Strong versus Weak Ties:

Social Mobility of British WWI Soldiers*

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Abstract

At the onset of World War I, Britain's military raised military units in three distinct ways: some regiments drew men from across all social classes and across the country, some regiments emerged from the local units of the Territorial Force (TF), and thirdly, some regiments enlisted family members, neighbors, and coworkers in groups. These cohesive and homogenous "Pals battalions" were, in part, a direct response to the opposition of upper class men to serve alongside the lower classes. This unique military structure allows us to test the effect of expanding your social network across class and occupation boundaries on occupational mobility. We compare regular regiment enlistees to the Territorial Force and Pals Battalions enlistees using World War I enlistment records and the post-war 1939 Register. Across a variety of measures of occupational mobility, we find suggestive evidence that, in particular for unskilled soldiers, the weak ties of non-Pals, non-TF soldiers contributed more to upward social mobility than the strong ties of Pals and the TF.

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I Introduction

Military service inevitably changes the lives of those who serve. One important channel is through each soldier's development of a new network of friends and contacts. For those who survive, transitioning back to civilian life after war, with a key component being finding a new job, is often difficult. Especially in Britain after the end of World War I, jobs were scarce. The end of the war saw a spike in unemployment and an economic downturn, as war-time spending receded but private demand remained suppressed and welfare policy changes complicated the recovery (Cole and Ohanian, 1999). Having a supportive network that channeled information about job opportunities was likely vital to many former soldiers. Not all soldiers who served in World War I, however, made the same type of new connections and friendships during the war.

In this paper, we exploit the institutional heterogeneity of enlistment in Britain in the early days of World War I to study the effects of network extensions on occupational and social mobility. Namely, we compare the social outcomes of soldiers who served in "Pals battalions," organizations started with the express purpose of encouraging joining up with the guarantee of service with friends and family members, with the outcomes of other soldiers. By studying exclusively soldiers who served in similar battles, we effectively hold exposure to the war itself fixed.

We perform our main analysis by estimating a Difference-in-Difference (Diff-in-Diff) model to compare the post-war (from enlistment to 1939) social mobility of Pals and non-Pals New Armies soldiers, whom we call non-Pals. We control for various physical characteristics recorded in the enlistment data. We further consider the role of Pals for different skill levels and initial social class by estimating separate Diff-in-Diff models. We also perform several robustness checks, including checking for pre-trends in social mobility using 1911 Census records; comparing the Pals' mobility to that of Territorial Force soldiers, whom we consider to be "extreme" versions of Pals; testing the endogenous selection of our matching protocol; and comparing the casualty rates of Pals vs. non-Pals as a proxy for the intensity of their war experiences. Finally, we compare the mobility patterns of Pals and non-Pals using the Altham statistic, as introduced by Altham and Ferrie (2007).

We find suggestive evidence that weak ties dominate strong ties, as proposed by Granovetter (1973), as Pals soldiers (and to an even greater degree, Territorial Force soldiers) typically experienced less upward social mobility than the non-Pal volunteers in the New Armies. Our point estimates are generally not statistically significant, however, in part due to sample sizes and in-

sufficient data quality. We are not surprised by this lack of significance, further, because the Pals battalions were merged with other battalions in 1916, leading to a general network extension even for the Pals soldiers. Moreover, British society has been marked by highly rigid class structures, with estimates of intergenerational class mobility usually being very small (Long and Ferrie, 2013; Erikson et al., 1979). Hence, finding even weak evidence is a strong vindication for the theory of weak ties.

This paper's contributions are twofold. First, we produce an original dataset, based on merging several distinct sets of historical records. This dataset could be used for further research and is unique, as far as we know. Second, we test an important theory in the social sciences: the possible dominance of a large network of weak ties over a smaller network of strong ties. While we are certainly not the first to consider Granovetter's theory, we hope to provide some insight in a fresh new setting.

The remainder of our paper is organized as follows. The next section introduces the historical background and the institutional features we wish to exploit and provides the intuition by which we consider a soldier's option to participate in a Pals battalion to be arguably exogenous. Section III discusses related literature. Section IV lays out a simple theoretical model that formalizes our hypotheses. Section V describes our data collection and matching process and discusses the social class measures and our associated definition of social mobility. Then, Section VI presents the main empirical analysis and results. We supply further tests of our hypothesis using the framework introduced by Altham and Ferrie (2007) in Section VII Section VIII discusses these results and concludes.

II Historical Background

When she declared war on Germany on 4 August, 1914, Britain had a small professional army of 450,000 men. Secretary of State for War Lord Kitchener expected the war to require more soldiers than this and consequently began a campaign to raise the number of enlistments. Because conscription was politically unpopular, the government sought methods to popularize the volunteering process. The new units formed during this wave of enlistment were coined the "New Armies" (Simkins, 2014). One method to increase volunteering, suggested and developed by General Henry Rawlinson and Lord Derby, respectively, was built on the premise that men might be more

willing to serve if they knew they could serve alongside people they already knew — family, neighbors, coworkers, etc. For instance, in Manchester, there was demand for restricted battalions because middle class men did not want to serve with the lower class. This campaign, popularly called the Pals battalions, was quite successful (Robinson, 2011). This campaign became highly competitive across the country, as cities competed to raised the most units, in the midst of recruitment for other New Armies volunteer battalions. In total, the Pals campaign raised 145 service and 70 local battalions.[1] We believe that the creation of Pals battalions in particular locales was due to idiosyncratic forces, such that the opportunity to serve in a Pals battalion was exogenous from the point of individual soldiers. Sometimes the Pals battalions were also limited to particular groups – the Middlesex 17th Battalion consisted of footballers while the Royal Fusiliers 10th Battalion was composed of stock-brokers – such that only some residents of the same town could participate. Below we effectively use Pals participation as an instrument for the opportunity to serve in a Pals battalion; though Pals participation is undoubtedly endogenous to each soldier, the opportunity to serve in Pals (which we consider to be the intent to treat) was arguably exogenous.

