A2)	0.863	0.655	0.842	0.515
A4. Employee sample	164,881	142,377	21,105	31,315
Panel B. Summary statistics of the employee sample				
Real earnings from main employment (HK$/month)	18,171	15,339	11,773	8000
Age	37.7	36.3	36.2	39.1
Educational attainment				
Primary & lower secondary education	31.1%	21.4%	48.1%	58.1%
Upper secondary education	34.2%	41.8%	26.4%	23.5%
Matriculation & post-secondary education	14.8%	16.3%	12.0%	10.7%
University graduates and postgraduates	19.9%	20.6%	13.5%	7.9%

that the estimated employment/earnings effects of immigration for female natives should be interpreted with more caution.

All individuals in our sample are disaggregated according to their highest level of education completed into four education groups: primary and lower secondary education, upper secondary education, matriculation and post-secondary education, and university and postgraduate education. Each education group is assigned a normal age of entry into the labor market: 15 for primary and lower secondary education, 17 for upper secondary education, 20 for matriculation and post-secondary education, and 22 for university and postgraduate education. For each individual, the potential years of work experience is calculated by subtracting the normal age of labor market entry corresponding to his/her education category from current age. The eight 5-year (potential) work experience cohorts range from 0–5 years to 31–35 years, along with the cohort associated with 36 + years of experience. A skill group in our study is a group of individuals of the same education attainment and work experience. For each gender and nativity, the four education groups and eight work experience groups defined above are used to allocate workers to 32 skill groups for each census year. After reconciling minor differences in the definition across census years, workers are assigned to four broad occupational categories (i.e., professionals, associate professionals, service and sales workers, and laborers) and 28 detailed occupations defined in Appendix Table A1.

Panel A of Table 1 shows four different sample definitions and for each definition reports the sample size of the pooled 1996–2011 data by immigration status and gender. Columns 1–2 report the statistics for natives. The overall sample (row 1) contains 271,979 males and 264,138 females and has a balanced sex ratio of 103 men per 100 women. The non-student sample (row 2) excludes approximately 9.0% individuals who were still in school and is used to examine the employment effect. The employed sample (row 3) further excludes unemployed job seekers and economically inactive population. A comparison of the sizes of the employed sample and the non-student sample indicates an employment ratio of 0.863 for males and 0.655 for females. Further excluding employers and self-employed from the employed sample leaves the employee sample (row 4) used to investigate the earnings outcome. Columns 3–4 report the same statistics for immigrants. It is worth noting two salient differences of the immigrant sample compared to the native sample. First, because of the dominance of Hong Kong bridegrooms marrying Mainland brides in the cross-boundary marriages, the sex ratio of the immigrant sample is very unbalanced: 50.7 men per 100 women. Second, female immigrants are much less likely to be employed compared to their native counterparts (0.515 vs. 0.655), although the employment ratios are very similar between male immigrants and male natives (0.842 vs. 0.863).

Panel B of Table 1 further reports the summary statistics on monthly earnings (in 1996 constant value), age, and educational attainment for the employee sample, also by immigration status and gender. An average male native worker is 37.7 years of age and has monthly earnings of HK$ 18,200; an average male immigrant worker is 1.4 years younger but earns one third less (HK$ 11,800 per month). An average female native worker is 36.3 years of age and earns HK$ 15,400 per month, whereas the immigrant counterpart is 2.9 years older and earns almost only half (HK $8000 per month). Part of the large observed native-immigrant earnings gaps can be explained by their differences in educational attainments. For example, among immigrant workers 48% of males and 58% females had their highest educational attainment below lower secondary school; in contrast among native workers only 31% males and 21% females had their highest educational attainment below lower secondary school.

4. Measuring immigrant exposure

4.1. Skill group-level immigrant ratio

A conventional way of measuring the extent of a native worker's exposure to immigrant labor supply is to employ the ratio of the number of immigrant workers to the number of native workers in his/her occupation (e.g., Friedberg, 2001). However, whether this occupation-specific ratio is indeed a valid measure of immigrant exposure depends crucially on native workers' occupational mobility. Studies using the occupation-specific immigrant ratio make a strong assumption that the adjustment costs of moving from one occupation to another always dominate the immigration-induced changes in inter-occupational wage differentials. Although for an average worker such adjustment costs can indeed be high enough to prevent an occupational change (e.g., Artuc, Chaudhuri, & McLaren, 2010)[11], the assumption of zero occupational mobility is violated as long as there exist some marginal workers for whom the adjustment costs are lower than the immigration-induced changes in inter-occupational wage differentials.

For concern over the occupational mobility of native workers, researchers (e.g., Borjas, 2003; Steinhardt, 2011) have resorted to measure the size of the immigrant labor supply at the skill group level defined upon more exogenous personal characteristics such as educational attainment and work experience (or age) since it is more difficult for native workers to switch between skill groups than occupations. Let j denote a skill-group index, which ranges from 1 to 32 in our baseline specification with 4 education groups and 8 experience groups. Let g denote gender, which equals 1 for males and 2 for females, and t index census year. Then, the immigrant ratio faced by native workers of skill group j and gender group g in census year t (r_{jgt}) can be defined as follows:

$$r_{jgt} = \frac{M_{jt}}{N_{jgt}}, \tag{1}$$

where M_{jt} is the number of immigrant workers (both males and females) from skill group j in census year t, and N_{jgt} is the number of native workers from skill group j and gender group g in census year t.

