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Military service and future earnings: Evidence from an Informed Difference-in-Differences (IDID) approach

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Abstract

Introducing a new informed difference-in-differences (IDID) approach, and utilizing particularities in the Israeli laws and regulations that exempt married women from military service, we provide evidence about the effects of compulsory military service on future earnings of veterans. The IDID estimates suggest that women experience a highly statistically and economically significant 9.9 percent increase in their wages due to their military service. These effects are smaller than those experienced by minority groups, in common with the evidence from this literature. Finally, the discrepancies we found between the naïve and the consistent estimates suggest that people who voluntarily avoid military service are those who face the highest opportunity costs of service.

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1. Introduction

The growing body of evidence suggests that military service causes a loss in civilian labor market experience. The literature, however, is not unanimous about the net effect of service (Routon, 2014). It is possible that the benefits of military service, for example from networking, more than compensate for the lost experience, providing a net positive effect on future earnings (e.g., Asali 2017). Moreover, serving members of minorities are likely to benefit more from (or be harmed less by) military service than their counterparts in the majority group (Hirsch and Mehay, 2003; Phillips et al., 1992; Angrist, 1990).

Using evidence from Israel, this study sheds light on both issues.[1] In particular, it uses law-induced random exemption from service to consistently estimate the effects of service for the majority (Jewish) group, and compares these with earlier findings for minorities. In doing so, the study also offers a new refined difference-in-differences estimator (DID), which we call Informed Difference in Differences (IDID) estimator. This estimator yields more consistent estimates of the effect in question, by addressing the issue of self-selection when that pertains only to one segment of the population. This general methodology can be applied to similar contexts where the difference-in-differences approach is naturally called for but applying the treatment is at the discretion of the potentially treated group—unlike natural experiments, where the treatment is applied to the whole treated group.

In particular, the study focuses on women in the Israeli labor market. While Israeli Arab women do not have to serve in the military, Jewish women must serve, unless they marry before the conscription age.[2] The exemption of married women from service is used to identify the effect of military service among female workers; in the first stage, to control for other wage-related consequences of early marriage, we use Arab women as a control group, and estimate the effect by means of a regular DID approach. Then, and given the fact that early-marriage is a choice variable, that might be induced by the intention to avoid service for Jewish women—but naturally not for Arab women—an informed difference-in-differences estimator is introduced and applied: by estimating the treatment-neutral age of marriage or probability of early marriage, we exclude from the sample early-married Jewish women who otherwise would have not married early had there been no military service exemption for this group. We then apply the usual difference-in-differences procedure on the refined sample, arriving at the IDID estimate.

The study finds a significant effect of military service on future earnings of women in Israel. The naïve difference-in-differences estimate is large (9.1%) and statistically significant, but is likely underestimated. The informed-difference-in-differences estimate is even larger (9.3-11.1% in one approach, and 9.9% in another) and is highly statistically significant. The downward bias of the naïve DID estimate suggests that women who married early only to avoid service own productive properties that would render their earnings higher in the labor market, regardless of military

[1] As argued in Kollias (1995), evidence from individual countries, like Israel in this case, can nevertheless contribute to the general understanding of an important question.

[2] Individuals can also be exempt from service on the ground of religiousness (that is, being defined as an ultra-orthodox Jew). However, from the original sample of males and females, using the single available religiousness-relevant variable ('years studied at a Yeshiva') and defining an ultra-orthodox as somebody who studied any number of years at a Yeshiva (from 1-16+), we essentially found that none of the females were ultra-orthodox based on this definition (as opposed to 2.5% of the males). Hence the religiousness cannot be used to identify the effect of military service among female workers.

service. In other words, people who voluntarily avoid military service are those who face the highest opportunity costs of service.

Finally, comparing these findings with earlier evidence about the effects among Arabs in Israel, as shown in Asali (2017), it is evident that the effects experienced by minorities are much larger, and can be twice as large as those experienced by members of the majority group; an outcome that resonates with evidence from this literature.

The following section describes the data used in this study. The methodology is presented in section 3. Section 4 reports the main results of this study. Section 5 concludes.

2. Data

We use data from the Israeli population census of 1995, a representative sample that includes 20% of the whole population, covering Israeli citizens of all ethnic and religious backgrounds. For the question at hand we split the sample by nationality (Jewish women versus Arab women).

We limit our sample to workers with positive income from salaried work, in the post-service, pre-retirement ages of 25-64. Table I reports summary statistics of the main variables used in this study.

