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The labor market impact of a taxi driver's license

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The labor market impact of a taxi driver's license[a]

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Abstract

We study the economic impact of becoming a taxi driver. Comparing individuals who pass the necessary written exams for a taxi driver's license to individuals who have not yet done so, we find that both immigrants and natives who enter into taxi driving have experienced negative employment trends. However, after passing the written taxi exams, immigrants increase their monthly earnings by nearly 50 percent between 1 and 3 years later, and usage of social insurance programs decreases as well. For natives, we find positive but much smaller effects of passing taxi exams, which are large enough for their post-taxi earnings to be roughly 10 percent larger. An analysis of heterogeneous effects shows that effects are larger for recently arrived immigrants. We also find evidence in favor of immigrants having poorer outside options in the labor market, which may be a reason for their larger earnings impact of taxi driving compared to natives.

Keywords: Taxi labor market; Driver's licenses; Immigrant-native earnings gaps
JEL-codes: J15; J22; J24; J60; J61

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1 Introduction

Immigrants in developed countries have weaker labor market outcomes than their native counterparts, and it remains an open question to what extent factors such as language barriers, discrimination, or human capital explain such gaps. Despite weak labor market integration for immigrants overall, specific sectors of the economy have a very high share of immigrants among employees. For example, in Sweden, immigrants make up 47 percent of taxi drivers and 48 percent of bus drivers (Statistics Sweden, 2017). This raises the question of what role service sector jobs with relatively low formal qualifications may play in the employment of immigrants, especially in settings where barriers to labor market entry are high.

This paper studies the role of the taxi labor market on the economic outcomes of immigrants and natives. We study selection into taxi driving and evaluate how outcomes evolve before and after gaining access to the taxi labor market. Our empirical analysis is based on confidential and previously unexploited data covering all written exam results for the taxi driver's license in Sweden between 2004 and 2017. We combine exam results for approximately 55,000 test takers with administrative data on individual labor market outcomes at the level of employment spells, yearly data on usage of social insurance systems, as well as background characteristics such as education, country of origin, and year of immigration.

Our empirical strategy uses difference-in-differences and an event-study design. Our main specifications focus on individuals before and after they gain access to the taxi driver labor market – which we define as having passed the relevant written exams – and compare them to a sample of individuals who have not yet gained access. We also replicate our results using the method of Borusyak et al. (2021), which takes into account recent discoveries about potential sources of bias in event-study estimation.

We begin our analysis by using sector-specific employment spell data to estimate how passing the written taxi license exams affects employment and the income derived from the taxi sector.[1] Our estimates indicate an immediate positive effect. Six months after passing written exams, immigrants and natives display large increases in the likelihood of employment in a taxi firm. One year later, approximately 60 percent of individuals in both groups have been employed by a taxi firm for at least one month, whereas pre-treatment averages are stable at zero. Over the same period, monthly taxi incomes increase by approximately 9,000 SEK for immigrants and 6,000 SEK for natives. Thus, passing the necessary written exams for the taxi driver's license impacts the likelihood of working as a taxi driver.

Selection into taxi driving is not random. Before passing written taxi exams, immigrants in treatment and control groups display parallel trends until 12 months before treatment, after which the treatment groups' income declines significantly. This divergence may be due to several factors, such as job separation, anticipation effects leading to lower labor supply, or investment costs related

[1] Obtaining a taxi driver's license requires passing three written exams as well as a driving test. We only observe written exam results, while data on driving test results or ultimate ownership of taxi drivers' licenses are restricted by law and not allowed for research.

to preparing for exams and job search limiting labor supply. Pre-treatment patterns differ somewhat for natives, who experience more pronounced declining income trends over the full 36-month period prior to passing written taxi exams. In percentage terms, however, both immigrants and natives have similarly pre-trends.

We then estimate the impact of access to the taxi labor market on employment and income from all sources. While outcomes were relatively similar across origin groups when looking at taxi sector activity, differences in outside options in the labor market for natives and immigrants may lead to overall labor market effects to differ. For example, descriptive statistics show that immigrants are more likely to enter the taxi labor market from unemployment, while natives are more likely to have been employed (see Table 3). Our results are consistent with this. 36 months after passing exams, immigrants' overall employment rate increases by 20 percentage points, while it increases by 11 percentage points for natives. Interestingly, the effect on incomes across groups is larger. For immigrants, we observe a significant and stable income increase after passing the written taxi exams. Between 12 and 36 months after gaining access to the taxi labor market, their monthly incomes are at least 5,000 SEK higher. When estimating the relative increase in incomes compared pre-taxi averages, those with access to the taxi labor market have at least 40 percent larger monthly incomes between 12 and 36 months after treatment. Natives also experience a rapid increase in monthly incomes after passing taxi exams. However, natives' incomes between 12 to 36 months after treatment are smaller at approximately 2,000 SEK larger per month compared to the control group. This represents an increase of roughly 10 percent. Thus, natives who enter the labor market can rapidly reverse their prior labor market decline, reaching higher incomes than the control group. Nevertheless, the overall effect is smaller than for immigrants, consistent with immigrants having weaker outside options in the labor market.

Having observed positive income developments for individuals who pass written taxi exams relative to the control group and their pre-taxi outcomes, a relevant question is whether there is an impact on the usage of social insurance programs. To measure this, we create a simple measure that takes value one if an individual does not receive any means-tested welfare or housing transfers in a given year. We also study the usage of unemployment insurance (UI). For both natives and immigrants, the likelihood of receiving UI benefits increases in the year before passing taxi exams. This result is consistent with the declines in income and employment rates observed during this period. However, both groups quickly reverse this trend after treatment and become less likely to use UI. We find similar results for means-tested transfers. For example, immigrants are 12.5 percentage points less likely to receive any transfers after 3 years, a nearly 25 percent decrease over the mean.

Our results indicate that the taxi labor market plays a different role for native-born Swedes and immigrants. For the former, it may represent a solution to regain one's previous economic standing after having experienced a long-run income decline. For the latter, entering the taxi labor market may represent a more significant shift from prior economic possibilities. We investigate to what extent this may reflect differences in personal characteristics related to outside options in the labor

market. Within the sample of immigrants, we find that the returns to a taxi labor market access are substantially larger among those who have arrived relatively recently. For recent arrivals (3–5 years in Sweden), the effect on monthly income is twice as large as for immigrants who have been in Sweden for longer than five years. Next, investigating the heterogeneous effects of education, we report two findings. First, earnings effects are much larger for immigrants with a post-secondary degree than for similarly educated natives. Second, while highly educated immigrants earn more than low-educated immigrants, the pattern is reversed among natives. This result is consistent with relatively weak outside options for highly educated immigrants, such that even highly educated immigrants who are not taxi drivers do not out-earn taxi drivers with a similar education level. These results indicate that the taxi labor market has larger benefits for immigrants because it can absorb individuals with relatively little labor market experience in Sweden and individuals who find it challenging to find work with higher formal requirements.

This study is, to our knowledge, the first to test for the effects of a taxi driver's license on labor market outcomes. The economics literature on taxi drivers has often tested theories of labor supply (Camerer et al., 1997; Farber, 2005). Häckner and Nyberg (1995) and Cairns and Liston-Heyes (1996) study the economics of taxi market regulation theoretically, while Ohlson (2008), SOU (2010), and Slavnic and Urban (2018) investigate the consequences of the Swedish taxi market deregulation of 1990. Several studies focus on the effects of car ownership on labor market outcomes (Ong, 2002; Raphael and Rice, 2002; Gurley and Bruce, 2005; Baum, 2009). Gautier and Zenou (2010) focus specifically on effects for ethnic minorities. Moreover, recent research has studied the effects of allowing undocumented immigrants to obtain a regular driver's license (Amuedo-Dorantes et al., 2020; Cho, 2022). These studies indicate positive effects, partly related to the ability to commute longer distances. There is also a growing literature on the role of ride-hailing services on labor market outcomes (Berger et al., 2018) and the role of work-hour flexibility (Angrist et al., 2021). Adermon and Hensvik (2022) investigate the effects of gig-work experience on the job search, and Ek et al. (2020) studies the importance of low-skilled jobs for future earning trajectories for newly arrived refugees in Sweden.

Our study also relates to the literature on occupational licensing, as the taxi driver's license acts as an occupational regulation that raises barriers to entry and enforces minimum education standards among workers. In the US and EU, approximately one-quarter of workers hold an occupational license. Several studies investigate the role of occupational regulations, including their effects on immigrants (Chapman and Iredale, 1993; Kugler and Sauer, 2005; Gomez et al., 2015; Sweetman et al., 2015; Tani, 2017). Brücker et al. (2021) find that immigrants who can validate their foreign qualifications and access regulated labor markets experience positive employment outcomes.

2 Background and institutional setting

2.1 Immigration to Sweden

Figure 1 shows two trends for the immigrant composition in Sweden between 1985 and 2018. First, Sweden has had a high inflow of immigrants in the last decades and the stock of foreign-born has steadily increased from around 8 percent in 1985 to 19 percent in 2018. Second, there has been a clear shift in the composition of immigrants over time, where non-Western immigrants made up 36 percent of the immigrant stock in 1985, and 78 percent in 2018.

Figure 1: Foreign-born in Sweden

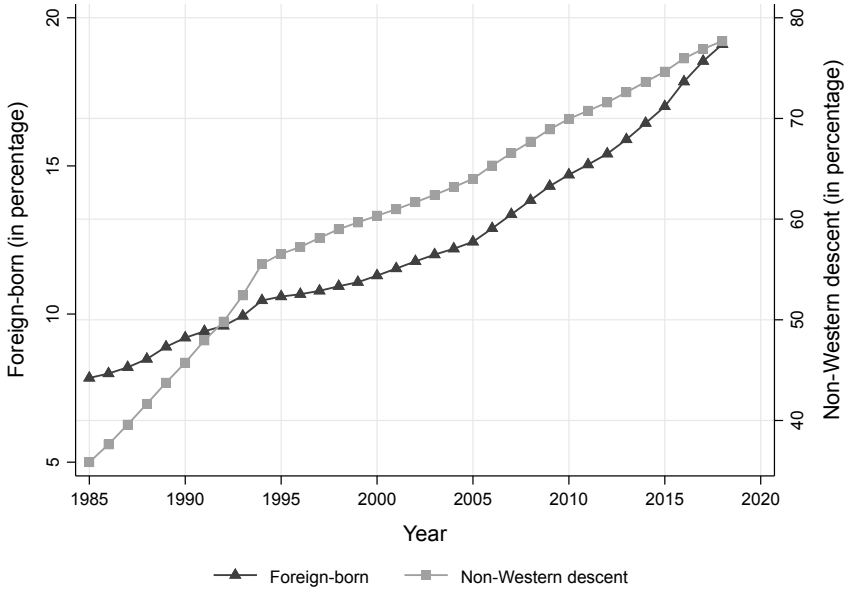
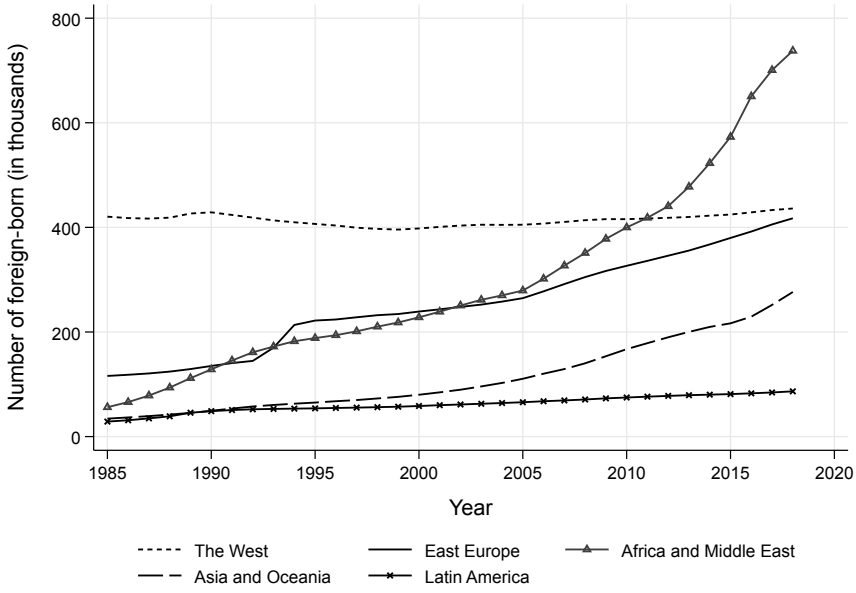