The 1996–2011 period witnessed a decline in the overall immigrant ratio in part because of the abolishment of the Touch Base Policy had halted the influx of illegal immigrants from Mainland China. Specifically, during this 15-year period, the average immigrant ratio declined from 0.401 to 0.308 for male native workers and from 0.523 to 0.334 for female native workers. As the overall intertemporal change in the immigrant ratio is accounted for in the census year fixed effect included in all our empirical specifications, in Fig. 1 we plot the relative immigrant ratio of each native skill and gender group in 1996 and 2011 after normalizing the average for each gender in each census year to be zero. In 1996, old native workers generally have a higher immigrant ratio than young native workers given educational attainment and gender. However, the pattern is reversed in 2011 when young native workers usually face a higher immigrant ratio than their elderly counterparts having the same educational attainment and gender. In terms of intertemporal changes, for every subpanel in Fig. 1 defined by educational attainment and gender, the relative immigrant ratio increased for young native workers and decreased for old native workers. Moreover, among young native workers, the rises in the relative immigrant ratio are most salient for those with the lowest educational attainment (i.e., lower secondary education or below), followed by those with the second lowest educational attainment (i.e., upper secondary education). An important reason underlying this observed pattern is that young immigrants admitted to Hong Kong through the OWP scheme as either spouses or dependents are generally less educated than their native counterparts, leading to disproportionate increases of the unskilled young labor force.

4.2. Skill group-level immigrant exposure

Notwithstanding the improvement over the occupation-level immigration ratio, the skill group-level immigrant ratio still cannot effectively measure the immigrant supply shock faced by natives if there exist cross-group substitution effects, i.e., the labor market outcomes of natives in a skill group are affected by the immigrant supply of other skill groups. In view of this problem, we borrow the insights from Altonji and Card (1991) to construct an *immigrant exposure* measure evaluating the level of exposure of native workers in a skill group to all immigrants (from both the same and other skill groups) through occupational competition. Let us first define an occupational-level immigrant ratio analogous to the skill group-level immigrant ratio defined in Eq. (1):

$$r_g t^k = (M_t^k)/(N_g t^k), \tag{2}$$

where $r_{gt}{}^k$ is the immigrant ratio of native workers of gender group g in occupation k in census year t, M_t^k is the number of immigrant workers (both males and females) employed in occupation k in census year t, and $N_{gt}{}^k$ is the number of native workers of gender group g employed in occupation k in census year t. Next, define occupation k's employment share among natives of skill group j and gender group g in census year t ($w_{jgt}{}^k$) as follows:

$$w_j g t^k = (N_j g t^k)/N_j g t, \tag{3}$$

[11] Considering the inter-sectoral labor adjustment, Artuc et al. (2010) estimate the cost of switching from one aggregated sector to another to be as high as several times average annual wages for an average worker, and in the meantime also show that there exists substantial worker heterogeneity in this cost along both the observed and unobserved dimensions. In a somewhat related paper considering interstate migration decisions in the US driven by income prospects, Kenna and Walker (2011) also show that although an average worker faces a very high moving cost (over US$300,000), the average cost of moves that are actually made is substantially lower after taking into account worker heterogeneity.