Table I: Summary Statistics

	Jewish Women		Arab Women	
	All	NME	All	NME
Log hourly wage	3.143	3.178	2.881	2.878
	(.735)	(.726)	(.898)	(.914)
Age	40.4	38.6	35.4	35.0
	(9.698)	(9.751)	(8.091)	(7.922)
Household size	3.79	3.64	4.81	4.74
	(1.518)	(1.539)	(2.124)	(2.211)
Number of children	2.28	1.96	2.56	2.39
	(1.556)	(1.701)	(2.664)	(2.915)
With 0-12 years of schooling	.528	.464	.560	.531
	(.499)	(.499)	(.496)	(.499)
With 13-15 years of schooling	.242	.261	.267	.276
	(.429)	(.439)	(.442)	(.447)
With 16+ years of schooling	.230	.275	.172	.194
	(.421)	(.447)	(.378)	(.395)
From Jerusalem, Tel-Aviv, or Haifa	.226	.253	.224	.228
	(.419)	(.435)	(.417)	(.420)
Married early	.396	0	.256	0
	(.489)		(.436)	
Observations	90,287	54,521	4,987	3,712

Notes: Samples include women workers aged 25-64, with strictly positive income from salaried work. "NME," standing for not-married-early, is defined as a woman who was not married at or before the age of 18-19: for Arabs, who do *not* serve in the military, it just means that they did not marry early or ever; for Jewish women, however, it also means that they did actually serve in the military. Standard deviations in parentheses.

The table shows summary statistics for the whole sample of Jewish and Arab women, as well as for the subsample of "non-married-early" (NME) women of both nationalities. NME is defined as a woman who was not married at or before the official service age (18-19) and hence, if she were Jewish, she had to serve in the military by decree.

The average log hourly wage of a serving Jewish woman is 3.178, while that of a non-serving (early-married) woman is 3.09, yielding a gross wage gap of about 8.8%.[3] For Arab women, the gap between the early-married and the rest is 0.003, which is statistically not different from zero.[4]

The early-married women, both Arab and Jewish, differ slightly from the general population of female workers: they are less likely to attain higher education, they are older—suggesting that early marriage is more likely to be associated with earlier generations, they have more kids, they live in dwellings with bigger households, and are less likely to live in a large city (Tel-Aviv, Haifa, or Jerusalem). These demographic differences, however, are not large; and they are comparable between the different nationalities, albeit Arab women are less highly-educated and live in larger households.

Interestingly, the incidence of early-marriage is more widespread among Jewish women. This might be an early sign that some of these early-marriages are likely induced by service-avoidance motives.[5]

3. Methods

Every resident and citizen of Israel has to serve in the military. By law and practice, however, Arab women are completely exempt from service. Exempt from service are also the early-married Jewish women (those who were already married at the official conscription age of 18-19).[6] We use this fact to identify the effect of military service on the future earnings of Jewish female workers. This can be captured by estimating the following equation, on a post-service sample (ages 25-64), separately for Jewish and Arab women:

$$\ln wage_{ig} = X_{ig}\beta_g + \gamma_g NME_{ig} + \varepsilon_{ig}, \quad i = 1,2,\dots,n; \quad g = Jew, Arab \tag{1}$$

where $wage_{ig}$ is the hourly wage of worker i of ethnicity g (Arab or Jewish); X_{ig} is a vector of control variables that includes the age of the worker, the squared age, dummy variables for schooling categories, dummy variables for marital status, dummy variables for the type of locality of abode, and industry and occupation controls. NME_{ig} is a dummy variable that takes on the value zero if the worker is a female who married early (at or before the age of 18-19), that is before service age—and thus, as a Jewish woman, did not have to serve. Arab women do not serve in the military, regardless of the value of NME, whether they married early or not. Otherwise, NME takes on the value one, signifying military service for Jewish women. ε_{ig} is the error term. The

[3] The hourly wage calculated here is the monthly earning from salaried work divided by the total monthly working hours. This does *not* include income from self-employment.

[4] Notice that we are only concerned with the differences or wage gaps and not the levels, as measures of the effect at hand. The clear differences in the wage levels between Jewish and Arab workers, however, is attributed to other labor market frictions in Israel, as documented in Asali (2010).

[5] Another interesting related fact from the sample is that the share of Jewish women who married more than once is almost three times that of Arab women (3.9% as opposed to 1.4% among Arab women).

[6] As mentioned earlier, also religious individuals can be exempt from service, but almost none of the women in our sample were defined as religious. See Asali (2017) for a background and thorough description of these laws and regulations.

coefficient of interest is γ_g which measures the effect of military service on the earnings of Jewish women ($g = J$) and Arab women ($g = A$). Since Arab women do not have to serve, we expect γ_g to be zero in their case, or to capture other effects of early-marriage on earnings (other than the military service effect).[7]

Because marrying early can be related to some unobservable variables that might have an effect on the earnings, beside its direct effect on the treatment—i.e., the exemption from service for Jewish women, we can net out this confounding effect by comparing the gross effect among Jewish workers with that among Arab workers. This is a simple difference-in-differences (DID) estimation of the following form:

$$\ln wage_i = X_i\beta + \gamma_1 NME_i \times Jewish_i + \gamma_2 NME_i + \gamma_3 Jewish_i + \varepsilon_i \quad (2)$$

Where the added terms are the dummy variable Jewish, and the interaction term $NME \times Jewish$, and the analysis is carried out for the pooled sample of Jewish and Arab women. The coefficient of the interaction term, γ_1, is the DID coefficient of interest which measures the net effect of military service on future earnings of Jewish women. It effectively measures the difference between the differences in earnings for early-married and non-early-married women of the two populations, controlling for a multitude of demographic and labor market variables.