Figure 2 shows that the number of immigrants from Africa and the Middle East has increased the most since 1985 and that it is the largest immigrant group in 2018 (constituting 38 percent of the foreign-born population in Sweden). Within this group, the main source countries for the immigrant inflows in the 1980s and 1990s were Iran, Iraq, Turkey, and Lebanon. During the 2000s and 2010s, there was an increased inflow from primarily Iraq, Afghanistan, Somalia, Eritrea, and Syria. As is further discussed in Section 3, Africa and the Middle East is also the main source region for immigrant taxi drivers in Sweden. Figure 2 furthermore shows that the group that has increased second most during the period 1985–2018 is East Europe, where there are two trend shifts. First in the mid-1990s when there was a large spike in asylum seekers from former Yugoslavia, and second in the mid-2000s with the expansion of the European Union (increased labor immigration from primarily Poland). Immigration from Asia and Oceania has mainly been coming from Thailand, China, and India, while Chile is the dominant source country for Latin America.

Figure 2: Regional origin of foreign-born in Sweden



2.2 The taxi market

Roughly half of the taxi drivers in Sweden are foreign-born and its workforce has the eighth highest share of foreign-born individuals as of 2019. This statistic is in line with other high-income countries. In Canada, half of the taxi drivers were foreign-born in 2006 (Xu, 2012), while 1 in 7 taxi drivers in the UK is from Pakistan alone (Dawn, 2013). As shown in Table 1, being a taxi driver is the 20th most common profession for foreign-born men in Sweden in 2019.

Along with the development in many other OECD countries (Bekken, 2005), the labor market for taxi drivers was deregulated in Sweden in 1990 (Swedish Competition Authority, 2018; Slavnic and Urban, 2018). This deregulation meant that the limit on the total number of taxi cars was removed along with price regulations. The argument for the reform was to increase competition, but the deregulation also made requirements to receive a taxi driver's license stricter. Since the deregulation in 1990, the number of taxi drivers and the fraction of foreign-born taxi drivers has increased. There were over 17,000 registered taxi cabs in Sweden in 2016, up from 12,700 in 1990. The Stockholm region is the largest single market, with nearly 7000 registered taxi cabs.

Demand for taxis comes from three clients: business, private, and publicly procured services such as medical and school transport. Publicly procured transports typically compose half of taxi firms' incomes (Svenska taxiförbundet, 2017). Even though the number of taxi cars and drivers has increased since 1990, there has been an increased consolidation in the market with fewer and relatively bigger taxi companies (Swedish Competition Authority, 2018; Svenska taxiförbundet, 2017). Many taxis are connected to "brand name" firms that act as franchises. Smaller firms, often owning only one or two taxis, can pay a fee to be connected to the brand name. By paying

Table 1: Most common occupations for foreign-born men in Sweden in 2019

Occupation	Foreign-born men	Total men	Foreign-born share
Warehouse and terminal staff	19241	68379	28%
Restaurant and kitchen helpers	16943	28190	60%
Cleaners and helpers in offices, hotels, etc.	14964	20726	72%
Home-based personal care and related workers	12404	20399	61%
Software- and system developers	12142	65773	18%
Bus and tram drivers	11912	20639	58%
Machine-tool operators	9869	43093	23%
Cooks and cold-buffet managers	9568	20616	46%
Heavy truck and lorry drivers	7966	53590	15%
Building caretakers	6711	34995	19%
Personal assistants	6550	18834	35%
Woodworkers, carpenters	6348	45886	14%
Assistant nurses, home care and elderly homes	6296	12401	51%
Primary school teachers	5807	27960	21%
Other service workers not elsewhere classified	5780	16428	35%
Shop sales, groceries	5729	30054	19%
Vehicle mechanics and repairers	5391	32240	17%
Shop sales, specialty stores	5268	43135	12%
Commercial sales representatives	5216	64397	8%
Taxi, car, and van drivers	5182	9588	54%

Note: Occupations are based on 4-digit SSYK 2012 occupational codes, which are the occupational codes used by Statistics Sweden. SSYK 2012 is based on ISCO–08. Occupations are ranked in descending order according to the frequency of foreign-born men. Source: Statistics Sweden.

a fee and following the franchise firm's guidelines, they can connect to the franchise's centralized booking services in which clients reserve taxis via telephone or apps. In 2016, the most common type of taxi firm owned a single taxi cab (4,459 firms), while there were 2,315 active limited liability corporations in the sector (Svenska taxiförbundet, 2017).

A majority of taxi drivers are paid on commission – their pay is thus determined as a share of the revenue they generate. While there are collectively bargained agreements negotiated between unions and employers, these are voluntary for employers to adopt. Employers who do not adopt the collectively bargained agreement may set compensation freely, with no minimum wage requirement. For example, a driver may keep 50 percent of their revenue, sometimes combined with an hourly wage.

2.3 Becoming a taxi driver

A taxi driver's license is required to work as a taxi driver. Obtaining the taxi driver's license requires that the individual (i) is at least 21 years old, (ii) has held a regular driver's license (type B or D) for at least two years without any revocation during that period, (iii) completes three written exams, and (iv) completes a road driving test. The individual must also pass the requirement on obedience to the law and medical requirements.

The written taxi exams in step (iii) must be completed within six months of each other but in no particular order. The exams cover three different subjects: (i) navigation and map reading, (ii) safety and good driving behavior, and (iii) laws and regulations (Swedish Transport Agency, 2021). There is a small fee of approximately $30 USD per test, and exams are relatively easy and fast to schedule. In our data, individuals took an average of 3 months to pass the three tests.

In addition to the written exams, a driving test must be passed to obtain a taxi driver's license. The driving test is largely similar to that for a regular driver's license, and it also includes tests of the ability to navigate using GPS and the ability to ensure passenger safety. As we do not observe information on driving tests, nor on whether individuals obtain the final taxi driver's license, it is reassuring that the road test is very similar to a regular driver's license road test. Therefore, we do not expect this step to be a significant barrier to obtaining a taxi driver's license. Below, we will test the relationship between passing the written exams and indicators of working in the taxi sector.

A foreign driver's license issued within the EEA fulfills the second requirement if the individual has sufficient documentation from the issuing agency and can show that it has not been revoked during the last two years. A driver's license issued in a non-EEA country is not valid as a driver's license when applying for a taxi driver's license.

3 Data and descriptive statistics

In this paper, we use data on all the scores for the written taxi driver's license exam in Sweden between 2003 and 2016 provided by the Swedish Transport Agency. For each exam taken, we

observe a pseudonymized identifier for the individual taking it, a test center identifier, the type of exam taken, the score, and whether or not the individual passed the exam.

The data on written exam scores are matched at the individual level to complete population register data on demographic variables (LISA) and linked employer-employee data (RAMS) provided by Statistics Sweden. For each individual, we have information on the duration of an employment spell (start and end months), income per spell, industry, sector, and employer. We can observe the employment and income history of all individuals, both within the taxi sector and all other sectors. In all of our analyses, we include both incomes from employment and self-employment.

To create a measure of monthly income, we transform spell-level data as follows. The first step is to divide the total income for a given spell by the spell's duration in months, such that we have the average monthly income coming from that spell for each month. Note that spells are specified by year and can therefore be at most 12 months long, from January to December. As individuals may have overlapping spells from different employers, we then take the sum of monthly incomes across all active spells in a given month. As a second step, we refine this approach to avoid a misreporting error caused by the tendency of employers to report spells as having a duration of one year, January to December, even when spells may, in reality, be shorter. We apply a correction for such misreporting errors only for spells that occur during the year in which an individual passes the required written taxi exams. For such spells, we consider any income coming from taxi firm employment as misreported if it occurs in the months prior to passing the written tests. We thus shift any taxi firm income to the remaining months of the spell instead. Note that we only perform this correction for *taxi* income occurring in the *same* calendar year as individuals pass the written taxi exams. For example, consider an individual who passes the exams in January and an employment spell at a taxi firm in the preceding months, i.e., in the preceding calendar year. In this case, we will not make any changes to the data and thus can detect potential pre-trends in taxi incomes. If the individual instead passes the exams in March, we shift any reported taxi income from January and February to the remaining months of the employment spell. Again, however, any taxi income occurring before January is left unchanged in the data. We thus only shift away taxi income arriving in the same year as passing written exams, but in the months before passing the exams. To check for the robustness of this correction, in Section 6 we also display results without the correction using the sub-sample of individuals who passed their tests from January to April in a given year, for whom the issue of misreported income will be minor.

In our main analysis, we divide the population into two groups: individuals of non-Western origin arriving in Sweden at an age older than 15 ("immigrants") and individuals born in Sweden ("natives"). This separation is motivated by previous research on labor market outcomes for individuals with an immigrant background. The main difference in outcomes between natives and immigrants is for immigrants originating in non-Western countries and arriving in Sweden at an older age (Eriksson, 2010; Åslund et al., 2014). Place of birth is given by a variable that either identifies the specific country or a group of countries (in the case that the number of immigrants from that country is very few in numbers).

Table 2 displays the frequency distribution of countries of origin among our sample. Out of 26,292 individuals who pass the written taxi exams between 2003 and 2016, 16,095 or 61 percent are born in Sweden. Among immigrants, the most common country of origin is Iraq (3,895 individuals), followed by Iran (954) och Somalia (933). Further down are Afghanistan (544), North Africa and the Middle East excluding Iran and Iraq (542) and Turkey (526). Hence, all of the most common source countries for taxi drivers are located in Africa and the Middle East. We can also see some differences in the average age and years in Sweden before taking the tests to become a taxi driver.