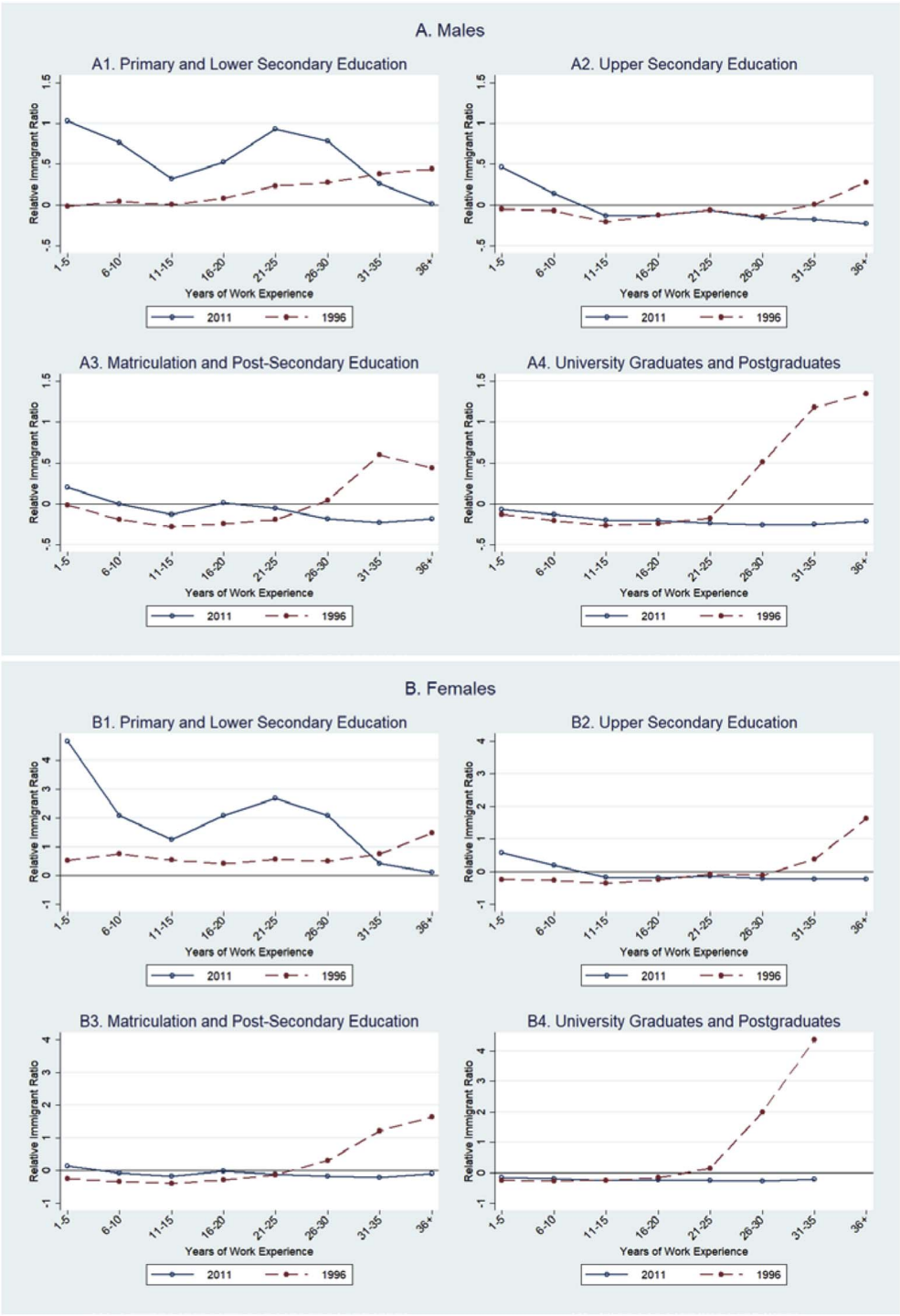

Fig. 1. Relative immigrant ratios, 1996 and 2011.

Notes: Each subpanel plots the relative immigrant ratios of a certain educational attainment and gender group by years of experience after normalizing the average immigrant ratio for each gender in each census year to be zero. Subpanel B4 does not show the immigrant ratio for female natives with university education and 36 + years of experience, for which there are less than 10 observations in 1996 and the ratios exceed the maximum scale displayed in the vertical axis.

where $N_{jgt}{}^{k}$ is the number of native workers from skill group j and gender group g employed in occupation k in census year t and N_{jgt} is the number of native workers from skill group j and gender group g in census year t defined previously. Then, the immigrant exposure of natives of skill group j and gender group g is the weighted average of the occupation-specific immigrant ratios with the weight for each occupation equal to its employment share in this native skill and gender group, i.e.,

$$IE_{jgt} = \sum_k w_{jgt}^k r_{gt}^k = \sum_k \frac{N_{jgt}^k}{N_{jgt}} \frac{M_t^k}{N_{gt}^k}. \tag{4}$$

While both defined at the skill group level, this immigrant exposure variable captures not only the within- group but also the cross-group substitution effects of immigrants, and thus more effectively measure the labor supply pressure faced by native workers compared to the immigrant ratio variable. A few remarks may help to understand the relationships between the two measures. First, pooling all skill groups together, the overall immigrant exposure and the overall immigrant ratio are identical, both equal to the number of immigrant workers divided by the number of native workers. Second, cross-group variations are smaller for the immigrant exposure than the immigrant ratio because allowing for cross-group substitution redistributes and equalizes immigrant labor supply shocks. Taking male native workers in 2011 as an example, the variance of the immigrant exposure (0.013) is only one-sixth of that of the immigrant ratio (0.079). Third, if a skill group is more/less concentrated in occupations with larger immigrant ratios, the immigrant exposure of this skill group would be larger/smaller than the overall immigrant ratio, and vice versa. In particular, if a skill group has the same occupational distribution as the entire native workforce, then its immigrant exposure would be the same as the overall immigrant ratio.

Fig. 2 plots the relative immigrant exposure of each native skill and gender group in 1996 and 2011, also normalized to have a zero mean for each gender in each census year. Note that the patterns of the plots in Fig. 2 do not always coincide with those in Fig. 1, suggesting that for some cases the two measures yield qualitatively different conclusions on the extent of immigrant competition faced by natives. Take male native workers in 1996 with the lowest educational attainment and no more than 15 years of experience as an example: subpanel A1 of Fig. 1 shows relative immigrant ratios very close to zero, indicating that they only face an average degree of competition from immigrants; however, the relative immigrant exposures in subpanel A1 of Fig. 2 are all positive and substantial in magnitude, suggesting that they face much higher than average degrees of competition from immigrants. The contradictory results of the two measures for least-educated, young native workers could be attributable to the occupational competition coming from immigrants with higher educational attainments, which is accounted for only in the immigrant exposure but not in the immigrant ratio. A most obvious pattern in Fig. 2 applying to both 1996 and 2011 is that given experience and gender, immigrant exposures decline almost monotonically with educational attainment, showing that lower-educated native workers are always exposed to more competition from immigrants than their more-educated counterparts. Another general pattern is that in seven out of eight subpanels in Fig. 2,[12] immigrant exposures generally decline with experience in 2011, indicating more severe immigrant competition faced by younger native workers than older ones. These two general patterns taken together suggests that among Hong Kong's native workforce in 2011, less-educated young workers are the ones who are most affected by competition from immigrants.