γ_1 will consistently measure the effect of military service on future earnings of women if NME captures the same productivity-related variables for both Arab and Jewish women. Assuming this is indeed the case, for some Jewish women, however, there is a single potential apparent difference between what NME captures for them and what it does for Arab women, and that is the incentive to avoid service. For Arab women, by definition and by construction the NME does not include any such variable as "avoiding service," because they do not have to serve in the military in the first place.

To alleviate this problem, the sample of early-married Jewish women should exclude those who would not have married early had there been no exemption from service for them. To do that, we propose the following two-step procedure, the resulting estimator of which we call the informed difference-in-differences estimator (IDID):

First step: *Refine the sample of the untreated (early-married) Jewish women*

We propose two methods to do that.

Method 1: From the sample of Arab women (the control group), we estimate the probability to marry early by a suitable limited dependent variable model (logit, or probit). We use a probit model in this study.

$$\Pr(NME = 1|Z, Arab) = \Phi(Z_A\delta_A) \quad (3)$$

Where Z is chosen to include some demographic variables that are potentially correlated with the timing of marriage, like schooling, age, squared age, the size of the household, the number of children in the household, cohort fixed effects (half-decadal intervals of birth year), own children born, and the type of locality of residence. Variables in Z can overlap with X, if the probability model used is nonlinear. For the identification strategy to be less fragile, however, it is advisable

[7] Estimates of this equation are not reported to conserve space, however the estimate of γ_A was an insignificant -0.02 (with standard error of .027), and that of γ_J amounted to a statistically highly significant 0.034 (SE .005).

that Z includes one or more variables that do not appear in X, and that affect the decision to marry early. The choice of Z as above satisfies this requirement.

It is important to note that with this procedure we aim at capturing only the correlations between these variables and early marriage, for predictive purposes only, regardless the direction of causality, if that exists at all.

Using the estimated δ_A from the sample of Arab women, we calculate the predicted values of the probability of early marriage for Jewish women, as $\Phi(Z_J\delta_A)$. As Arab women do not have a "service avoidance" component in their early-marriage decisions, using δ_A in predicting the probabilities of early marriage for Jewish women results in consistent estimates of these probabilities that do not suffer from the service avoidance consideration.

Notwithstanding, it is worth emphasizing that the likely major cultural and social differences between the two populations in question might result in an estimate of δ_A that cannot accurately represent the unbiased (avoidance-incentives-free) δ_J, rendering this refining procedure fragile and inaccurate. Unfortunately, for the lack of data, these potential cultural and social differences cannot be controlled for or alleviated in the probability equation. Results based on Method 1, therefore, should be taken with caution.

We then drop from the sample of early-married Jewish women all those who are predicted (beyond some probability) not to have married early based on the above calculated probabilities—this being defined as $\Pr(NME) > p$. Since the threshold p is essentially arbitrary, we use different values of p to refine the sample, and test the sensitivity of the procedure to the chosen threshold (we report results based on $p \in [0.3 - 0.7]$). Smaller values of p result in better control samples—less confounded by service-avoidance motivation—yet at the cost of smaller samples. It is also worth emphasizing that in the extreme case of $p = 1$, no observations will be eliminated, and the IDID estimator boils down to the regular DID estimator. Finally, we use the refined sample for analysis in the second step.

Method 2: We use the sample of Jewish women to estimate the average age at the first marriage (AFM), estimating the following equation:

$$AFM_i = \pi_J + Z_{iJ}\eta_J + e_{iJ} \tag{4}$$

Where Z is defined as above. We then estimate the predicted age at first marriage ($\widehat{AFM}$) for the early-married Jewish women (for whom the actual $AFM \leq 19$). Finally, we exclude from the sample all these early-married Jewish women whose predicted age at first marriage is above 19 ($\widehat{AFM} > 19$). We then use this thus-refined sample in the second stage of analysis.

Second Step: *estimate equation (2) using the informed (reduced) sample from the first step*

This produces the informed difference-in-differences estimates from the refined sample (IDID). Rendering the control group and the treatment group more comparable, the coefficient of interest from this estimation will then measure the causal effect of military service on future earnings, absent the potential bias caused by unobservable and immeasurable variables, like the tendency to avoid service by marrying early.