Table 2: Regions of birth and characteristics for the main sample of taxi drivers

Region	Count	Age	Years in Sweden
Afghanistan	544	33.6	5.9
Africa	241	38.9	8.9
Bosnia and Herzegovina	358	38.4	10.7
Central America	19	43.9	11.2
Central Asia	118	37.6	4.4
Chile	47	46.5	18.6
China	33	39.5	6.6
East Europe	299	36.1	7
Egypt	46	36.1	6.9
Eritrea	225	38.4	9.5
Ethiopia	264	39.3	12.5
India	56	36.7	10.3
Iran	954	41.2	12.2
Iraq	3895	35.2	6.4
Lebanon	315	37.9	12.1
North Africa and Middle East	542	36.4	8.2
Other	37	38	10.3
Poland	118	44.3	15.6
Romania	47	39.4	11.6
Somalia	933	32.2	5.8
South America	74	42.5	12.8
South Asia	250	37	9.2
South-East Asia	25	39.3	12.6
Sweden	16095	35	—
Syria	231	38.1	10.4
Turkey	526	36	10.9

Note: The table shows the country or region of birth for the individuals included in our main analysis. For privacy reasons, data on the country of birth are grouped to the regional level for source countries with relatively few observations. "Other" includes the Baltic, East Asia, North America, Oceania, and Thailand. "Age" and "Years in Sweden" refers to the average of two years before passing the written exams.

Table 3 displays descriptive statistics for our sample and the total population, split between

immigrants and natives. Taxi drivers are observed two years prior to passing exams, while the total population figures are averaged over the sample period. Taxi drivers are mostly male and younger than the population as a whole. Compared to non-taxi driving counterparts of the same origin, taxi drivers have lower earnings, are more likely to receive UI and welfare benefits, and have lower rates of higher education. Notably, the difference in higher education is considerable for natives at 13 percentage points, while the difference among immigrants is less than a percentage point.

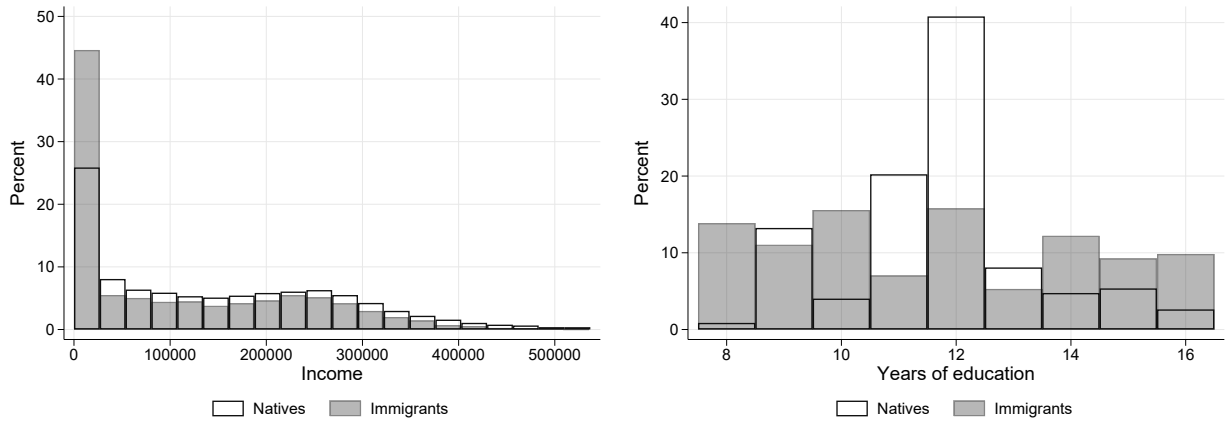
Table 3: Comparison of taxi drivers and non-taxi drivers

	Taxi drivers		Others	
	Immigrants	Natives	Immigrants	Natives
Male	0.972	0.802	0.483	0.510
	(0.165)	(0.398)	(0.500)	(0.500)
Age	36.43	35.03	41.64	43.16
	(8.844)	(13.56)	(10.38)	(12.70)
Income	8807.0	12923.6	9057.9	16588.5
	(10072.7)	(12193.5)	(11934.7)	(15677.3)
No UI Benefits	0.812	0.811	0.864	0.899
	(0.390)	(0.392)	(0.343)	(0.301)
No Welfare Benefits	0.510	0.882	0.684	0.934
	(0.500)	(0.323)	(0.465)	(0.248)
Years of schooling	11.72	11.74	11.97	11.99
	(2.635)	(1.708)	(2.827)	(2.322)
Higher education	0.366	0.208	0.373	0.336
	(0.482)	(0.406)	(0.484)	(0.472)
Days in unemployment	74.42	35.00	27.82	12.01
	(108.6)	(73.79)	(70.49)	(46.32)
Observations	10197	16095	2481669	31206682

Note: The table includes the individuals in our main analysis separated by immigrant status. "Income" is given in average monthly income in SEK. All variables refer to two years before passing the written exams.

Immigrant taxi drivers also differ from natives in several regards. Firstly, immigrant drivers are almost exclusively male (97 percent versus 80 percent among natives), have 32 percent lower pre-taxi incomes, and are more likely to have been unemployed (though no more likely to receive UI benefits), and 37 percentage points more likely to receive welfare benefits. The average years of education are similar across the two groups, but there is a substantially larger fraction of higher-educated immigrants than natives. This is explained by observing the full distributions of years of education, as displayed in Figure 3. While distributions for both immigrants and natives are centered around high-school completion, immigrants have a more evenly dispersed distribution of education levels compared to natives, where the majority have either 11 or 12 years of education.

Figure 3: Income and education distribution two years before passing the written exams



(a) Income *(b) Education*

Note: Income is given by annual income in SEK.

Figure 4 displays distributions of years in Sweden and age at the time of passing exams. There is substantial variation in years since migration, which peaks at five years before slowly decreasing with time in Sweden. Age distributions are very different across natives and immigrants, with the most common test-taking ages among natives being just above the legal threshold of 21 years of age. Immigrants, by contrast, arrive at different ages, and their distribution is more bell-shaped.

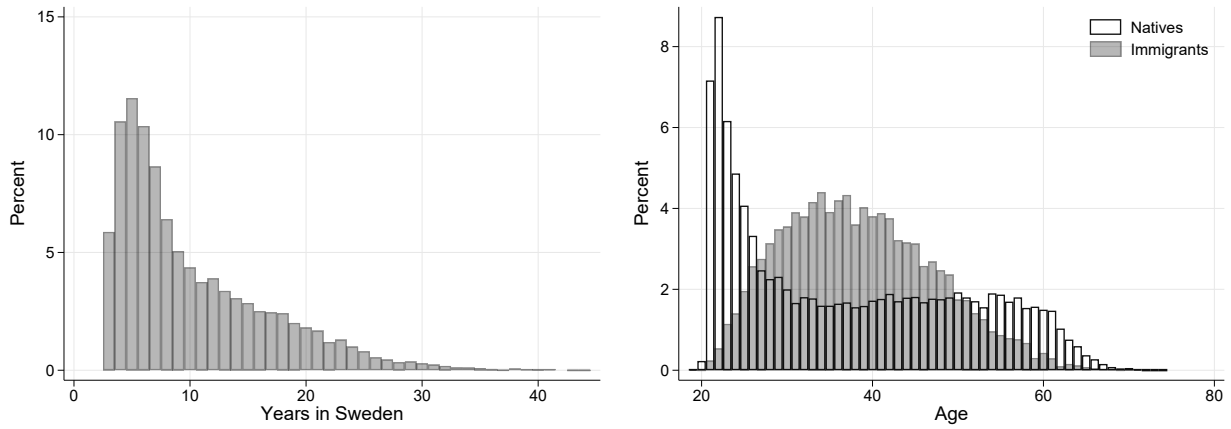
Lastly, Table 4 displays descriptive statistics for the immigrant sample separated by years since migration. More recent arrivals tend to be younger, have lower incomes, and are more likely to rely on welfare benefits but are, in contrast, more likely to have a post-secondary education.

4 Empirical framework

Our administrative data allow us to track individuals from age 16 or immigration to Sweden. Moreover, we observe precise dates of written taxi driver's license exams, allowing us to observe individuals before and after they pass the required exams. In the following, we use "treatment" to refer to passing the three required written taxi exams and "treated individuals" to refer to individuals who have done so. In our main specifications, we use the panel dimension of our data to compare labor market outcomes between individuals that pass and those that have yet not passed but will do so later in the sample period. In Section 6, we also include individuals that never passed or took the test to become a taxi driver, applying the method of Borusyak et al. (2021) to take into account issues relating to heterogeneous treatment effects in staggered treatment designs.

We apply an event-study design, where the dynamic effect of treatment is obtained (Angelov et al., 2016; Kleven et al., 2019). This method has two main benefits. First, it makes potential pre-trends easier to detect. Second, the full trajectory of the labor market outcomes can be analyzed.

Figure 4: Statistics when taking the first test to become a taxi driver



(a) Time of residency in Sweden *(b) Age*

Note: Individuals with a time of residency in Sweden of three years or less are excluded due to the restriction of using a balanced panel in our analysis.

Table 4: Descriptive statistics for immigrants depending on years since migration

	<5 years	5-10 years	>10 years	All
Male	0.987	0.969	0.955	0.972
	(0.111)	(0.172)	(0.207)	(0.165)
Age	32.40	34.96	43.27	36.43
	(7.630)	(7.651)	(7.445)	(8.844)
Income	6294.7	9845.7	10941.3	8807.0
	(8296.6)	(10081.7)	(11392.9)	(10072.7)
No UI Benefits	0.894	0.780	0.741	0.812
	(0.307)	(0.414)	(0.438)	(0.390)
No Welfare Benefits	0.329	0.545	0.707	0.510
	(0.470)	(0.498)	(0.455)	(0.500)
Years of schooling	11.86	11.50	11.76	11.72
	(2.830)	(2.683)	(2.281)	(2.635)
Higher education	0.433	0.343	0.305	0.366
	(0.496)	(0.475)	(0.461)	(0.482)
Observations	3911	3277	3009	10197

mean coefficients; sd in parentheses

Note: The table includes the individuals in our main analysis separated by years since immigration to Sweden. "Income" is given in average monthly income in SEK. All variables refer to two years before passing the written exams.

The outcome variable Y_{ist} denotes labor market outcomes for individual i, in calendar year $\times$ month s and, in event time t. Even though our main outcome variable is income, we also focus on other relevant measures of labor market outcomes, such as employment, UI, and welfare benefits. Our baseline specification includes a balanced panel of individuals that we observe 36 months before passing the written exams and 36 months after. Hence, the calendar year $\times$ month that the individual pass the third required exam is time $t = 0$. We include event time dummies for all periods (t) ranging from 36 months prior to the event to 36 months after. The event time dummy for period $t = -24$ is omitted and provides the baseline, i.e., all effects are relative to the outcome two years before the event. The coefficient of interest is β and shows the effect of receiving the license on labor market outcomes (Y_{ist}). We therefore run the following regression for individual i, observed t periods before or after treatment and in calendar year $\times$ month s, separately for natives and immigrants:

$$Y_{ist} = \sum_{j \neq -24} \beta_j \cdot \mathbf{I}[j = t] + \lambda_i + \lambda_s + \lambda_{is} + \varepsilon_{ist}. \tag{1}$$

We include a full set of indicator variables for gender (λ_i), calendar year $\times$ month (λ_s), and age and years since immigration (λ_{is}). We omit years since migration for natives. Including a full set of indicator variables are important to control non-parametrically for life and business cycle trends. We are interested in identifying β_j, the effect of passing the written taxi exams on labor market outcomes. To do so, the identifying assumption is that the labor market outcomes of individuals who passed the exams would have evolved in parallel with those of individuals who have not yet passed the exams. The variation in age for when they pass the tests is used to identify the effects. This means that we, at any given calendar year $\times$ month, compare individuals with the same gender, age, and years since migration but at different periods relative to passing the test.