Despite the initial success, the Pals battalion program became controversial during the Battle of the Somme, which began 1 July 1916 and was the first battle for most of the volunteers, both Pals and non-Pals. The British experienced massive casualties during this battle, and, in particular, saw several Pals battalions lose large majorities of their soldiers. Since the Pals battalions were inherently sourced from small regions, this meant that some town's populations of young men were nearly wiped out, devastating the country. The Pals battalions program was discontinued in 1916, as the country turned to conscription, and some Pals battalions were filled in with other soldiers while others were disbanded and their soldiers sent to fill other posts.

This Pals campaign was unique in the way that soldiers who served in the Pals units were exposed to less heterogeneity of peers than soldiers who served in other types of units. This may have led to Pals soldiers gaining less of a network from the war and possibly solidifying the ties they had coming into the war. That is, while Pals soldiers interacted with fewer soldiers outside of their pre-war social circles, they may have become even more bonded to the men with whom they chose to serve. Meanwhile, non-Pals soldiers may have been exposed to a larger variety of social classes, leading to more various relationships post-war. This supposition is plausible, as soldiers typically

[1]Each battalion typically was composed of around 1000 soldiers. See `http://www.longlongtrail.co.uk/army/definitions-of-units/what-was-a-battalion-of-infantry/` for more details.

only consistently interacted with soldiers from same battalion (Boff, 2014).

A further anomaly of the British military structure, compared to continental forces, was the existence of a local volunteers force called the Territorial Force. Soldiers in the Territorial Force were initially under contract to serve if and only if enemy soldiers invaded Britain; when the war began, many of these soldiers agreed to serve abroad instead. These units were unique in that they were solely comprised of local men, making them even more homogeneous than the Pals battalions. That is, each Pals battalion could span many groups of friends that were not necessarily connected or from the same small town, while the Territorial Force was restricted to a local area. Before the war most other regiments were regionally sourced, but once enlistments began for WWI, soldiers in the New Armies and the Regular Army were sent where they were needed, even if it meant they joined a regiment from the opposite side of the country (Boff, 2014).

In the analysis below, we typically consider the role of participation in a Pals battalion as compared to service in a non-Pals New Armies battalion in determining post-war social mobility. We consider the Territorial Force soldiers experiences as a robustness analysis for our findings; we do not focus on the Territorial Force soldiers in our main sample because their service is arguably less exogenous than that of the Pals.

1 Types of Battalions

For our empirical analysis below, it is important to identify the correct "control" group of non-Pals. Specifically, there are several types of battalions that served in the first few years of World War I:

First, some battalions belonged to the Regular Army. These battalions existed in some form before World War I, and often contained soldiers who were serving in the military before the war broke out. We generally exclude the soldiers who served in these battalions, as they are more likely to be career soldiers and thus may be different than the civilian men who became soldiers during the war. In Section VII we do, however, consider the reserve Regular Army battalions, which were almost wholly composed of new volunteers and were thus somewhat similar to the New Armies battalions.

Second, some battalions formed the Territorial Force. This group was formed in 1908 from even more irregular and locally sourced militias and was a reservist home defense force. Each battalion was composed of men from a particular locality. In some ways, we think of the Territorial

Force as an even more extreme version of the Pals, as they were more homogeneously local. We typically exclude soldiers who served in the Territorial Force before the war started, but consider them in a robustness analysis.

Third, some battalions comprised the New Armies, which were formed specifically for World War I. This large group includes the Pals battalions, which provided soldiers with the opportunity to serve with their friends and coworkers (along with others outside their immediate social circle). We typically focus on the New Armies soldiers who did not serve in Pals battalions as the basis for our control group, and refer to these soldiers as "non-Pals" going forward.

III Related Literature

Our study involves three intersecting components: networks, labor markets, and war. These topics have been analyzed by many social scientists. Here we discuss some of these treatments that are most related to our work.

In terms of the relationship between war and labor outcomes, Laschever (2013) presents the most related study to ours; Laschever (2013) studies the peer effects of American WWI infantrymen and finds that soldiers whose military-unit-mates had higher unemployment rates after the war were also more likely to be unemployed post-war. In a similar vein, Costa and Kahn (2003) study peer effects for American Civil War soldiers, in terms of probability of desertion and arrest.

Angrist (1990) focuses on the effect of serving in the military, by using the Vietnam War draft to study how military service affects post-war earnings. This is a different angle from our study, as well as from Laschever (2013) and Costa and Kahn (2003), since we effectively control for the effect of ordinary service by having both our "control" and "treatment" groups drawn from soldiers.

Several authors have developed theoretical models, both search-oriented and strictly network based, to study the potential role for workers' networks in transmitting information about job opportunities. Boorman (1975) proposes a model in which a worker encounters a vacant job and either takes it, if she is unemployed, or defers the job to a member of her network. In a similar model, Calvó-Armengol and Jackson (2007) demonstrate how even slightly-heterogeneous social networks can lead to persistent differences in wages, when workers learn about jobs through the networks. Galenianos (2014) presents a search model, discussed more in Section IV, in which employed workers refer members of their networks to job openings at their firms. On the more empirical side, Topa

(2001) explains clustering of unemployment in Chicago neighborhoods by the probability of members of those neighborhoods interacting in networks that transmit information.

Furthermore, the importance of networks for labor market outcomes is not a recent discovery: de Schweinitz (1932) demonstrates that nearly half of workers in the Philadelphia hosier industry received their jobs with the help of friends and family. However, it was not until Granovetter (1973) that the role of connections beyond friends and family was thought to be potentially just as important as the role of close connections. Granovetter (1973) provides the seminal origin of network theory, in sociology, by arguing that it is weak ties, rather than strong ties, that can yield productive outcomes. That is, weak ties provide a cohesive power that can allow for relations between different groups, leading to a potential dominance of weak ties over strong ties, in terms of spreading information. This contrasted significantly with the prior historical view of the utmost importance of strong ties.

The importance of social networks, beyond the scope of labor outcomes, has been well-demonstrated. The contexts for networks' relevance are wide ranging. For instance, Bertrand et al. (2000) demonstrate how networks can influence the choice to take-up welfare, while Bayer et al. (2009) show the role of networks for juvenile delinquents for the likelihood of recidivism.