4. Empirical Results

Table II reports the main results of this study. The first column reports the simple difference-in-differences estimate of the effect of military service on earnings (γ_1 from Equation 2).

As can be seen from the table, the premium of service is estimated at 9.1%, which is economically and statistically significant at all conventional levels. The middle panel of the table and the last column report, respectively, the IDID estimates resulting from using Method 1 and Method 2 in the first step.

Table II: The Effects of Military Service on Future Earnings of Women

		IDID-1					
	DID	0.3	0.4	0.5	0.6	0.7	IDID-2
NME	.091***	.111***	.101***	.097***	.095***	.093***	.099***
$\times Jewish$	(.026)	(.026)	(.026)	(.026)	(.026)	(.026)	(.026)
NME	-.076***	-.072***	-.073***	-.074***	-.075***	-.075***	-.071***
	(.025)	(.025)	(.025)	(.026)	(.025)	(.025)	(.025)
$Jewish$	.192***	.165***	.176***	.179***	.182***	.187***	.179***
	(.026)	(.026)	(.026)	(.026)	(.026)	(.026)	(.026)
Age	.045***	.049***	.048***	.047***	.046***	.045***	.048***
	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)	(.002)
Age^2(x1000)	-.408***	-.449***	-.437***	-.423***	-.412***	-.402***	-.440***
	(.022)	(.025)	(.024)	(.024)	(.023)	(.023)	(.025)
Constant	1.612***	1.483***	1.522***	1.555***	1.576***	1.601***	1.519***
	(.061)	(.068)	(.066)	(.065)	(.064)	(.062)	(.068)
R-squared	.275	.260	.264	.267	.270	.271	.257
Observations	95,274	70,675	75,465	80,449	84,890	88,968	68,733

Notes: DID stands for the difference-in-differences estimates. IDID stands for the informed-difference-in-differences estimates. IDID-1 uses the predicted $\Pr(NME) > p$ to remove early-married (ME) Jewish women from the sample, where p appears in the column titles above (0.3, 0.4, 0.5, 0.6, 0.7); the predicted probabilities are calculated using coefficients from a probit regression of late marriage (NME) among Arab women. IDID-2 removes ME-Jewish women from the sample based on the predicted age of marriage (if that is greater than 19), which is estimated from a Jewish-only sample of women. The dependent variable is the log of hourly wage. Other included explanatory variables are: schooling, marital status, type of locality, industry, and occupation. Samples include female workers aged 25-64, with strictly positive income from salaried work. *NME,* standing for not-married-early, takes on the value 1 if the woman did not marry early (before the age of 18-19) or ever, and zero otherwise. For Jewish women only, *NME=1* also means that they served in the military. Robust standard errors in parentheses.
*** Significant at the 1% level.

Working with the refined sample, that excludes early-married Jewish women who are predicted to not have married early had there been no military-avoidance considerations, produces the ultimate consistent informed-difference-in-differences estimates as reported in the middle panel and the last column of the table.

The effect of military service on future earnings of Jewish women is a large and positive 11.1% (if we choose the threshold of $p = .3$ in the first exclusion method); the effect is relatively insensitive to the chosen threshold, yet understandably it converges to the DID estimate of 9.1% when p increases (i.e., when it becomes less strict in excluding observations).

Using Method 2 for refining the sample—a method that is free from any observed or unobserved cultural and social differences between Arab and Jewish women—yields a more stable and consistent estimate of the effect, as reported in the last column of the table (IDID-2). The 9.9%

service premium thus estimated is highly statistically significant, and it is slightly larger than the DID estimate.

The likely downward bias of the naïve DID estimates (and the OLS estimates) is a sign that people who avoid military service do so because they are likely to face higher opportunity costs of service—hence, excluding them from the control sample lowers its marginal productivity, and results in a higher measured gap between the treated and the untreated. The absolute bias between the DID and the IDID estimates, not being that large, however, suggests that this avoidance activity is not of a major concern.

5. Conclusion

This paper suggests a two-step procedure that enhances the difference-in-differences (DID) estimator by making the untreated comparison group more homogeneous—by excluding untreated observations that would likely have been treated had there been no option for self-selection out of treatment.

We refer to this estimator as the informed-difference-in-differences (IDID) estimator, and we apply it in this study to measure the effect of military service on future earnings of Jewish women in Israel.

The study finds a statistically and economically significant effect of military service on future earnings of Jewish women in Israel, that amounts to a premium of 9.9%.

Comparison with earlier evidence on the effects of military service among Israeli Arabs shows that the benefits experienced by minorities are considerably larger than those experienced by members of the majority group—a finding that is in line with evidence from this literature. Incidentally, our evidence also suggests that people who voluntarily avoid military service are likely those who face the highest opportunity costs of service.

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