To keep individuals with zero income in the analysis, we use income in levels rather than logs as the outcome (Y_{ist}) in Equation 1. To study percentage change in income (P_t) we follow Kleven et al. (2019) and use the following transformation:

$$P_t \equiv \hat{\beta}_t \; / \; \mathbf{E}\left[\widetilde{Y}_{ist} \mid t\right], \quad \text{where} \quad \widetilde{Y}_{ist} \equiv \lambda_i + \lambda_s + \lambda_{is} \tag{2}$$

5 Results

5.1 Employment and income from taxi firms

We begin by estimating the impact of passing written taxi exams on the likelihood of ever being employed in a taxi firm. This is a test of whether passing the written exams is predictive of later obtaining a taxi driver's license and beginning to work as a taxi driver. Figure 5 displays the effect using 36 months of pre- and post-treatment data. For each month, the estimate indicates the difference between treatment and control groups in their likelihood of ever being employed in a taxi firm. Before passing exams, treatment and control groups have very similar outcomes, as is to be expected before either group passes the written taxi exams. Starting in the treatment

month, however, panel (a) shows that immigrants' taxi firm employment rises sharply, by nearly 20 percentage points relative to the control group. This effect gradually increases to 60 percent after 15 months and ultimately reaches approximately 70 percentage points after 36 months. For natives, panel (a) also shows that effects are largely similar but with a faster development, where the indicator for ever having taxi firm employment reaches 60 percentage points after nine months. This may reflect differences in the ability to find a job at a taxi firm, even conditional on having a taxi driver's license, or differences in the ability to obtain the taxi driver's license after having passed the written tests.

We next display the evolution of monthly incomes from taxi firms in panel (b) of Figure 5. For immigrants, taxi incomes rise immediately after passing written exams, increasing to 7,500 SEK after 12 months, equivalent to $750 USD. Between 12 and 36 months post-treatment, taxi incomes rise somewhat and remain stable at above 7,500 SEK per month compared to the control group. For natives, the dynamic effects are somewhat different. Similar to the case with employment, taxi income rises faster than for immigrants. However, the effect of income reaches its peak at a lower level of roughly 6,000 SEK 12 months after treatment, after which it gradually declines to less than 5,000 SEK after 36 months.

Panels (c) and (d) display two related measures: the share of total monthly income from taxi firms and an indicator variable for having taxi income as the largest contributor to total income. Both panels show that immigrants experience an increase in these measures of more than 40 percentage points between 12 and 36 months after treatment. The increase remains at this level throughout the sample period. Natives, by contrast, experience a peak at approximately 40 percentage points, after which there is a decline over time by ten percentage points. Note that these are reduced-form estimates that include all individuals who never became taxi drivers, as per panel (a), or who subsequently left the taxi sector.

We conclude that passing the written taxi exams has a substantial and immediate impact on the likelihood of ever being employed in the taxi sector, on the level of income derived from taxi firms, as well as the propensity to have taxi driving as the main employment.[2]

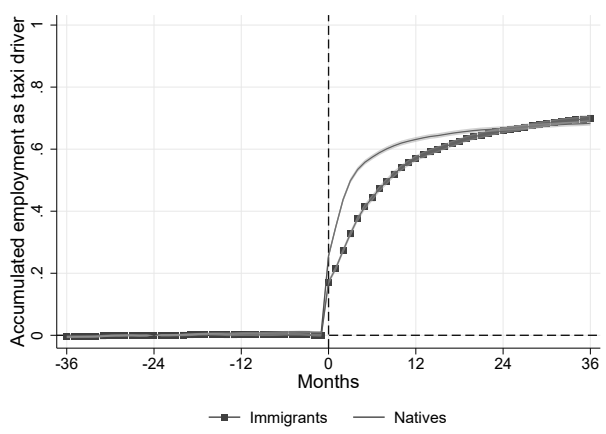
5.2 Employment and income from all sources

Having established that passing the written taxi driver's license exams on engagement in the taxi labor market, we proceed to study its impact on overall employment and income. If individuals who access the taxi labor market would otherwise have found jobs of a similar type as before, we may find that the overall effect on labor market incomes is negligible, despite having a large effect within the taxi sector.

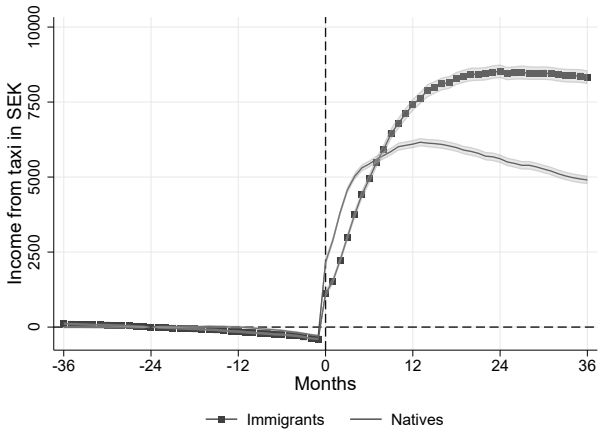
Table 5 displays our results. Column 1 shows that total labor income increases by 4,522 SEK per month, which is statistically significant at the 1 percent level. This represents a large increase

[2]It is possible that some individuals who are employed at taxi firms are not in fact taxi drivers. For example, individuals may do administrative or managerial work. However, it is unlikely that the timing of such employment would coincide with passing taxi exams, as such positions are not covered by occupational licensing.

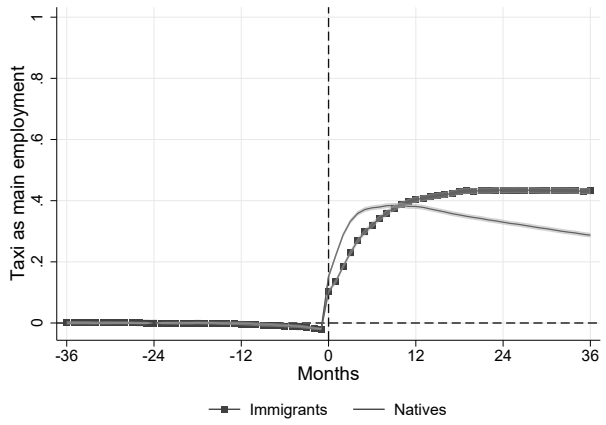
Figure 5: Impact of passing written exams on income and employment from taxi firms



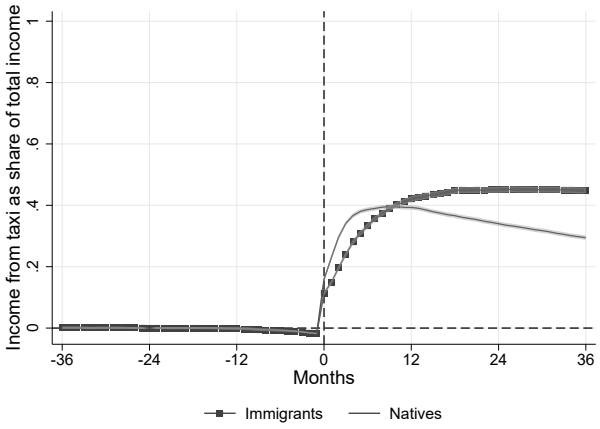
(a) Taxi Employment



(b) Taxi Income



(c) Taxi as Main Occupation



(d) Share of Total Income from Taxi

Note: "Accumulated employment as taxi driver" is equal to one if an individual has ever had income from a taxi firm up until the period in question, and zero otherwise. "Taxi as main employment" is a dummy equal to one if the income from taxi firms is larger than income from non-taxi firms. In our data, we can see whether individuals were employed by firms in the taxi sector, but not if they were employed as taxi drivers. However, as shown in the figure, income and employment within these firms increase substantially when passing the written tests, indicating that they are working as taxi drivers rather than with something else within the firm. This data limitation also explains why the treatment group can have a slight negative trend in "income from taxi" before passing the written exams.

in incomes compared to pre-treatment levels. Relative to the pre-treatment average of 8,956 SEK, individuals who pass written taxi exams increase their monthly income by 50 percent. Column 2 shows that immigrants raise their overall employment rate by 18.1 percentage points, where employment is defined as having a positive income in a given month. Again, this is a large increase relative to the mean outcome of 57.5 percent two years before treatment.

Table 5: Average impact of passing written exams on labor market outcomes

	Immigrants		Natives	
	Income	Employment	Income	Employment
Passing	4522.2***	0.181***	2000.5***	0.135***
	(36.00)	(0.00129)	(32.48)	(0.000843)
Observations	744381	744381	1174935	1174935
Mean outcome	8956.6	0.575	12576.4	0.755

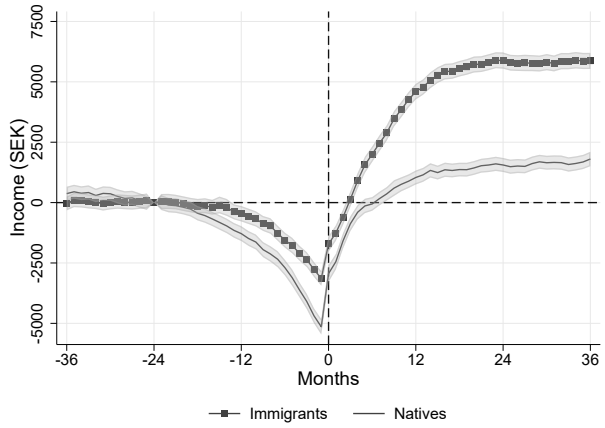
*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The table shows the regression on labor market outcomes when including indicator variables for age and year on a balanced panel with individuals included 36 months before and after passing the written exams for the taxi driver license. "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-month. Mean outcome refers to two years before passing the written exams.

The next two columns of Table 5 display results for natives. Compared to immigrants, natives who pass taxi license exams experience a smaller but also positive effect on average monthly incomes, amounting to 2,000 SEK. Since natives have higher incomes before passing taxi exams, however, the relative effect is also smaller. Relative to the mean of 12,576 SEK, the incomes of natives increase by 15.9 percent. Employment rates increase by 13.5 percentage points on average, a relative increase of 17.8 percent compared to immigrants.