One important way in which our study differs from much of the recent literature is that our level of potential randomness is not at the group-composition level but rather at the group-formation level. That is, while several other studies analyze the impact of networks in cases in which the networks were formed randomly[2], we study the difference between soldiers who chose to be in a group with their peers and soldiers who were quasi-randomly assigned to a group. As we have argued, the opportunity to choose to be in a group with peers was a quasi-random occurrence, due to the regionally idiosyncratic participation in the Pals campaign.

Granovetter (1973)'s original hypothesis of the strength of weak ties has been busily tested and broadly confirmed since its very inception. See for example Langlois (1977) for a very early analysis of Quebecois labour market data and the further articles cited and discussed in Granovetter (1983). A recurring result in these papers is that manual jobs and lower skilled jobs were more likely to be referred via strong ties than high skill and white collar jobs, which arise predominantly from referrals via weak ties. However, these papers could do little to determine whether this is an innate feature of blue collar jobs (workers can only be referred by a close acquaintance for reasons of reliability and other less easily observable characteristics, say) or testament to the disadvantaged

[2]See Bayer et al. (2009); Sacerdote (2001); Zimmerman (2003); Kling et al. (2007), etc.

network position of low skilled workers (they would and could escape towards better jobs if they just had a better network). Our study can try to make some headway in this direction by considering an exogenous shock to the network of an almost representative sample of the population, including both high and low skilled workers.

Less directly related to the original labor market considerations, researchers have tested elements of the causal mechanism proposed by Granovetter; i.e., that information acquired and refined in tightly-knit groups is transmitted via weak "bridging" ties to different, not otherwise connected groups. For example, Friedkin (1980) considers ties of information flow between researchers and finds confirming evidence for Granovetter's hypothesis and hypothesized causal channel. More recently, for example Baer (2010) has also studied information flow along weak ties and its positive effect on innovation.

IV Theoretical Model

In this paper, we seek to determine how the composition of a soldier's battalion may affect his experience post-war. Namely, we study if being surrounded by men whom a given soldier knew before the war (as in the Pals battalions or the Territorial Force, strong ties) experiences better or worse relative labor market experiences after the war than a soldier surrounded by people who were strangers to him before the war (New Armies, weak ties). We posit that there are two potentially countervailing forces here: the number of links a person has, and the intensity of those links. In our story, a non-Pal may have more links than a Pals soldier, since he was less likely to insulate himself in the group of men he already knew before the war, but a Pals soldier might have more intense links. In the language of Granovetter (1973), Pals have a few strong ties, while non-Pals have many weak ties.

We consider a simple partial equilibrium model, à la Galenianos (2014), in which we model search with referrals. There are a large number of firms and workers. Firms are identical but workers are heterogeneous in that each worker has an idiosyncratic network of connections to other workers, through which the worker learns imperfect information about the employment status of her connected workers. The heterogeneity is in both the number of ties a worker has and the intensity, i.e. the degree of imperfectness of information regarding employment status, of those ties.

Entrepreneurs start firms and hire one worker in a standard labor market in which firms

set vacancies, at a cost, and unemployed workers match with these vacancies, given an exogenous matching function. Wages are determined by Nash bargaining. Once a firm and worker are matched, they remain together indefinitely. Firms operate one establishment and employ one worker at the establishment. The key action in this simplified model occurs when firms expand. A firm exogenously[3] chooses to expand at Poisson rate λ, creating a new establishment. Once the firm expands and successfully find a worker, it sells this new establishment to a dense market of agents, who will operate this establishment as a new firm. This guarantees that all existing firms will continue to have one employee, operating at a single establishment.

During expansion, a firm necessarily hires a new worker for this establishment. Existing firms, unlike brand new firms, have two optional methods to find a worker: through the standard labor market or through a referral by their current employee. Since searching for a worker is costly, it may be cheaper to first ask its current employee for a referral and then, if the referral was unsuccessful, to post a vacancy in the standard labor market. If the referral is successful, by matching an available worker with the new establishment, the firm does not need to pay the vacancy-posting cost but does need to pay the worker a bonus (smaller than the vacancy-posting cost) in order to incentivize a good referral[4].

During a referral, the employee attempts to make a successful referral by naming a member of their network. A referral is successful if the worker that the employee names is not currently employed. Because workers' networks are idiosyncratic, the probability that this referral is successful differs by the employee's network. Specifically, this probability an increasing function of both the number of links she has and the intensity of these ties. That is, if the current employee is connected to many other workers, there is a better chance that she names an unemployed worker, regardless of how much she knows about the workers; and, separately, if the current employee knows her links' employment statuses with higher certainty, there is a better chance that she names an unemployed worker.

To demonstrate the mechanism of network-based referrals better, we simplify the heterogenity of workers by restricting ourselves in the possible types of workers. Let there be two types of workers: S and W. S types have a relatively small number of high intensity network ties; W types have a relatively large number of low intensity network ties. Let N be a measure of the number of ties a

[3] A simplification, like in Galenianos (2014)

[4] Montgomery (1991) and Greenwald (1986) present arguments for why employers may seek referrals from their employees and why the employees may face a moral hazard problem when deciding whom to refer for a job.

worker has, and I be a measure of how intense the ties are, both, for simplicity, measured on the interval $[0, 1]$. Thus, S types have relatively low N (close to 0) and high I (close to 1); W types have relatively high N and low I.

The main question in this model concerns which type of worker will be "more productive" as an employee in terms of successful referrals. The answer to this question depends on the relative importance of N and I in the function of the probability with which a referral is successful.

We can see this by considering simple examples. Suppose an employee completes a successful referral with probability

$$p(N, I) = \alpha N^2 I,$$

where α is a scaling parameter to guarantee a probability measure. In this case, having a larger number of ties is less important than having more intense ties (note the domain of N and I). In this case, W types may be more productive in the sense discussed above than S types. Alternatively, suppose an employee completes a successful referral with probability

$$p(N, I) = \alpha N I^2.$$

We are now in the reverse case, where having a larger number of ties is more important than having more intense ties. In this case, S types may be more productive in the sense discussed above than W types.

In this simplified model we can see the potential for trade-offs between number and intensity of ties. The goal of this paper is to empirically determine, for one concrete example, which element proves more important.