5. Empirical strategy

5.1. The immigrant ratio approach

Following the conventional skill group approach, we first employ a fixed-effect estimation of the relationship between the native labor market outcome and the immigrant ratio across skill groups over our study period as follows:

$$y_{jgt} = \beta_{1g} r_{jgt} + \pi_{1jg} + \delta_{1gt} + \varepsilon_{1jgt}, \tag{5}$$

where y_{jgt} is a labor market outcome measure (i.e., employment rate or log real monthly earnings) of natives of skill group j and gender group g in census year t, π_{1jg} is the gender-specific skill group fixed effect absorbing the time-invariant factors specific to skill group j and gender group g, δ_{1gt} is the gender-specific census year fixed effect accounting for the underlying time trends and business cycle fluctuations common to all natives of gender group g in census year t, and ε_{1jgt} is a stochastic error term. Since the skill group level immigrant ratios used are gender specific, Eq. (5) is estimated separately for males and females.

5.2. The immigrant exposure approach

As mentioned, the immigrant ratio measures used in Eq. (5) ignore the cross-skill group substitutions through which the labor market outcomes of natives in a skill group can be affected by immigrants in other skill groups. We therefore replace the conventional immigrant ratio in Eq. (5) with the immigrant exposure and estimate the following equation:

$$y_{jgt} = \beta_{2g} IE_{jgt} + \pi_{2jg} + \delta_{2gt} + \varepsilon_{2jgt} \tag{6}$$

A challenge to the identification of the impact of immigrants on native employment or earnings is that occupational choices of both immigrants and natives are endogenous to occupation-level demand shocks, which could potentially result in some spurious correlation between changes in the immigrant exposure and changes in employment or earnings of native workers across skill

[12] The only exception is subpanel B1 of Fig. 2 for female native workers with lower secondary education or below, in which immigrant exposures exhibit no systematic relationship to experience.