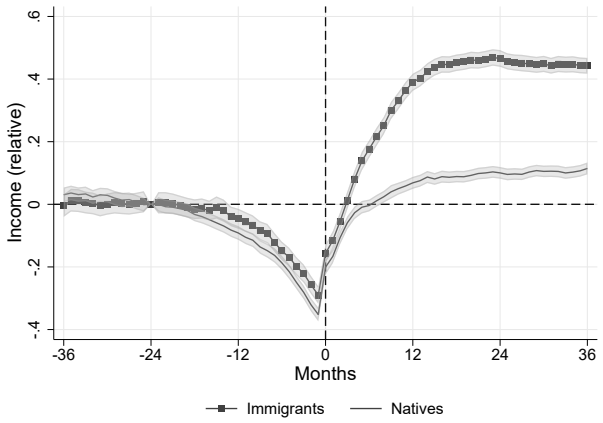
Event-study estimates for the impact of access to the taxi labor market on income are presented graphically in Figure 6. For immigrants in panel (a), differences between treatment and control groups are close to zero and stable until approximately 12 months before passing the written taxi exams. Subsequently, incomes begin to decrease significantly for the treatment group. In the month before passing written tests, the treatment group has more than 2,500 SEK lower income than the control group, corresponding to a nearly 30 percent decline relative to $t = -24$ as shown in panel (b). Below, we discuss possible interpretations and reasons for this divergence from parallel trends.

Moving on to post-treatment outcomes, we observe a sharp increase in monthly income in the month of passing exams. Incomes continue to rise monthly until reaching a peak of nearly 5,000 SEK higher than the control group after 12 months. This effect increases somewhat over the remainder of the sample period. As there is a clear transition phase during the first post-treatment year, Table 6 displays regression results exactly 36 months after treatment to estimate the effects net of this transition. Column 1 indicates that overall income is 5,865 SEK higher for immigrants after 36

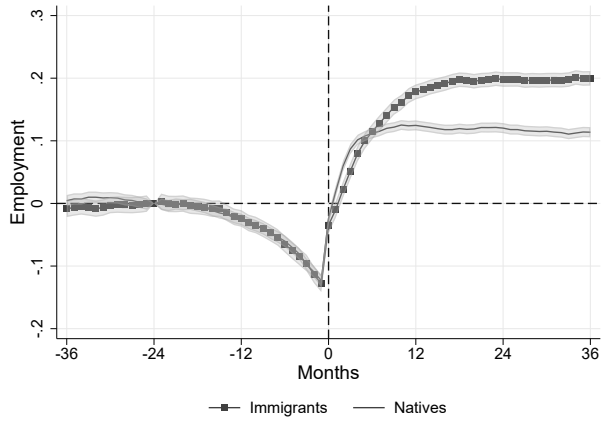
Figure 6: Impact of passing written exams on labor market outcomes



(a) Income in levels



(b) Income relative to period -24



(c) Employment

Note: "Income in SEK" is income in Swedish Krona on a monthly level. "Income" is income in the given time period relative to the income two years before passing the test. "Employment" is equal to one if the individual has an income > 0 in the given time period, and zero otherwise.

months, compared to the average effect of 4,522 SEK noted above. Panel (b) of Figure 6 displays the event-study estimates for incomes relative to 24 months before treatment. The figure shows that between 12 and 36 months after passing exams, incomes increase by more than 40 percent in the treatment group relative to not-yet-treated controls. Column 2 of Table 6 indicates that the effects for employment are 20 percentage points after 36 months, also somewhat higher than the average effect.

Table 6: Average impact of passing written exams on labor market outcomes at 36 months after passing the test

	Immigrants		Natives	
	Income	Employment	Income	Employment
Passing	5865.5***	0.200***	1805.2***	0.114***
	(170.7)	(0.00595)	(152.4)	(0.00419)
Observations	744381	744381	1174935	1174935
Mean outcome	8956.6	0.575	12576.4	0.755

*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The regressions include indicator variables for age, year, month, gender, and, years since migration (for immigrants). "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-month. Mean outcome refers to two years before passing the written exams.

Turning next to natives' dynamic effects, panel (a) of Figure 6 shows that natives experience an earlier and more pronounced decrease in their incomes before passing the written taxi exams, visible around the start of the sample period. The decrease in natives' incomes reaches a low point of close to −5000 SEK in the month prior to passing taxi exams, nearly twice what is observed for immigrants. However, in relative income in panel (b), natives and immigrants have a similar negative trend in the 12 months before passing the tests, suggesting that immigrants start with a lower income in the years preceding the taxi exam. Similar to the case for immigrants, incomes for natives increase rapidly post-treatment. After passing the written taxi exams, incomes rise sharply for several months. After 36 months, column 4 of Table 6 shows that natives' incomes are 1,805 SEK higher per month. The pattern of effects differs in magnitude between immigrants and natives, such that pre-treatment declines are larger and post-treatment increases are smaller for natives. As seen in Figure 6, natives display a pattern closer to Ashenfelter's dip, raising the possibility that natives' incomes would have increased even in the absence of becoming taxi drivers. This possibility will be investigated further in Section 5.2.1.

Lastly, panel (c) of Figure 6 displays dynamic effects on the probability of being employed. Interestingly, pre-treatment trends are highly similar in this outcome across immigrants and natives. However, a larger difference of approximately ten percentage points appears post-treatment, such that immigrants who pass taxi exams have employment rates that are higher by 17 percentage

points after 36 months, while natives' employment rate is higher by 11 points, as shown in Table 6.

5.2.1 Analysis of pre-treatment trends

Taken together, our results suggest that both immigrants and natives seek out the taxi driver labor market following an adverse shock in the labor market. After passing taxi exams, both groups see large income increases, with immigrants experiencing substantially larger effects. For our estimates to capture the causal effect of passing taxi exams, one must assume that trends in outcomes would have evolved in parallel between the treatment and control groups in the absence of treatment. While we cannot test this assumption, the observed divergence of pre-treatment trends between treatment and control groups indicates that the parallel trends assumption may be violated in our setting. In this section, we discuss how the observed pre-trends may be interpreted and point to their implications for interpreting our estimates.

One possibility is that the observed negative pre-treatment trends indicate that the counterfactual outcomes for the treatment group would have been a continued deterioration relative to the control group. Under this assumption, our estimates would be an underestimate of the causal effect of passing the written taxi exams on income since the control group's outcomes would be higher than the true counterfactual for the treatment group. In such a case, our estimates would provide a lower bound on the causal effect of passing taxi exams on income. However, it is implausible to assume that the observed pre-trends would continue indefinitely in a negative direction, as individuals would likely find other occupations in the absence of becoming taxi drivers. We, therefore, distinguish between two more plausible mechanisms to explain the negative pre-trends and discuss how they would affect the interpretation of our estimates.

The first mechanism is that pre-trends reflect anticipation effects. Individuals who anticipate switching occupations to taxi driving need to spend time studying and researching the labor market, leading to less time or effort spent in their current occupations. This anticipation effect can thus be considered to reflect the investment cost of becoming a taxi driver and constitute part of the net return of becoming a taxi driver. The gross return, excluding these investment costs, can then be estimated by suitably excluding observations before treatment. We propose to exclude 12 months, which is when we start to observe diverging pre-trends. Note that under this assumption, parallel trends hold once we exclude the period of anticipation. Table 7 shows that doing so leads to an estimate of average post-treatment income of 3,607 SEK for immigrants, compared to 4,522 SEK in the standard specification. Thus, while considering anticipation effects decrease our estimated treatment effect, our estimates remain positive and both economically and statistically significant. The effect on employment decreases from 20 to 14.7 percentage points. Similarly, estimates for natives also decrease, with an estimated increase in a monthly income of 680 SEK – down from 1,805 SEK – but a largely similar effect on employment at 10 percentage points. Estimates for monthly income decrease by around 20 percent for immigrants, and 63 percent for natives. Hence, estimates for natives are more sensitive to assuming that pre-trends are driven by anticipation effects, with a relatively small impact on estimates for immigrants, which remain large.

Table 7: Dropping observations 12 months pre-treatment to avoid anticipation effects

	Immigrants		Natives	
	Income	Employment	Income	Employment
Passing	3607.9***	0.147***	680.3***	0.103***
	(42.63)	(0.00152)	(37.32)	(0.000971)
Observations	632214	632214	997890	997890
Mean outcome	9017.7	0.583	13086.0	0.773

*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The table shows the regression on labor market outcomes when including indicator variables for age and year on a balanced panel with individuals included 36 months before and after passing the written exams for the taxi driver license. Observations 12 months before passing taxi exams are excluded. "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-month. Mean outcome refers to two years before passing the written exams.

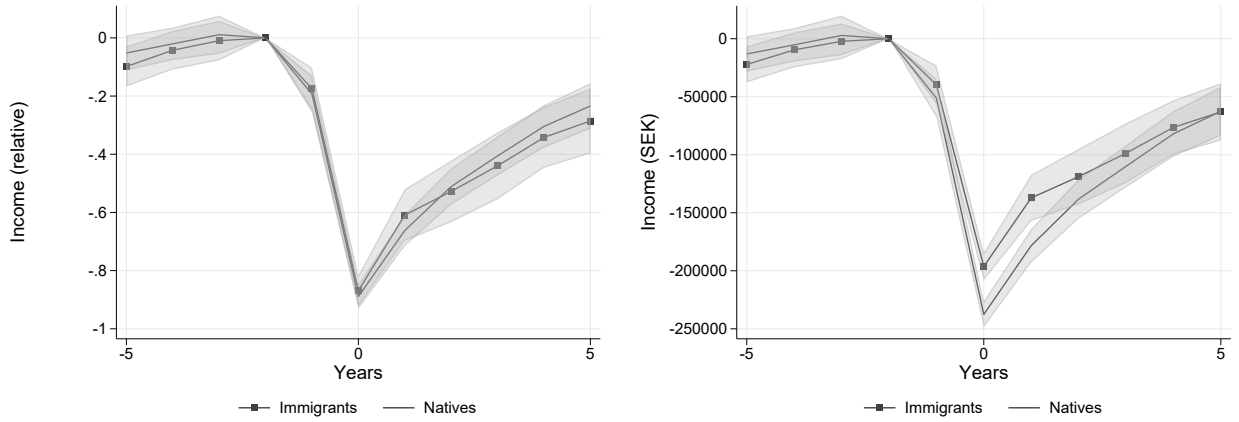
The second potential mechanism for negative pre-treatment trends is that individuals tend to pass the taxi exams following a negative labor market shock, such as losing their employment. If so, it is plausible that incomes would recover to some extent over time, as individuals find new jobs. Therefore, under this assumption, individuals who turn to the taxi labor market would in this scenario have seen their labor market outcomes improve even in the absence of becoming taxi drivers, although it is a priori unclear to what extent they would be able to recover. This is a version of Ashenfelter's dip, a phenomenon in which individuals select into a labor market program in response to a negative shock, after which their incomes improve due to mean reversion rather than a causal program effect (Ashenfelter, 1978). We note, however, that the standard Ashenfelter mechanism cannot explain the pattern of estimates that we observe for immigrants, as immigrants' incomes rise substantially over pre-treatment levels and thus appears unlikely to be explained by mean reversion.