V Data

1 Census and 1939 Register

Our pre- and post-war data comes from the 1911 Census and 1939 Register.[5] The Census is one iteration of Britain's decennial census of its population and contains information on households,

[5]We accessed the 1911 Census records via the website Lives of the First World War (`https://livesofthefirstworldwar.org/`), while the 1939 Register is solely found on the website Find My Past (`http://www.findmypast.co.uk/`).

including each member's name, age, and occupation, and the location of the household. Britain releases their censuses 100 years after their date, and thus we are unable to use censuses after the 1911 one, as of this paper. Instead, we use the 1939 Register, a special census-like survey that contains household members' names, occupation, date of birth, and address, which is available upon the death of a person, to collect data for post-war results.

2 War Records

In World War I, Britain documented relatively robust information on its soldiers, including information from each soldier's enlistment, including occupation, records of transfers and service, and documentation of death or discharges.[6] Unfortunately, much of the stockpile of records were destroyed in a fire during the bombing of London in World War II. Thus, the availability of war records limits our sample. We believe that this does not bias our results, since we believe that the destruction of records was not on a Pals vs. non-Pals basis.

We form our primary dataset by considering the soldiers for whom we have military records, from the Surrey Recruitment Registers. The Surrey Recruitment Registers contain the attestation documents for $84,672$ men who volunteered with regiments in Surrey recruitment offices or were conscripted and attested at Surrey recruitment offices, between the years 1908 and 1920. Of these, $63,095$ men fall within World War I. This includes infantry regiments, cavalry soldiers, artillery soldiers, air-force soldiers, and men enlisting in trainings and labor battalions. Restricting the dataset further to infantry soldiers who enlisted between 1914 after the start of the war and 1916 before conscription began, we are left with $16,795$ soldiers. Of these soldiers, we observe sufficiently detailed records for roughly 50%, $8,542$, which includes detailed regimental and battalion data as well as the demographic data.

We choose this particular Surrey data set because the Surrey regiments' enlistment records were relatively well preserved and survived relatively completely through World War II. Furthermore, attestation data has the advantage of supplying us with many correlates of health and wealth (height, weight, chest expansion) that can serve as checks for our assumptions of non-selection into different groups.

[6] These records are also accessible on the website Lives of the First World War.

3 Merging Datasets

Given these military records, we merge with the 1939 Register records, on the basis of first name, last name, year of birth (plus/minus one year due to imprecise record keeping) and location (where available in the records), with room for imperfect matching on first names (e.g., for many soldiers we only have initials for first and middle names available). Whenever more than one record is available that matches on all of these categories, the soldier is excluded from the main analysis.

4 Occupations and Social Classes

For our main analysis, we use the military and Register records of occupation to track occupation and social class changes. We classify these occupations according to the Historical International Standard Classification of Occupations (HISCO), a scheme with over $1,600$ occupation-specific 5-digit codes. HISCO is based on the 1968 International Standard Classification of Occupations and, importantly for our analysis, has been customized for historical data by van Leeuwen et al. (2002). We map the soldiers' occupations to HISCO occupations using the mapping on the History of Work Information System website (`www.historyofwork.iisg.nl`).[7]

By measuring occupational changes for the soldiers, we also measure social class changes, in which social class is based on the Historical International Social Class Scheme (HISCLASS). HISCLASS is a useful mapping from HISCO occupations to social classes and was developed by van Leeuwen and Maas (2005) and formalized in van Leeuwen and Maas (2011). The philosophy behind HISCLASS defines a social class as "a set of persons with the same life chances." Thus, by using HISCLASS as our basis for measuring social mobility, we hope to identify meaningful changes in life opportunities for the soldiers. There are 12 social classes, according to HISCLASS. These 12 classes can also be compressed into 7 social classes, in case some classes have a small number of observations. The basis for these class divisions fall along several divides, most importantly: manual vs. non-manual, degree of skill, level of supervision of others, and economic sector. Table 1 demonstrates the breakdown of these classes, with the highest class being class 1.

The mapping from HISCO to HISCLASS is not trivial but rather based on both expert knowl-

[7] In order to map the occupations to HISCO through the History of Work website, we first needed to standardize some of the observed occupations, which otherwise would not match due to typographical errors or excessive specificity. This standardization was done manually by a single person and without reference to the full dataset, so as to minimize the potential bias. Furthermore, in the 1911 sample used for pre-trend analysis, there were some observations whose occupations were apprenticeships to professions; for these we count the observations as belonging to the profession, as we believe their apprenticeships should predict their occupations and statuses.

Table 1: HISCLASS Coding

Manual/ non-manual	Skill	Class Label	12-class system	7-class system
Non-manual	High-skilled	Higher managers	1	1
		Higher professionals	2	1
	Medium-skilled	Lower managers	3	2
		Lower professionals, clerical and sales personnel	4	2
	Lower-skilled	Lower clerical and sales personnel	5	2
Manual	Medium-skilled	Foremen	6	3
		Medium-skilled workers	7	3
		Farmers and fishermen	8	4
	Lower-skilled	Lower-skilled workers	9	5
		Lower-skilled farm workers	10	6
	Unskilled	Unskilled workers	11	7
		Unskilled farm workers	12	6

Notes: Adapted from van Leeuwen and Maas (2005). Class 1 is the highest social class.

edge from historians and classifications from the 1965 Dictionary of Occupational Titles (DOT). DOT is an occupation classification scheme developed by the United States Employment Service and is based on surveys of plants and businesses in the United States that collected detailed data on the tasks performed by and skills required of different workers. The 1965 version includes over 10,000 categories. Since DOT's information may be problematically anachronistic for studying other places and parts of history, van Leeuwen and Maas (2011) merge the classification from DOT with expert historian knowledge. That is, van Leeuwen and Maas (2011) first matched the HISCO codes to DOT categories and, using the DOT information, binned the HISCO codes into the HISCLASS groups. Independently, the developers also consulted several historians for how they would classify the HISCO codes into HISCLASS groups[8] In cases in which a majority of the experts disagreed with the classification given by DOT, HISCLASS largely defers to the experts.