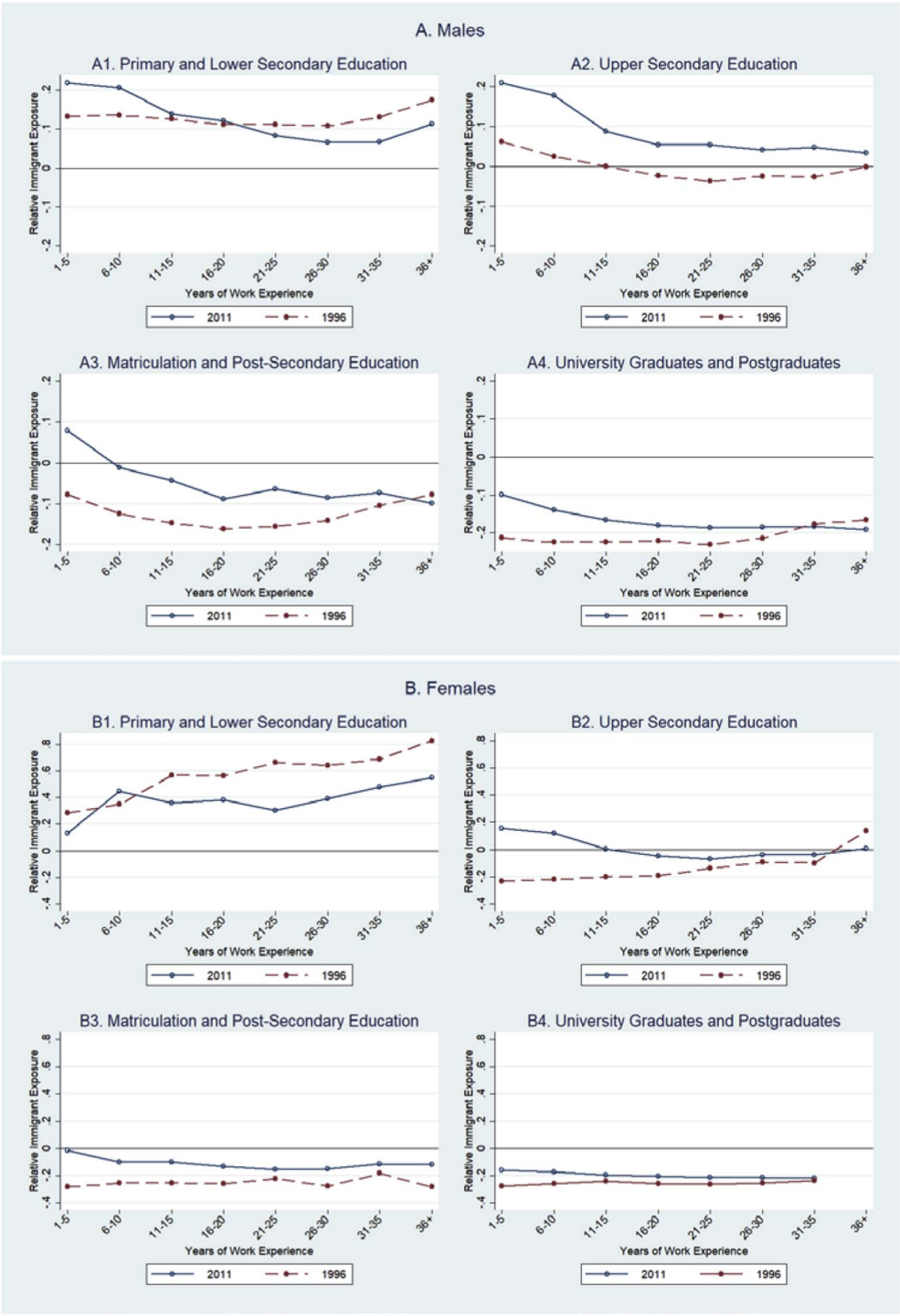

Fig. 2. Relative immigrant exposures, 1996 and 2011.

Notes: Each subpanel plots the relative immigrant exposures of a certain educational attainment and gender group by years of experience after normalizing the average immigrant ratio for each gender in each census year to be zero. Subpanel B4 does not show the immigrant exposures for female natives with university education and 36 + years of experience, for which there are less than 10 observations in 1996 and the measures exceed the maximum scale displayed in the vertical axis.

Table 2
OLS estimations of baseline group-level regressions.

	Males		Females	
	Employment ratio	Mean log earnings	Employment ratio	Mean log earnings
	(1)	(2)	(3)	(4)
Panel A. Immigrant ratio approach				
Immigrant ratio	− 0.086***	− 0.109	− 0.020	− 0.006
	(0.022)	(0.075)	(0.016)	(0.036)
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
Number of observations	128	128	128	128
Panel B. Immigrant exposure approach				
Immigrant exposure	− 0.109	− 1.100***	− 0.217***	− 0.350***
	(0.180)	(0.226)	(0.036)	(0.043)
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
Number of observations	128	128	128	128

Notes: In this table, the 128 skill groups for each gender are defined by broad education category (4) × experience group (8) × census year (4). For each gender-specific skill group, the employment ratio is calculated using all non-students, whereas the mean log real earnings are the average log real monthly earnings in 1996 constant dollars calculated using employees only. The odd columns use the total number of non-students in each gender-specific skill group as the regression weight, and the even columns use the total number of employees in each gender-specific skill group as the regression weight. Standard errors in parentheses are clustered at the broad education category × experience group level.
*Significant at 10%, **significant at 5%, ***significant at 1%.

groups.[13] In view of this potential problem, we construct a projected immigrant exposure measure by applying the lagged gender and skill group specific occupational employment structure to the contemporary skill distribution for both natives and immigrants, and then use this projected immigrant exposure as a Bartik-style instrument for the observed immigrant exposure. Specifically, the projected immigrant exposure of native workers in skill group j and gender group g in census year t is calculated as follows:

$$\widehat{IE}_{jgt} = \sum_k w^k_{jgt-1}\hat{r}^k_{gt} = \sum_k \frac{N^k_{jgt-1}}{N_{jgt-1}}\frac{\widehat{M}^k_t}{\widehat{N}^k_{gt}}, \tag{7}$$

where $w^k_{jgt-1} = \frac{N^k_{jgt-1}}{N_{jgt-1}}$, occupation k's employment share among natives of skill group j and gender group g in census year t-1; $\widehat{M}^k_t = \sum_s \frac{M^k_{st-1}}{M_{st-1}}M_{st}$, the predicted number of immigrant workers (both males and females) employed in occupation k in census year t when the lagged skill group specific employment share of occupational k for immigrant workers ($\frac{M^k_{st-1}}{M_{st-1}}$) is applied to the contemporary size distribution of immigrant workers across skill groups (M_{st}); $\widehat{N}^k_{gt} = \sum_s \frac{N^k_{sgt-1}}{N_{sgt-1}}N_{sgt}$, the predicted number of native workers of gender group g employed in occupation k in census year t when the lagged gender and skill group specific employment share of occupational k for native workers ($\frac{N^k_{sgt-1}}{N_{sgt-1}}$) is applied to the contemporary size distribution of native workers of gender group g across skill groups (N_{sgt}); and $\hat{r}^k_{gt}$ is the ratio of $\widehat{M}^k_t$ to $\widehat{N}^k_{gt}$.

Note that in the formula for computing the skill group level predicted immigrant ratio, all skill groups employ the same predicted occupational level immigrant ratio ($\hat{r}^k_{gt}$) but differ only in their initial occupational employment structure ($w_{jgt-1}{}^k$). As a result, the exogeneity of the Bartik-style instrument constructed in Eq. (7) hinges on the assumption that except for the immigrant exposure, other time-varying, skill group specific determinants of native workers' labor market outcomes are uncorrelated with the skill group's lagged occupational employment structure. Thus, a potential threat to identification is that the unobserved time-varying determinants of native workers' labor market outcomes may happen to be correlated with a skill group's initial occupational employment structure, e.g., the skill groups initially specializing more in professional jobs receive more favorable demand shocks than the skill groups initially concentrating more in laborer jobs. To address this concern, we further include in Eq. (6) the respective initial employment share of three out of four broadly defined occupations (i.e., professionals, associate professionals, and service and sales workers) among native workers in a skill group to capture the initial differences in occupational employment structure across skill groups and allow such differences to be correlated with differences in time-varying, skill group specific determinants of native workers' labor market outcomes.