Nevertheless, to quantitatively assess the extent to which mean reversion after job loss could explain the pattern of effects that we observe, we set up a separate event-study design. More specifically, we follow individuals who experience sudden negative income shocks and study the effect on income dynamics in the subsequent years. The idea is to observe what occurs when individuals experience sudden declines in income outside of getting a taxi driver's license. We can then check whether labor market dynamics following income shocks match the pattern of results obtained after passing taxi exams. If post-shock incomes quickly recover and even surpass prior income levels, this would cast doubt on the claim that our estimates capture the causal effect of access to the taxi labor market. Instead, it would indicate that other labor market dynamics associated with job loss are driving our observed effects. To have similar individuals as the ones we have in our main analysis, we create a sample of non-taxi drivers that match our taxi drivers using coarsened exact matching (Blackwell et al., 2009; Iacus et al., 2012). The variables used to

match are region of birth, age, years since migration, and education. This procedure means that we match taxi drivers in their pre-period (before passing the tests) with individuals that never took a test to become taxi drivers.

Using yearly data on income, we define an *income shock* as the year during which an individual has income below a threshold of two price basic amounts (roughly 100 000 SEK or $10 000 USD) after having had an income above that level for at least five consecutive years. We exclude women since taxi drivers are in general men (see Table 3), and we further restrict attention to individuals aged 20 to 60 years old to avoid identifying retirements. We estimate event-study models using the income shock as the event using the same methodology described in Section 4 but using yearly data. Figure 7 displays our results with relative income as the outcome. We find that the income shock is associated with long-term adverse effects on income. One year after the shock, individuals have substantially lower incomes than the pre-shock level, approximately 85 percent lower. This effect persists for several years. Five years later, incomes remain more than 20 percent lower than in the control group. The impact of the income shock is similar for immigrants and natives in relative terms (panel a), but the short-run negative impact in SEK is slightly larger for natives (panel b). In the year of the shock, incomes drop sharply and slowly recover over time. Yet, even five years later, incomes remain over 20 percent lower. These results thus stand in sharp contrast to what we observe for individuals who pass the written taxi exams. While our taxi estimates indicate that incomes quickly rise above the previous mean incomes, the effects of job loss are negative even 5 years later. Thus, it appears unlikely that our results could be explained by dynamics related to income shocks by themselves.

Figure 7: Effect of job loss on income



(a) Relative impact *(b) Impact in SEK*

Note: These graphs show the loss in income after a job loss (defined as going from an income above two price base amounts for at least 5 years to an income less than two price base amounts in a succeeding year). Individuals within the age range of 20 to 60 are included. The figures are not restricted to taxi drivers, but rather a matched sample of individuals.

It is important to note that the above exercise is conducted on a different (but matched) set of individuals than those that eventually become taxi drivers. Therefore, the trends observed after these income shocks may not fully reflect the counterfactual experiences of our taxi driver sample. Nevertheless, the results in Figure 7 indicate that individuals who are subject to an adverse labor market shock tend to experience long-term earnings losses and, on average, do not recover or surpass previous income levels in the way observed for taxi drivers. Therefore, it appears unlikely that individuals who pass the written taxi exams would have experienced the observed increases in income in the absence of treatment. Indeed, Figure 7 implies that our estimates are a lower bound for the causal effect of passing taxi exams, as the true counterfactual is to have an income that is lower than what we observe in the control group.

5.3 Usage of social insurance systems

In this section, we estimate how access to the taxi labor market affects the usage of the social insurance system using data at yearly intervals. We use two outcomes. The first is an indicator taking value one if an individual receives neither social welfare transfers nor housing subsidies, both of which are means-tested, and zero otherwise. The second is an indicator of not receiving unemployment insurance (UI) benefits in a given month. Since unemployment insurance is partly driven by income and contributions to the UI system, we separately analyze such benefits as they have a more direct link to our outcome.

Columns 1 and 3 of Table 8 show our results for UI benefits. For immigrants, we find that they are no less likely (in terms of statistical significance) to receive UI benefits on average in the three years after passing taxi exams, while natives increase their use of UI by 1.3 percentage points. The dynamic effects reported in panel (a) of Figure 8 show that before passing exams, UI usage increases for both groups in the year before treatment. In the treatment year, usage increases by at least ten percentage points. This corresponds well with the observed pre-treatment trends in employment rates, which declined similarly for both groups, as seen in panel (c) of Figure 6. After passing taxi exams, however, both immigrants and natives rapidly reduced their usage of UI benefits. Focusing on the long-run effect three years after treatment, Columns 1 and 3 of Table 9 indicate that both immigrants and natives are significantly less likely to receive UI benefits, with a decrease of 8.5 and 5.8 percentage points, respectively.

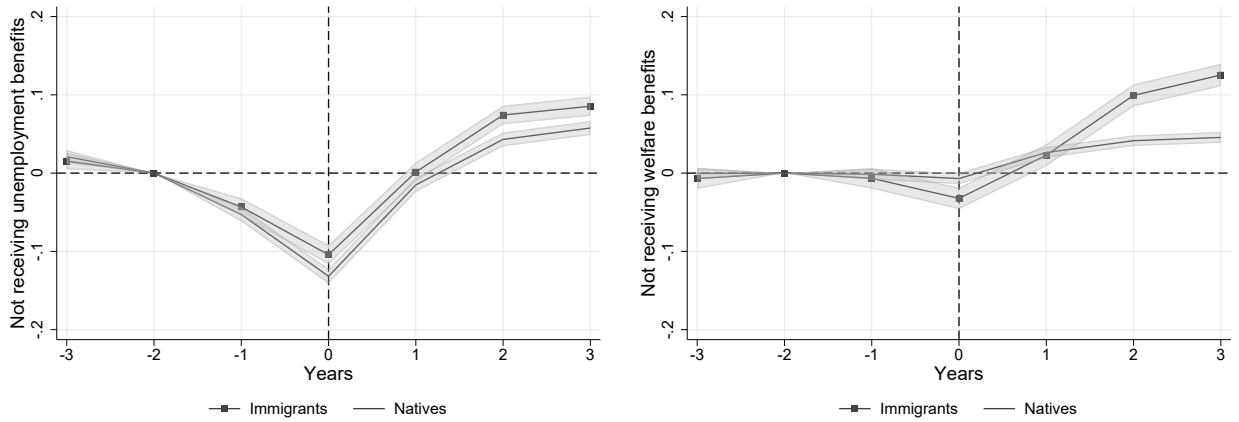
Columns 2 and 4 of Table 8 show our results on receiving means-tested transfers. Two years before passing the written taxi exams, 50 percent of immigrants did not receive any means-tested welfare benefits. After treatment, this is increased by 3.8 percentage points, corresponding to an increase of 7.5 percent. Among natives, the pre-treatment usage of means-tested social welfare is considerably lower, as 88 percent receive no benefits. This is further increased by 2.2 percentage points after passing taxi exams. Panel (b) of Figure 8 shows corresponding event-study estimates. Interestingly, there are only minor trends in pre-treatment usage of welfare benefits among both immigrants and natives. After treatment, however, the share of individuals that receive no welfare benefits rises rapidly, most notably among immigrants. Table 9 shows that immigrants are 12.5

Table 8: Average impact of passing written exams on welfare and UI benefits

	Immigrants		Natives	
	No UI Benefits	No Welfare Benefits	No UI Benefits	No Welfare Benefits
Passing	0.00483	0.0377***	-0.0134***	0.0220***
	(0.00404)	(0.00448)	(0.00298)	(0.00219)
Observations	72898	72898	117299	117299
Mean outcome	0.804	0.508	0.801	0.883

*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The table shows the regression on welfare and UI benefits when including indicator variables for age and year on a balanced panel with individuals included 3 years before and after passing the written exams for the taxi driver license. "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-month. Mean outcome refers to two years before passing the written exams.

Figure 8: Impact of passing written exams on welfare benefits



(a) Not receiving UI benefits

(b) Not receiving welfare benefits

Note: "Not receiving welfare benefits" is equal to one if an individual does not receive means-tested welfare or housing subsidies in a given month, and zero otherwise. "Not receiving unemployment benefits" is equal to one if an individual does not receive UI benefits in a given month, and zero otherwise. The omitted category is two years before passing the written exams.

Table 9: Average impact of passing written exams on welfare and UI benefits at 3 years after passing the test

	Immigrants		Natives	
	No UI Benefits	No Welfare Benefits	No UI Benefits	No Welfare Benefits
Passing	0.0854***	0.125***	0.0576***	0.0456***
	(0.00626)	(0.00734)	(0.00457)	(0.00358)
Observations	72898	72898	117299	117299
Mean outcome	0.804	0.508	0.801	0.883

*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The regressions include indicator variables for age, year, gender, and, years since migration (for immigrants). "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-year. Mean outcome refers to two years before passing the written exams.

percentage points more likely not to receive welfare benefits after three years, an increase of 25 percent over the pre-treatment average. Natives also see a larger effect at 4.6 percentage points, corresponding to an increase of 5 percent.

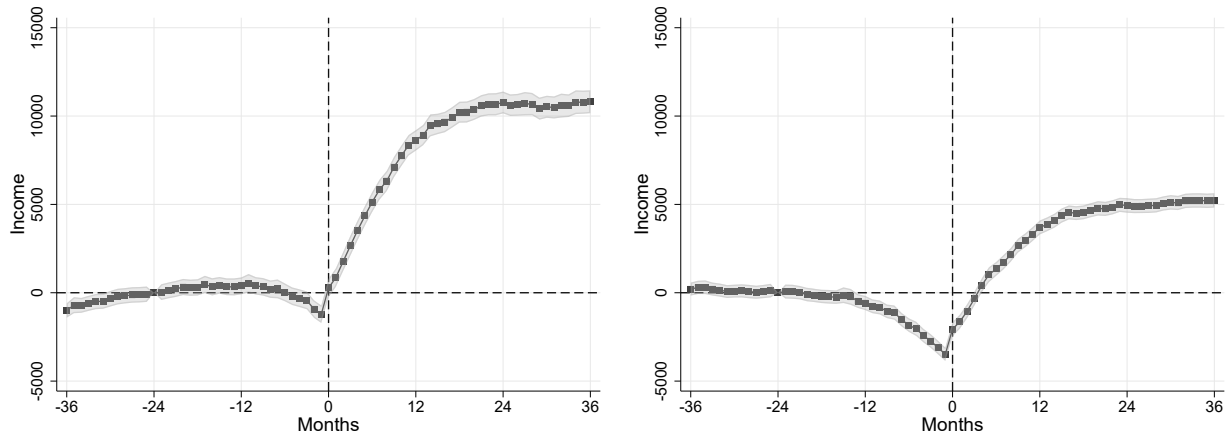
5.4 Heterogeneous effects

The results in Section 5.2 indicate that the immigrants who gain access to the taxi labor market see substantial gains in income, with a smaller effect visible for native Swedes. In this section, we investigate whether there are other heterogeneous effects of treatment, specifically concerning education and length of residence in Sweden.