By using HISCO and HISCLASS, we are confident that we have an arguably valid method for determining occupational and social mobility from 1911 to 1939 for the soldiers. This method is commonly used to study social mobility and other topics (see Abramitzky et al. (2011); Pélissier et al. (2005); Holt (2005); Bull (2005); Schumacher and Lorenzetti (2005); Arrizabalaga (2005); Lanzinger (2005); Dribe and Lundh (2005); Van de Putte et al. (2005); Bras and Kok (2005)).

[8]Per van Leeuwen and Maas (2005), these experts were Marie-Pierre Arrizabalaga, Hans Henrik Bull, Gordon Darroch, Sren Edvinsson, Georg Fertig, Matts Hayen and Jan Kok.

Our main dependent variables in the analysis below are the 7-class system and 12-class system social class changes from WWI to 1939. For both systems, We construct a soldier's post-war social class change by subtracting his WWI HISCLASS code from his 1939 HISCLASS code.

VI Empirical Analysis

1 Sample

As noted above, the destruction of British World War I records during World War II limits our sample. We choose to focus on the recruitment records of the county of Surrey (and surrounding areas), since this subsample of the British army contains both Pals and non-Pals and has many existing records. Further, we only consider infantry soldiers, as most Pals served in infantry positions.

We are able to access approximately eighty thousand enlistment records of Surrey men, stating each man's name, birth year, address, occupation before entry into the army, and rudimentary physical information, including height, weight, chest size and expansion, and, crucially, for which unit they enlisted. Of these records, approximately, sixteen thousand are of infantry soldiers who enlisted before conscription began on March 2, 1916 through the Military Service Act. Of these, approximately eight thousand records have insufficient information on the regiment and battalion entry to identify the type of unit they joined.

Finally, we restrict our sample to soldiers with whom we can uniquely match 1939 records, and require the both the war records' and 1939 occupations to have viable HISCLASS classifications[9]. We can uniquely match 3,539 soldiers out of a total sample of 8,542, a matching rate of almost 41.43%; Table 2 presents the distribution of battalion types in which these matched soldiers served.[10]

Our final sample is restricted to Pals and soldiers who served in the New Armies, who have viable data on observable characteristics and occupations. Our sample of Pals and non-Pals (New Armies) soldiers in Surrey has 1,025 soldiers, 463 (45.17%) of whom are Pals.[11] Table 3 presents

[9]For instance, when an occupation is too vague, e.g. "Assistant", they are assigned a HISCLASS code of -1; we exclude soldiers with such HISCLASS codes.

[10]We classify these battalion into Pals and non-Pals using the potentially-incomplete list of Pals battalions on Wikipedia (`en.wikipedia.org/wiki/List_of_pals_battalions`). We cross-checked this information using the website The Long, Long Trail (`www.longlongtrail.co.uk`), from which we also classified battalions into Regular, New Armies, Territorial Force, etc. Notably, some of our soldiers have incomplete information on the specific battalion in which they served, but rather just their regiments. In cases when the regiment had zero Pals battalions, we include these soldiers and classify them as non-Pals. Meanwhile, when the regiment either contained some Pals or, according to Wikipedia, contained but did not raise any local Pals battalions, we exclude these observations from the analysis entirely.

[11]While we primarily consider the Pals soldiers as the "treatment" group and the non-Pal (New Armies) soldiers

Table 2: Battalion Types

Type	Number of Soldiers
New Armies – Non-Pals	696
Pals Units in the New Armies	558
Reserves for the Regular Army	1,266
Non-Reserves in Regular Army	89
Territorial Force	654
Total	3,539

Notes: This is the distribution of soldiers across battalion types in our dataset of pre-conscription infantry soldiers who were uniquely matched with 1939 records and whose records contain sufficient occupation information.

Table 3: Sample Restrictions

Restriction	Number of Soldiers
Accessible in Surrey data	84,672
Infantry, pre-conscription	16,795
Have sufficient information on military unit	8,542
Matched in 1939, with 1939 occupations	3,539
Served in Pals or New Armies, viable data	1,025

Notes: Restrictions apply cumulatively; that is, the final line presents the number of soldiers in the our main sample - pre-conscription infantry soldiers in the Surrey data for whom we have sufficient information on military unit and occupations and matched 1939 data and who served in either a Pals or New Armies battalion.

the restrictions that lead to our final sample.

2 Baseline

Before we proceed to comparing the Pals and non-Pals (New Armies) soldiers' post-war outcomes, we want to check how similar the two groups are.

Table 4 presents the means and standard deviations of various observable characteristics for non-Pals and Pals, as well as their differences and associated T-statistics. In particular, we present birth year, date of attestation (entrance to military), physical characteristics, and social class during World War I, according to both the 12- and 7- class systems. These means demonstrate that, on average, Pals typically were about 1 year older than non-Pals, joined the military slightly before non-Pals, and were slightly shorter and weighed less. While the T-statistics for these differences are

as the "control" group, we also have used propensity score matching. The results from a five strata aggregated point estimate, using propensity score matching, are similar to our main results, and we do not report them.

Table 4: Baseline Characteristics of Our Main Sample

	Non-Pals		Pals		Difference	
	Mean	Std Dev	Mean	Std Dev	Diff	T-Stat
Birth Year	1888.795	6.055	1887.708	6.295	1.087	2.799
Attestation Year	1915.237	0.425	1915.119	0.324	0.118	5.032
Height (ft)	5.490	0.203	5.446	0.252	0.043	2.995
Weight (lb)	129.136	14.203	127.192	16.835	1.944	1.973
Chest Expansion (in)	2.575	0.676	2.588	0.678	-0.013	-0.313
Chest Size (in)	35.324	1.885	35.372	1.956	-0.048	-0.399
WWI HISCLASS (12 classes)	7.692	2.689	7.471	2.873	0.221	1.263
WWI HISCLASS (7 classes)	4.181	1.994	4.078	2.104	0.104	0.804
Observations	562		463		1025	