[13] Imagine that natives in skill group j are disproportionately employed in occupation k which experience a positive demand (wage) shock. The average earnings of natives in skill group j will also increase more rapidly due to the overrepresentation of workers employed in occupation k in this skill group. However, the immigrant exposure measure of this skill group could either increase or decrease depending on whether immigrants are more or less responsive to occupation-level demand shocks than natives. In the former case, a spurious positive correlation will arise between the immigration exposure and the average earnings in this skill group, whereas in the latter case a spurious negative correlation will emerge.

Table 3
Baseline group-level IV estimations.

	Males		Females	
	Employment ratio	Mean log earnings	Employment ratio	Mean log earnings
	(1)	(2)	(3)	(4)
Panel A. w/o initial occupational employment structure controls				
Immigrant exposure	0.143	− 0.699***	− 0.170***	− 0.251***
	(0.235)	(0.216)	(0.033)	(0.044)
Initial occupational employment structure controls	No	No	No	No
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
First-stage regression results:				
Projected immigrant exposure	0.683***	0.679***	0.832***	0.841***
	(0.089)	(0.085)	(0.085)	(0.075)
First-stage F-statistics	59.27	63.92	96.04	124.03
Number of observations	128	128	128	128
Panel B. w/ initial occupational employment structure controls				
Immigrant exposure	− 0.084	− 0.476***	− 0.155***	− 0.009
	(0.205)	(0.250)	(0.053)	(0.119)
Lagged occupational employment structure controls	Yes	Yes	Yes	Yes
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
First-stage regression results:				
Projected immigrant exposure	0.678***	0.681***	0.756***	0.741***
	(0.094)	(0.090)	(0.134)	(0.121)
First-stage F-statistics	51.83	56.68	32.00	37.62
Number of observations	128	128	128	128

Notes: In this table, the 128 skill groups for each gender are defined by broad education category (4) × experience group (8) × census year (4). For each gender-specific skill group, the employment ratio is calculated using all non-students, whereas the mean log real earnings are the average log real monthly earnings in 1996 constant dollars calculated using employees only. The odd columns use the total number of non-students in each gender-specific skill group as the regression weight, and the even columns use the total number of employees in each gender-specific skill group as the regression weight. In all regressions, the projected immigrant exposure of a gender and skill group in the census year is used as an instrument for the observed immigrant exposure. Standard errors in parentheses are clustered at the broad education category × experience group level.
*Significant at 10%, ** significant at 5%, *** significant at 1%.

6. Empirical results

6.1. The OLS estimations

In Panel A of Table 2, we use the skill group-level immigrant ratio to measure the extent of immigrant competition and estimate the conventional skill group-level specification in Eq. (5). Separate analyses are conducted for native males (columns 1–2) and native females (columns 3–4). The dependent variable is the employment ratio among non-students for each native skill group in the odd columns and the average logarithm of real earnings among employees for each native skill group in the even columns. All regressions include skill group and census year fixed effects. The coefficient on the immigrant ratio is negative in all regressions, showing that changes in the immigrant ratio are always negatively correlated with changes in the employment or earnings across native skill groups. However, three out of the four coefficients are statistically insignificant, suggesting that the relative size of immigrants from the same skill group may not be a very powerful measure of the overall competition from immigrants due to the omission of competition from immigrants of other skill groups in this measure.

To address the limitation of the immigrant ratio measure, in Panel B of Table 2 we replace it with the immigrant exposure measure and estimate the skill group-level specification in Eq. (6). Except for the insignificant coefficient for the employment regression for native males (column 1), the coefficient on the immigrant exposure measure of all other regressions is negative and significant at the 1% level. These point estimates suggest that an increase in Mainland immigrants amounting to 1% of native workers would depress the earnings of native male workers and native female workers by 1.10% and 0.35%, respectively, and reduce the employment ratio of native females by 0.22 percentage points.

6.2. The IV estimations

For concern over the spurious correlation between changes in the immigrant exposure and changes in the labor market outcomes across native skill groups that may arise from the endogenous occupational choices of both immigrants and natives, in Panel A of Table 3 we carry out the IV estimations of Eq. (6) employing the projected immigrant exposure constructed using the lagged occupational employment structure as a Bartik-style instrument. The IV estimates of the coefficient on immigrant exposure are qualitatively the same as the OLS estimates: the estimate for the employment regression for native males remains insignificant, but all

other estimates are negative and significant at the 1% level. Quantitatively these IV estimates are all smaller than the OLS estimates, suggesting that an increase in Mainland immigrants amounting to 1% of native workers would depress the earnings of native male workers and native female workers by 0.70% and 0.25%, respectively, and reduce the employment ratio of native females by 0.17 percentage points. The corresponding first-stage coefficients on the projected immigrant exposure of these IV estimations range from 0.679 to 0.841 and are always significant at the 1% level. The first-stage F-statistics all exceed 59, far above the rule-of-thumb threshold of 10 for the weak-instrument test, suggesting that these IV estimations are not subject to the weak-instrument problem.