Figure 9 displays our results for immigrants split by those who are recent arrivals and have been in Sweden for 3–5 years in panel (a) and those who have been in the country for more than five years in panel (b). The panels display marked differences in outcomes. For recent arrivals, pre-treatment trends in income are close to zero and display only a minor income decline in the months leading up to passing exams. By contrast, panel (b) shows that the pre-treatment decline in income that we observe in the full sample is driven by immigrants who have been in Sweden for at least five years. Interestingly, post-treatment incomes are substantially larger among recent arrivals, with estimates indicating that monthly incomes are twice as high in this group compared to those with more experience in Sweden. Table 10, column 1 displays regression output for the heterogeneity, which indicates that average post-treatment incomes are 1,958 SEK smaller for individuals who have been in Sweden 10 years longer, relative to a baseline estimated income increase of 7,913 SEK. Column 2 shows that the same pattern holds for employment, as immigrants who have 10 years long experience in Sweden have a 7.8 percentage point lower effect on employment. Table 11 displays our results when looking at social insurance usage. Since recent arrivals are less likely to be eligible for UI benefits, our effects indicate that treatment effects decrease reliance on UI the

most for immigrants who have been in the country for a longer period. By contrast, the usage of welfare transfers follows the same pattern as labor market outcomes. The baseline effect on the likelihood of not receiving welfare transfers is 27.7 percentage points, which is reduced by 11 percentage points for individuals who arrive 10 years earlier. This result is consistent with returns to taxi driving being largest for those with the weaker outside options in the labor market, such as recent arrivals that tend to have weaker language skills, social networks, and formally recognized qualifications.

Figure 9: Effects of passing written exams on income by years since immigration



(a) 3–5 years *(b) >5 years*

Note: Figures display income effect for immigrants with 3–5 years in Sweden when passing the test (a), and >5 years in Sweden when passing the test (b).

Next, we investigate the heterogeneous effects of education. To do so, we define a dummy taking value one for individuals that have completed an education comparable to more than 12 years of school. Hence, this variable captures post-secondary education. Figure 10, panel (a) displays our results for immigrants. Both higher and lower-educated immigrants display similar dynamics up to one year after treatment, at which point the incomes of higher-educated immigrants increase relatively more. Table 12 shows that higher-educated immigrants earn a significantly higher income of 371 SEK per month, 8.5 percent higher than the low-education effect of 4369 SEK. This result is interesting since it indicates that wages are highest among those immigrants who would presumably be able to earn higher incomes in other, more skilled professions given their level of education. This stands in contrast with results from the same specification on the native sample. For natives, panel (b) of Figure 10, as well as column 3 of Table 12, show that higher-educated natives earn significantly less than their lower-educated counterparts. Table 13 repeats the analysis using welfare and UI benefits as outcomes, showing a statistically significant heterogeneous effect only for high-income natives' usage of welfare benefits.

The finding that more educated natives earn less than their lower-educated counterparts indicates that there is an earnings penalty for entering a lower-skilled occupation such as taxi driving

Table 10: Average impact of passing written exams on labor market outcomes relative to years since immigration

	Immigrants	
	Income	Employment
Passing	7913.2***	0.316***
	(56.04)	(0.00204)
Event × Years since migration	-195.8***	-0.00778***
	(4.926)	(0.000159)
Years since migration	334.0***	0.0127***
	(3.850)	(0.000137)
Observations	744381	744381
Mean outcome	8956.6	0.575

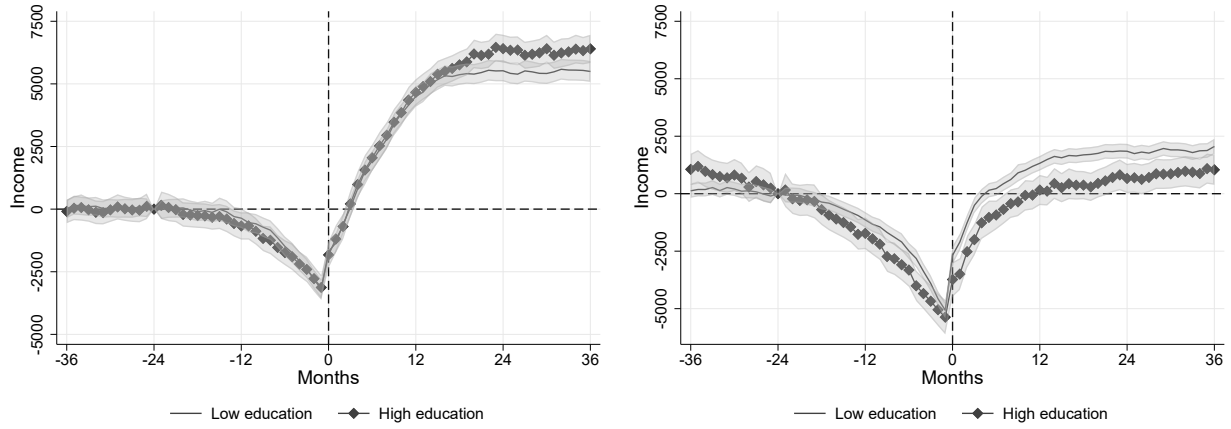
*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The regressions include indicator variables for age, year, gender, and, years since migration (for immigrants). Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-month. Mean outcome refers to two years before passing the written exams.

Table 11: Average impact of passing written exams on welfare and UI benefits relative to years since immigration

	Immigrants	
	No UI Benefits	No Welfare Benefits
Passing	-0.0827***	0.270***
	(0.00574)	(0.00703)
Event × Years since migration	0.00464***	-0.0111***
	(0.000468)	(0.000515)
Years since migration	-0.00790***	0.0273***
	(0.000383)	(0.000434)
Observations	72898	72898
Mean outcome	0.804	0.508

*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The regressions include indicator variables for age, year, gender, and, years since migration (for immigrants). Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-year. Mean outcome refers to two years before passing the written exams.

Figure 10: Effects passing written exams on income by type of education



(a) Immigrants *(b) Natives*

Note: "Low education" means less 12 years of education or less and "high education" means more than 12 years of education. 12 years corresponds to Swedish high school. The distribution of years of education among natives and immigrants is shown in figure 3.

Table 12: Average impact of passing written exams on labor market outcomes relative to the level of education

	Immigrants		Natives	
	Income	Employment	Income	Employment
Passing	4369.2***	0.180***	2107.8***	0.131***
	(41.47)	(0.00149)	(34.22)	(0.000936)
Event × Education	371.7***	0.00356*	-428.4***	0.0153***
	(59.57)	(0.00212)	(64.40)	(0.00163)
Education	300.8***	0.0114***	-308.7***	-0.0250***
	(41.44)	(0.00170)	(47.98)	(0.00132)
Observations	744381	744381	1174935	1174935
Mean outcome	8956.6	0.575	12576.4	0.755

*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The regressions include indicator variables for age, year, month, gender, and, years since migration (for immigrants). "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-month. Mean outcome refers to two years before passing the written exams. Education is an indicator variable equal to one if having more than 12 years of education, and zero otherwise.

Table 13: Average impact of passing written exams on welfare and UI benefits relative to the level of education

	Immigrants		Natives	
	No UI Benefits	No Welfare Benefits	No UI Benefits	No Welfare Benefits
Passing	0.00183	0.0379***	-0.0140***	0.0245***
	(0.00467)	(0.00523)	(0.00339)	(0.00253)
Event × Education	0.00663	-0.00476	0.00340	-0.00821**
	(0.00607)	(0.00712)	(0.00501)	(0.00377)
Education	0.00926**	0.0429***	0.0454***	0.0166***
	(0.00465)	(0.00558)	(0.00387)	(0.00303)
Observations	72898	72898	117299	117299
Mean outcome	0.804	0.508	0.801	0.883

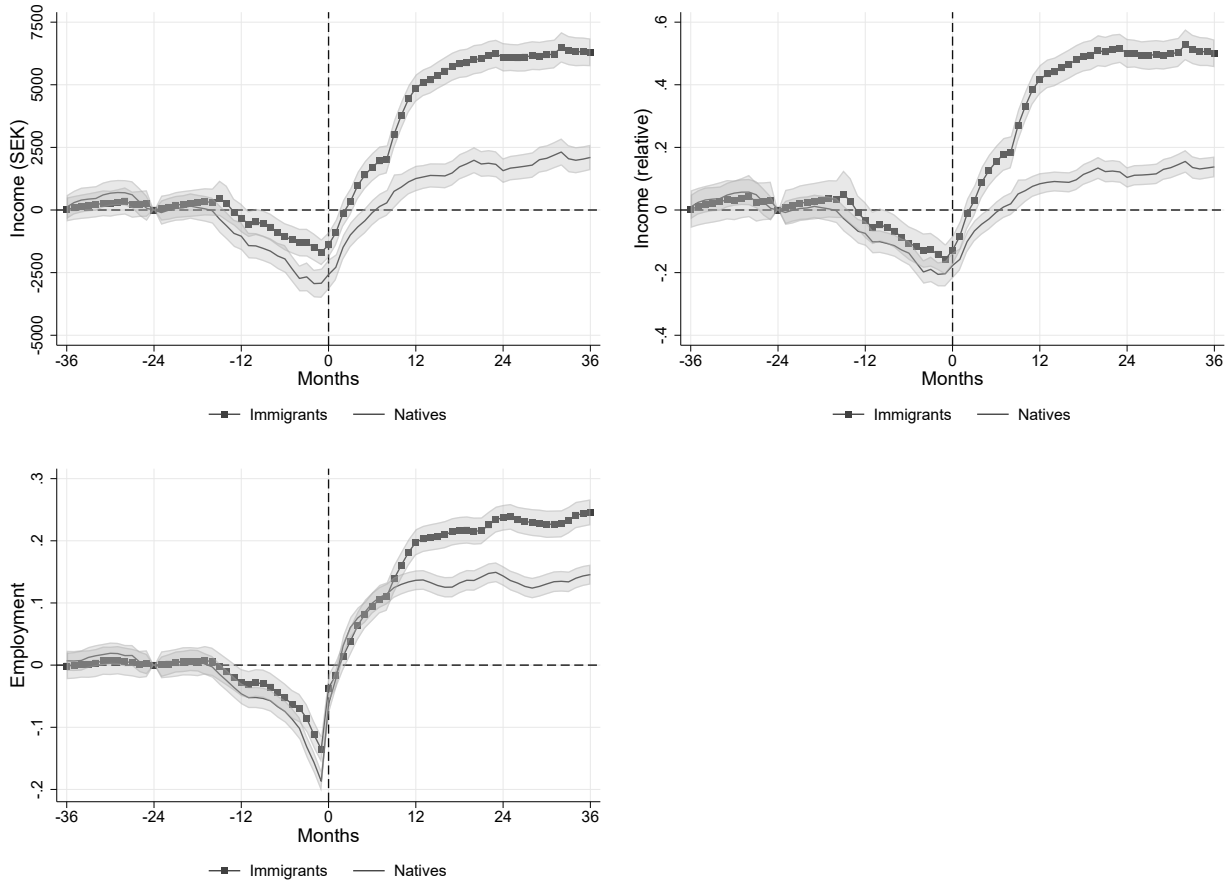
*Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01.*
Note: The regressions include indicator variables for age, year, month, gender, and, years since migration (for immigrants). "Passing" is the event of passing the exams. Income is income in SEK. All specifications control for fixed effects for age, year, month, gender, and, years since migration (for immigrants). Observations are individual-by-year. Mean outcome refers to two years before passing the written exams. Education is an indicator variable equal to one if having more than 12 years of education, and zero otherwise.

instead of one that requires post-secondary schooling. The fact that high-educated immigrants do not experience this wage penalty indicates that higher-education degrees acquired abroad are difficult to use effectively in the Swedish market. The finding that higher-educated immigrants earn more than both higher-educated natives and lower-educated immigrants is in line with the phenomenon of "over-educated" immigrants who turn to low-skill occupations due to difficulties in transferring their foreign human capital to the host country.