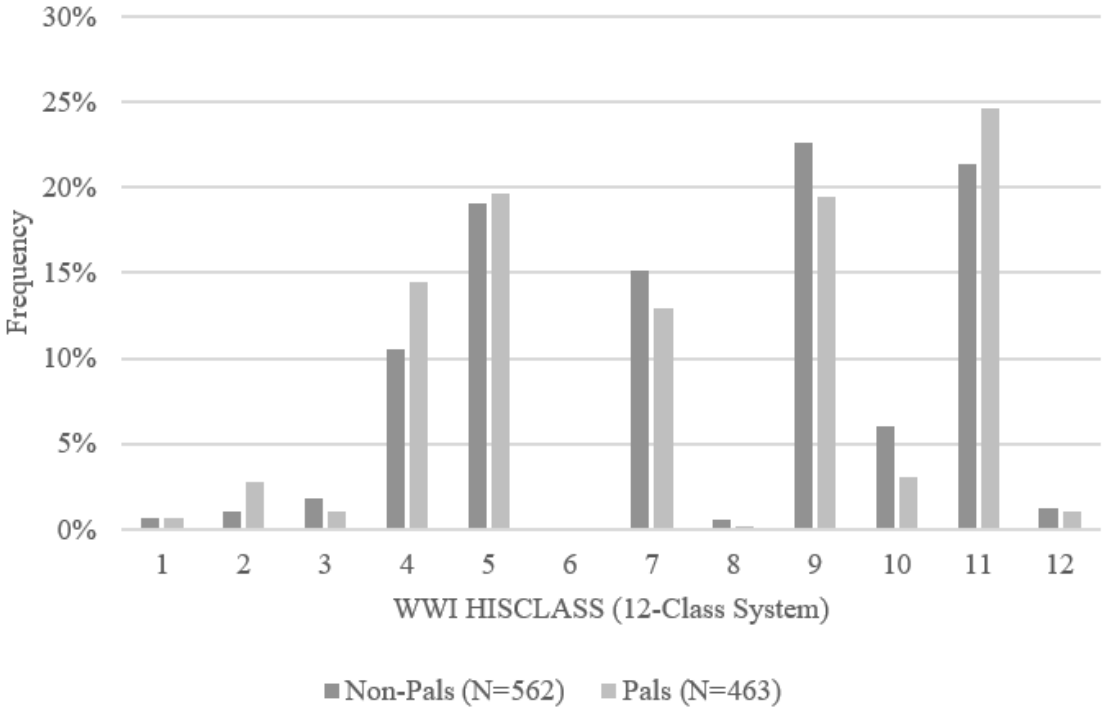
https://www.overleaf.com/project/5c6458b3a2fd321d13a891aa

Notes: This table presents the baseline characteristics of soldiers in our main sample of 1,025 soldiers, conditional on serving either in a Pals or Non-Pals battalion. The first two columns present the mean and standard deviation of various observable characteristics, measured in the military records, for Non-Pals soldiers. The following two columns present similar information for Pals soldiers. The final two columns present the difference in means (Non-Pals - Pals) and the associated T-statistic. On average, Pals soldiers were one year older, joined the army one and a half months earlier, and were slightly shorter and lighter than non-Pals; these differences are statistically significant but arguably not large economically. Pals and Non-Pals had similar measures of lung health (chest expansion and size) and pre-war occupation-based social classes.

significant, the differences are largely economically insignificant. Furthermore, the typical members of the group belong to similar social classes. We use these results as evidence that the Pals and non-Pals are similar prior to the war.

We can further expand upon the comparison of social classes for Pals and non-Pals by considering the distribution of social classes for each group, at the time of attestation. Figures 1 and 2 present the distribution of social classes for our main sample of 1,025 observations, for the 12- and 7-class systems, by Pals vs. non-Pals. The figures demonstrate that Pals and non-Pals have similar class distributions during World War I in our sample. Notably, no social class is both highly represented in our sample and mostly represented by either Pals or non-Pals; this allows us to consider the effect by social class in Table 8. Furthermore, they show that it may be important to analyze the data using the 7-class system rather than the 12-class system, as the 12-class system contains 5 classes that appear relatively infrequently in our data, while the aggregated 7-class system is less sparse. We note that, as apparent in both systems, we have very few farmers ad fishermen in our sample (class 8 in the 12-class system, 4 in the 7-class system). This is unsurprising, as we might expect these groups both to be less common in Surrey, a relatively industrial area, and to be less

Figure 1: Distribution of WWI (12) Social Classes, by Pals vs. Non-Pals

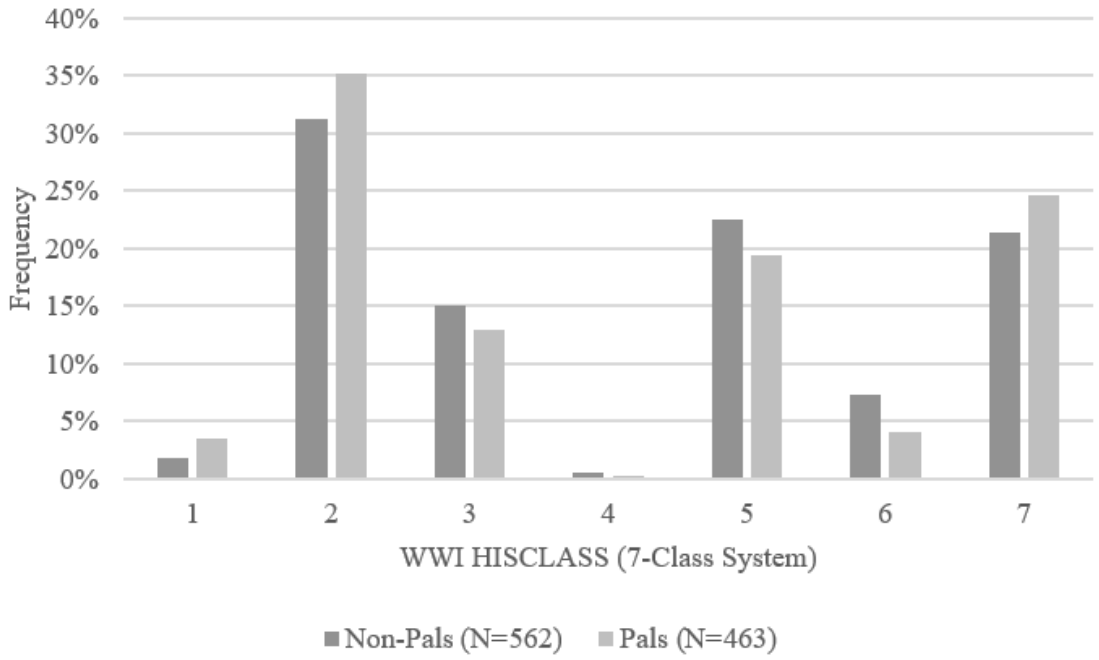


Notes: This is the distribution of soldiers' occupation-based social classes (in the 12-class system) at the time of their enlistments, for soldiers in our main sample by Pals participation.

likely to volunteer to serve, due to a higher opportunity cost. Further, we have zero members of 12-class system class 6.