As discussed in Section 5.2, a potential identification threat for the IV estimations is that the unobserved time-varying determinants of the labor market outcomes of natives in a skill group may happen to be correlated with the skill group's lagged occupational employment structure that has been used in constructing the projected immigrant exposure. To address this concern, in Panel B of Table 3 we include the lagged employment share of three out of four broadly defined occupations for each native skill group to account for potential correlations between a native skill group's lagged occupational employment structure and its time-varying determinants of labor market outcomes. The magnitudes of the IV estimates of the coefficient on immigrant exposure are further reduced with inclusion of lagged occupational employment structure as additional controls. As a result, the estimated coefficient for the earnings regression for native females (column 4) becomes indistinguishable from zero, although those of the earnings regression for native males and the employment regression for native females remain negative and significant at the 1% level. The point estimates in Panel B of Table 3 indicate that an increase in Mainland immigrants amounting to 1% of native workers would depress the earnings of native male workers by 0.48% and reduce the employment ratio of native females by 0.16 percentage points, but has no significant effect on the employment of native males or earnings of native females. It is worth noting that the differences between the IV estimates of the earnings effects of immigrant exposure in Panel B of Table 3 and the OLS estimates in Panel B of Table 2 are statistically significant for both native males (-0.48 vs. -1.10) and native females (-0.01 vs. -0.35), suggesting that the cross-sectional relationships reflected in the OLS estimates overstate the adverse effect of immigrant competition on native earnings.

So far our estimations are at the skill group level in which the employment ratio or mean log real earnings of each native skill group is used as the dependent variable. To verify whether the results hold at the individual level, we estimate an individual-level version of Eq. (6) replacing the dependent variable by each native individual's employment status or log real earnings. The IV estimations of these individual-level regressions, reported in Appendix Table A2, yield quantitatively the same coefficients on immigrant exposure as those from the skill group-level regressions in Table 3.

Table 4
Robustness analysis: IV estimations with alternative skill group definitions.

	Males		Females	
	Employment ratio	Mean log earnings	Employment ratio	Mean log earnings
	(1)	(2)	(3)	(4)
Panel A. Finer disaggreation of education				
Immigrant exposure	0.265	−0.611*	−0.148***	−0.173***
	(0.292)	(0.330)	(0.037)	(0.060)
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
First-stage regression results:				
Projected immigrant exposure	0.557***	0.563***	0.689***	0.720***
	(0.063)	(0.058)	(0.088)	(0.082)
First-stage F-statistics	77.08	92.98	60.85	76.42
Number of observations	255	255	256	256
Panel B. Age in place of experience				
Immigrant exposure	0.198	−0.662***	−0.156***	−0.246***
	(0.180)	(0.159)	(0.036)	(0.044)
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
First-stage regression results:				
Projected immigrant exposure	0.655***	0.674***	0.810***	0.818***
	(0.082)	(0.080)	(0.087)	(0.079)
First-stage F-statistics	64.57	70.26	86.80	108.18
Number of observations	144	144	144	144

Notes: In Panel A, the 256 skill groups for each gender are defined by detailed education category (8) × experience group (8) × census year (4). For males, the total number of skill groups is 255 instead of 256 because in 2011 no native male belongs to the skill group category for primary school dropouts with less than five years of work experience. In Panel B, the 144 skill groups for each gender are defined by broad education category (4) × age group (9) × census year (4). For each gender-specific skill group, the employment ratio is calculated using all non-students, whereas the mean log real earnings are the average log real monthly earnings in 1996 constant dollars calculated using employees only. The odd columns use the total number of non-students in each gender-specific skill group as the regression weight, and the even columns use the total number of employees in each gender-specific skill group as the regression weight. In all regressions, the projected immigrant exposure of a gender and skill group in the census year is used as an instrument for the observed immigrant exposure. Standard errors in parentheses are clustered at the detailed education category × experience group level in Panel A and at the broad education category × age group level in Panel B.
*Significant at 10%, **significant at 5%, ***significant at 1%.

6.3. Robustness checks

Since the immigrant exposure measure is constructed at the skill group level, there may be concern over the sensitivity of the results to the skill group definitions. To mitigate this concern, we perform two robustness analyses employing alternative skill group classifications to the one used in the baseline analysis. In Panel A of Table 4, we disaggregate individuals into eight finer education groups: (1) primary school dropouts; (2) lower secondary school dropouts; (3) lower secondary school graduates; (4) upper secondary school graduates; (5) matriculation; (6) post-secondary education/preparatory courses for college education; (7) undergraduates; and (8) postgraduates. As the result of this finer disaggregation of educational attainment, for each gender the total number of skill groups increases from 128 to 256 over four census years.[14] In Panel B of Table 4, we redefine 144 skill groups over four census years for each gender using nine age groups starting from 20–24 and ending at 60–64 to interact with the four original education groups. The results of both robustness analyses are qualitatively the same as those obtained using the baseline skill group definition, showing that the estimates are not sensitive to the choice of skill group classifications.

7. Conclusion

This paper proposes to employ the immigrant exposure measure to examine the impact of immigration on the labor market outcomes of natives along the skill group dimension, which not only mitigates the usual problem caused by the tendency of factor price equalization in studies using a region or an occupation as the unit of analysis but also takes into account cross-group substitutions of immigrants from different skill groups. Unlike the conventional immigrant ratio measure, this immigrant exposure variable considers the degree of similarity in occupational employment structure between immigrants and a given native skill group. Our estimation shows that an increase in the number of Mainland immigrants amounting to 1% of native workers depresses the earnings of native male workers by 0.48–0.70% and decreases the employment ratio of native females by 0.15–0.17 percentage points. There is also some evidence that immigrant competition may have reduced the earnings of female native workers, although the effects are smaller in magnitude than males and not always significant.