6 Robustness checks

In Section 3, we describe our spell-level data are adjusted to create a monthly income measure that avoids a common practice of employers reporting year-long employment spells rather than specifying exact dates. To test for the robustness of this adjustment, we next use the unadjusted data on the subset of individuals who passed their written taxi exams during the first four months of the year, January to April. For this group, misreporting of incomes will play a smaller role as there is less scope for employers to erroneously pre-date employment spells. Thus, by comparing results in this group with those of the full sample with adjusted income data we may ascertain if our adjustments have an impact on outcomes. Figure 11 displays our results. Comparing panels (a) through (c) shows that income and employment trends follow highly similar patterns in this subgroup compared to the full sample in which we adjust incomes. This is reassuring as it indicates that our results are not due to our adjustments of employment-spell data.

Figure 11: Impact of passing written exams on labor market outcomes (January–April)



Note: The figures show the same regressions as figures as in figure 6 but only for individuals passing the tests between January and April.

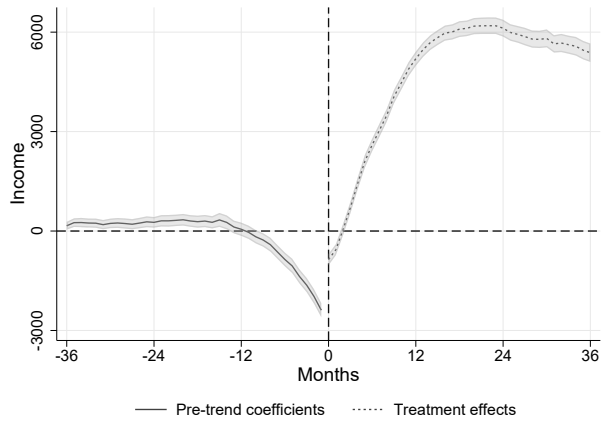
Recent advances in difference-in-differences and event-study methodology have highlighted certain specification issues inherent to these models. In particular, bias may arise with a staggered treatment design combined with heterogeneous or dynamic treatment effects (Baker et al., 2021). The core of the problem with standard methods lies in the control group being incorrectly specified. For staggered treatments, Goodman-Bacon (2021) shows that the two-way fixed effects estimator is a weighted average of 4 different types of comparisons. One type of comparison uses already treated observations as a control group, even though their outcomes may still be dynamically affected by the treatment. Borusyak et al. (2021) call these "forbidden comparisons". To avoid the potential biases of standard methods, we next apply the imputation estimator developed by Borusyak et al. (2021), which is robust to these issues. A key feature of the estimator is that it exploits never-treated units in the control group to create better comparisons, most notably for long-run estimates. The imputation estimator works as follows. First, it uses only never-treated and not-yet-treated observations to estimate the model's basic parameters, namely the individual and time-fixed effects. Second, these parameters are used to impute counterfactual outcomes for treated observations. Third, comparisons are made between treated observations and their counterfactual imputed values, which are then aggregated using appropriately chosen weights to estimate ATT.

Figure 12 displays our results for income and employment outcomes using the Borusyak et al. (2021) imputation estimator. For immigrants in panel (a), pre-treatment patterns are very similar to our results in Figure 6. Post-treatment outcomes are also similar: incomes rise rapidly starting in the month of passing exams and reach a peak between 12 and 24 months later. Compared to our baseline model, however, incomes show a decreasing trend between 24 and 36 months after treatment. This may indicate that there is some catch-up of the control group to those who pass taxi exams. Nevertheless, incomes for those who passed the taxi exams remained substantially higher in levels throughout the sample period.

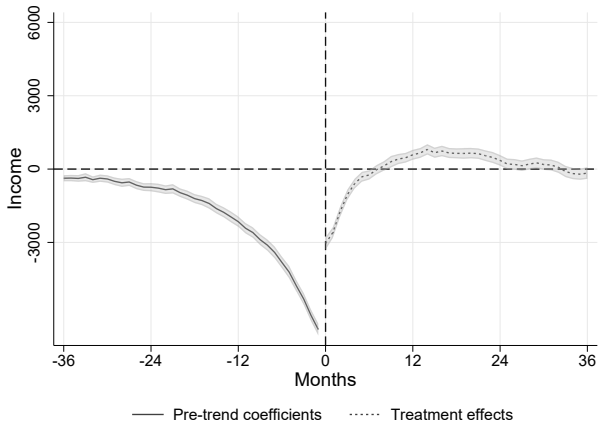
The pattern of results is different for native Swedes, shown in panel (b). Here, the imputation estimator indicates that while natives' incomes do rise after treatment, income increases are notably smaller than in our baseline models, leading treatment and control groups to have the same level of income 36 months after treatment. Similar to the case with immigrants, estimates show a small declining trend over time which is not observed in our baseline models. This may be due to the inclusion of the never-treated group, which over time is on an increasing income trend and therefore catch up to the treated individuals.

Panels (c) and (d) display our results using employment as an outcome. Here, post-treatment results for both immigrants and natives are similar to what our baseline models indicate. Interestingly, therefore, the imputation estimator indicates that natives increase their employment rates significantly over time compared to the control group, but that incomes do not differ. Overall, applying a robust event-study estimator we find similarly large and positive effects for immigrants, albeit with indications that the effect is attenuated somewhat over time. By contrast, the results for natives suggest that their returns to taxi driving are much smaller than for immigrants and

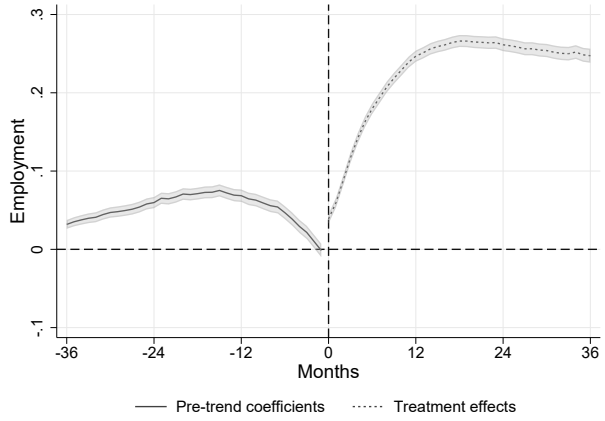
Figure 12: Impact of passing written exams on labor market outcomes including never treated



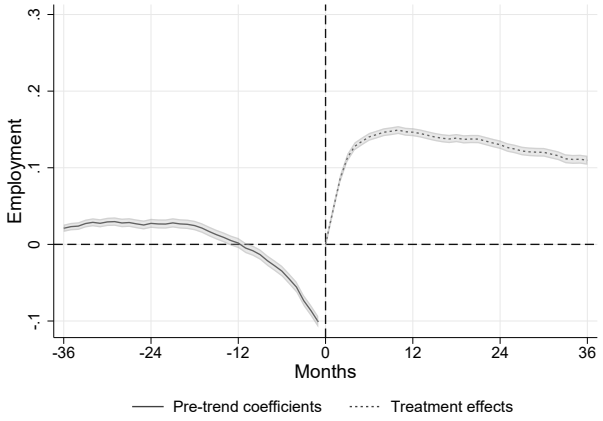
(a) Immigrants



(b) Natives



(c) Immigrants



(d) Natives

Note: "Income" is given in Swedish Krona. "Employment" is equal to one if the individual has an income > 0, and zero otherwise. The graphs include also individuals that never take or pass the written tests to become taxi drivers. The graphs are produced using the approach proposed by Borusyak et al. (2021).

close to zero. Thus, it is important to interpret the results from our baseline model for natives with caution.

7 Conclusions

Despite difficulties faced by many immigrants in finding employment in high-income countries, certain sectors of the economy accommodate large shares of immigrants into their workforce. This paper focuses on one such sector – taxi driving – and estimates the impact of access to the taxi labor market separately for non-Western immigrants and native-born Swedes. To do so, we use individual-level data on written taxi exams as a determinant of who has access to the taxi labor market. We then apply an event-study design to study individuals who pass the necessary written exams required to obtain a taxi license.

Our results indicate that taxi driving plays a different role for immigrants and native-born Swedes. Immigrants see large and persistently positive effects on their monthly incomes, with average relative increases of 50 percent over pre-taxi income levels. In addition, immigrants who pass the taxi driver exams become substantially less likely to rely on means-tested welfare benefits. Native-born Swedes experience smaller positive or potentially zero effects on income relative to pre-taxi averages, but still, have higher rates of employment.

Moreover, our results indicate that selection into taxi driving is not random, but driven by declining labor market outcomes in the months preceding passing taxi exams. It is therefore important to be cautious when interpreting results, as the parallel trends assumption may not hold. Nevertheless, we argue that our pattern of results is unlikely to have occurred in the absence of individuals entering the taxi labor market. Our estimated effects are not driven by the poor pre-treatment incomes artificially amplifying post-treatment effects as results are robust to dropping 12 months of observations before passing exams. We argue that mean reversion is unlikely to explain our results, as a separate event study of individuals who experience income shocks shows that incomes generally persistently decrease for such individuals, rather than recovering or even surpassing pre-treatment incomes. Indeed, both of these robustness tests indicate that our estimates represent lower bounds on the causal effect of passing taxi exams.

The fact that we observe substantially larger effects for immigrants, both in absolute and relative terms, is consistent with outside options in the labor market being very different across these groups. Whereas taxi driving constitutes one occupation among many for natives, the alternatives for immigrants appear to be fewer, thus yielding larger effects when compared to their relative control groups. Analysis of heterogeneous effects supports this hypothesis, as effects are largest for recently-arrived immigrants, who have less experience in location-specific skills. Moreover, many more highly educated individuals take up taxi driving among immigrants than natives. Highly educated immigrants have higher post-taxi earnings compared to lower-educated immigrants, while the opposite is true for natives. We take this to indicate that outside options are generally lower for highly educated immigrants, compared to highly educated natives, in line with studies finding

foreign-acquired human capital having lower economic returns (Friedberg, 2000).

Applying the recent event-study methodology of Borusyak et al. (2021) shows that our results for immigrants are robust to issues such as heterogeneity in treatment effects. However, these results indicate that the standard event-study estimates may be exaggerated for native-born Swedes. The fact that natives who enter the taxi sector regain or potentially surpass their pre-treatment income levels indicates that the taxi labor market represents an opportunity to cope with adverse labor market shocks for this group. In addition, this result further bolsters the divergence in treatment effects across immigrants and natives, highlighting the particular importance of this labor market for non-Western immigrants.

Taken together, our results indicate that the taxi labor market may represent a substantially positive earnings opportunity, especially for immigrants but also natives who experience declining labor outcomes. Moreover, the taxi sector also likely entails a positive fiscal effect, as higher incomes increase tax contributions and the lower use of social insurance systems decreases fiscal costs.

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