Finally, we can check how if the Pals battalions are more homogeneous, in terms of WWI social class, than the non-Pals. Table 5 presents the results from regressing the standard deviation or range of WWI social classes, for both the 12- and 7-class systems, within regiments, by Pals participation, for our main sample. These results indicate that Pals battalions are significantly less heterogeneous than non-Pals, which supports our supposition that Pals soldiers were less likely to meet members of other social classes. We note that this is an incomplete method of measuring the homogeneity of the regiments, since we have sparse data for many regiments and are weighting by the number of observations we observe for each regiment. Nevertheless, we take these results as support for the motivation behind our analysis.

Figure 2: Distribution of WWI (7) Social Classes, by Pals vs. Non-Pals



Notes: This is the distribution of soldiers' occupation-based social classes (in the 7-class system) at the time of their enlistments, for soldiers in our main sample by Pals participation.

Table 5: Heterogeneity of WWI Social Class, by Pals

	Dependent Variable:			
	Std. Dev. 12-class	Std. Dev. 7-class	Range 12-class	Range 7-class
Pals	-0.130***	-0.133***	-1.585***	-0.495***
	(0.027)	(0.022)	(0.111)	(0.061)
Mean of Dep Var	2.593	1.908	8.660	5.312
Std Dev of Dep Var	0.406	0.325	1.888	0.944
Observations	1025	1025	1025	1025

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressing a measure of heterogeneity of WWI social class (standard deviation in the first two columns and the range in the last two columns) on an indicator equal to 1 for Pals soldiers and a constant. Standard errors are robust.

3 Empirical Model

In order to estimate the differential impact of serving as Pal instead of a non-Pal on a soldier's social mobility, we estimate a Difference-in-Difference (Diff-in-Diff) model in which each solider appears in 2 observations, one in WWI and the other in 1939:

$$Class_i = \alpha_0 + Pals_i\alpha_1 + Post_i\alpha_2 + Pals_i * Post_i\alpha_3 + \epsilon_i,$$

where $Class_i$ is soldier i's social class, measured using either the 12- or 7-class system. $Pals_i$ is equal to 1 if i served in a Pals battalion. $Post_i$ is equal to 1 if the observation is from the post-period, 1939 in our main specifications. $Pals_i * Post_i$ is the interaction between the two indicators and is equal to 1 if an observation belongs to a Pals soldier and is from 1939. ϵ_i is the associated error. α_3 is the coefficient of interest.

While we argued that the Pals and non-Pals were quite similar at the start of World War I, there were statistically (but not necessarily economically) significant differences. Thus we also control for these differences and further estimate:

$$Class_i = \beta_0 + Pals_i\beta_1 + Post_i\beta_2 + Pals_i * Post_i\beta_3 + \mathbf{X}_i\gamma + \nu_i,$$

where $\mathbf{X}_i$ is a vector of observed characteristics, including birth year, attestation date, height, weight, chest expansion, and chest size; this is constant across each soldier's two observations. ν_i is the associated error. Here, β_3 is the coefficient of interest.

4 Empirical Results

First, it is useful to comment on the frequency with which class changes occur. In the 12-class system, 384 (68.33%) of non-Pals change classes between World War I and 1939, and 331 (71.49%) of Pals change classes. In the 7-class system, these numbers are 350 (62.28%) and 285 (61.56%). Social mobility as measured by our class changes was thus not uncommon.

Furthermore, while the early 20th century was a period of general upward mobility, there is not a total upward movement in social class. In the 12-class system, 225 (40.04%) of non-Pals move up the social class ladder, while 159 (28.29%) move down it; 199 (42.98%) of Pals move up and 132 (28.51%) move down. In the 7-class system, 197 (35.05%) of non-Pals move up and 153 (27.22%)

move down; 162 (34.99%) of Pals move up and 123 (26.57%) move down.

Table 6 presents the point estimates for the estimated Diff-in-Diff models, both with and without control variables. Note that, since class 1 is the "highest" class, a positive point estimate implies that Pals have on average larger differences between their WWI and 1939 social classes; that is, their occupation-based social class was more likely to be lower over time.

For both the 12- and 7-class systems, both with and without controls, we get positive but not statistically significant coefficients on the Pals indicator. The sign of the coefficients indicate that, consistent with our interpretation of Granovetter (1973), Pals were less likely to move up the social ladder than non-Pals. The fact that our point estimates are not statistically significant is not surprising, due to the fact that our sample's distribution of social classes does not lend itself well to large results when differencing. However, despite the relatively large standard errors, we do find it meaningful that our estimates suggest that the weak ties gained by non-Pals may contribution to relative social mobility. We next we explore ways of corroborating this argument.

In order to understand how the potential role of service in a Pals battalion may be determined, we perform separate regressions by skill-level and social class. First, we can consider the impacts of Pals participation, by skill-level. We perform this for the 12-class system's designation of skill level, detailed in Table 1. Table 7 presents these results. Notably, the impact of Pals participation on social class mobility appears to be non-monotonic. In particular, we see that, barring relatively large standard errors, Pals participation tends to hurt medium- and unskilled soldiers in terms of social mobility, while marginally helping high- and low-skilled soldiers.

Next, we consider the role of Pals participation in determining social class mobility, by WWI social class, using the 7-class system. Table 8 presents these results, with each column presenting the regression for the associated WWI social class. While the breakdown into social classes leads to some small sample sizes, the results do suggest that the impact of Pals participation may be non-monotonic in social class, in line with our analysis in Table 7. In particular, the main social class for whom Pals participation appears to be feasibly harmful for upward social mobility is the lowest class, class 7. This is in line with the results from Table 7, since these are the more unskilled soldiers. We believe that these results may corroborate our support of Granovetter (1973)'s claims, since it is feasible that the lowest class soldiers are the ones who could gain the most from serving with other classes, as they may have been the most vulnerable group to job loss after the war.