Our empirical results bear important policy implications. The adverse impacts of Mainland immigrants on the local labor market call for more active policies to help the low-skilled labor in Hong Kong, natives and immigrants alike. In a rapidly transforming economy like Hong Kong, low-skill labor can easily fall behind. The large number of low-skilled immigrants has further expanded the size of this social group. To alleviate this problem, policies to upgrade their general skills and provision of vocational training would be very important. Policies that reduce the frictions in these segments of local labor market will also be helpful.[15] Another issue is whether the composition of immigrants to Hong Kong will change towards a more desirable direction. If more of the immigrants possessing higher skills, they may play a complementary role to the low-skill natives. There are signs of favorable changes in recent years. According to the statistics from the Immigration Department, 20.8% of the OWP entrants aged 15 or above have post-secondary education in 2015, up from 10.6% in 2005. Equally important, the Hong Kong government has attempted to encourage immigration of talents and professionals through other schemes.[16] For example, the Immigration Arrangements for Non-local Graduates (IANG) scheme, now the second largest source of immigrant intake in Hong Kong, granted 9541 entry permits to non-local graduates with a first degree or higher qualification in 2015 (Liu, Lam, & Shui, 2016). The impact of this new trend of developments on the local labor market can only be analyzed when comprehensive data is available, and thus will be left for future research.

Appendix

Appendix Table A1
Broad and detailed occupation definitions.

Broad occupation categories	Detailed occupations
Professionals (P)	P1. Government administrators and foreign diplomats
	P2. Corporate managers
	P3. Small business managers
	P4. Physical, mathematical and engineering science professionals
	P5. Life science and health professionals
	P6. Teaching professionals
	P7. Legal, accounting, business and related professionals
	P8. Social science and other professionals

[14] For native males, the total number of skill group-level observations over four census years is 255 instead of 256 because the skill group corresponding to primary school dropouts with less than five years of work experience has no observation in 2011.

[15] One example is the transport subsidy scheme for low-income workers, which can help those residing in remote regions (where there is high density of low-income population) but work in central commercial districts.

[16] These schemes include the General Employment Policy (GEP), Admission Scheme for Mainland Talents and Professionals (ASMTP), Capital Investment Entrant Scheme (CIES), and Quality Migrant Admission Scheme (QMAS).

Associate professionals (A)	A1. Physical, mathematical and engineering science associate professionals
	A2. Life science and health associate professionals
	A3. Teaching associate professionals
	A4. Legal, accounting, business and related associate professionals
	A5. Social services and other associate professionals
Sales and service workers (S)	S1. Office clerks
	S2. Customer services clerks
	S3. Personal and protective services workers
	S4. Salespersons and models
	S5. Transport and other services workers
Laborers (L)	L1. Market-oriented skilled agricultural and fishery workers
	L2. Extraction and building trades workers
	L3. Metal and machinery trades workers
	L4. Precision, handicraft, printing and related trades workers
	L5. Other craft and related workers
	L6. Industrial plant operators
	L7. Stationary machine operators and assemblers
	L8. Drivers and mobile machine operators
	L9. Sales and services elementary occupations
	L10. Laborers in mining, construction, manufacturing, agriculture and fishing

Appendix Table A2
Baseline individual-level IV estimations.

	Males		Females	
	Employment	Log earnings	Employment	Log earnings
	(1)	(2)	(3)	(4)
Panel A. w/o initial occupational employment structure controls				
Immigrant exposure	0.143	− 0.699***	− 0.170***	− 0.251***
	(0.235)	(0.216)	(0.033)	(0.044)
Lagged occupational employment structure controls	No	No	No	No
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
First-stage regression results:				
Projected immigrant exposure	0.683***	0.679***	0.832***	0.841***
	(0.075)	(0.072)	(0.072)	(0.064)
First-stage F-statistics	81.81	88.22	132.55	171.18
Number of observations	248,691	164,881	240,032	164,881
Panel B. w/ initial occupational employment structure controls				
Immigrant exposure	− 0.084	− 0.476***	− 0.154***	− 0.009
	(0.205)	(0.250)	(0.046)	(0.119)
Lagged occupational employment structure controls	Yes	Yes	Yes	Yes
Skill group fixed effects	Yes	Yes	Yes	Yes
Census year fixed effects	Yes	Yes	Yes	Yes
First-stage regression results:				
Projected immigrant exposure	0.678***	0.681***	0.756***	0.741***
	(0.079)	(0.076)	(0.112)	(0.101)
First-stage F-statistics	73.95	80.86	45.65	53.66
Number of observations	248,691	164,881	240,032	164,881

Notes: For each gender, the odd column uses all non-students and the even column uses all employees. In all regressions, the projected immigrant exposure of a gender and skill group in the census year is used as an instrument for the observed immigrant exposure. Standard errors in parentheses are clustered at the broad education category × experience group level.
*Significant at 10%, **significant at 5%, ***significant at 1%.

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