It is worth noting for analysis in Table 8, the social class changes for soldiers in the lowest

Table 6: The Impact of Serving in Pals on Social Class Change

	Dependent Variable: Social Class			
	12-class	12-class	7-class	7-class
Pals (=1 if Pals)	-0.221	-0.282	-0.104	-0.151
	(0.175)	(0.171)	(0.129)	(0.126)
Post (=1 if 1939)	-0.687***	-0.687***	-0.381**	-0.381**
	(0.168)	(0.167)	(0.117)	(0.116)
Pals*Post	0.160	0.160	0.096	0.096
	(0.255)	(0.252)	(0.178)	(0.175)
Birth Year		0.017		0.010
		(0.011)		(0.008)
Height (ft)		-1.961***		-1.485***
		(0.343)		(0.242)
Weight (lb)		0.004		0.003
		(0.007)		(0.005)
Chest Expansion (in)		-0.237*		-0.186**
		(0.100)		(0.069)
Chest Size (in)		0.077		0.060
		(0.047)		(0.033)
Mean of Dep Var	7.285	7.285	3.966	3.966
Std Dev of Dep Var	2.878	2.878	2.001	2.001
Observations	2050	2050	2050	2050

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressions of occupation-based social class (either measured in the 12- or 7-class system) on the difference-in-different covariates, demographic controls (in columns 2 and 4), and a constant. There are two observations per solider, such that these regressions describe results for 1,025 soldiers. The coefficient of interest is on the interaction term $Pals * Post$; this describes the impact of serving in a Pals battalion on a soldier's social mobility between WWI and 1939. A positive coefficient indicates moving down the social class ladder. Standard errors are robust.

Table 7: The Impact of Serving in Pals on Social Class Change, by WWI Skill Level

	Dependent Variable: Social Class			
	High-Skilled 12-class	Medium-Skilled 12-class	Low-Skilled 12-class	Unskilled 12-class
Pals (=1 if Pals)	-0.233	-0.251	-0.371	-0.039
	(0.700)	(0.183)	(0.192)	(0.075)
Post (=1 if 1939)	4.100**	0.911***	-0.511*	-3.409***
	(1.163)	(0.245)	(0.219)	(0.285)
Pals*Post	-0.787	0.322	-0.135	0.594
	(1.420)	(0.368)	(0.333)	(0.386)
Birth Year	-0.122	0.042**	0.006	-0.022
	(0.128)	(0.015)	(0.014)	(0.017)
Height (ft)	3.931	-1.031*	-1.275**	0.023
	(2.593)	(0.502)	(0.447)	(0.559)
Weight (lb)	-0.030	-0.000	0.003	-0.002
	(0.028)	(0.009)	(0.009)	(0.011)
Chest Expansion (in)	0.213	-0.042	-0.254	-0.185
	(0.652)	(0.144)	(0.136)	(0.156)
Chest Size (in)	-0.310	0.030	0.093	0.011
	(0.256)	(0.056)	(0.066)	(0.090)
Mean of Dep Var	3.538	6.033	7.109	9.488
Std Dev of Dep Var	2.973	2.281	2.545	2.656
Observations	52	580	926	492

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressions of occupation-based social class (either measured in the 12- or 7-class system) on the difference-in-different covariates, demographic controls, and a constant, conditional on WWI skill level. There are two observations per solider. The coefficient of interest is on the interaction term $Pals*Post$; this describes the impact of serving in a Pals battalion on a soldier's social mobility between WWI and 1939. A positive coefficient indicates moving down the social class ladder. Standard errors are robust.

Table 8: The Impact of Serving in Pals on Social Class Change, by WWI Class

	Dependent Variable: Social Class						
	1	2	3	4	5	6	7
Pals (=1 if Pals)	-0.322	0.005	-0.006	0.000	-0.005	-0.032	-0.048
	(0.443)	(0.010)	(0.044)	(.)	(0.026)	(0.110)	(0.048)
Post (=1 if 1939)	2.000**	1.148***	0.671***	-0.333	-0.827***	-1.683***	-2.650***
	(0.645)	(0.126)	(0.178)	(1.018)	(0.164)	(0.335)	(0.197)
Pals*Post	-0.188	0.024	0.213	-1.667	-0.273	-0.001	0.264
	(0.839)	(0.185)	(0.289)	(1.018)	(0.260)	(0.579)	(0.276)
Mean of Dep Var	1.942	2.580	3.379	3.625	4.530	5.158	5.739
Std Dev of Dep Var	1.720	1.332	1.257	1.061	1.401	1.715	1.957
Observations	52	678	290	8	434	120	468

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressions of occupation-based social class (either measured in the 12- or 7-class system) on the difference-in-different covariates, demographic controls (the same as in the full regressions in Table 6, though not listed here), and a constant, conditional on WWI social class. There are two observations per solider. The coefficient of interest is on the interaction term $Pals * Post$; this describes the impact of serving in a Pals battalion on a soldier's social mobility between WWI and 1939. A positive coefficient indicates moving down the social class ladder. Standard errors are robust.These regressions include the same demographic covariates as in our main results.

class (7) are bounded above by zero, while the social class changes for soldiers in the highest class (7) are bounded below by zero. This is because the measure of social class change uses the WWI social class as the base; so, a class 7 soldier can only stay in class 7 or move up in class in 1939. By the way we construct our mobility measure, this means that the class 7 soldier's social mobility will necessarily be weakly negative. Further, the soldiers with the interior WWI social class (2-6) also have bounded potential class changes. This point is also somewhat relevant for the analysis in Table 7, since the lowest and highest skill levels' class changes are bounded. This does not dictate the signs of the coefficients on Pals participation, however, but it does potentially affect the interpretation of the coefficients. In Section VII, we provide an analysis of the overall patterns of class change, which is more robust to this interpretation issue.

5 Robustness and Extensions

i Pre-Trends

As with any Diff-in-Diff, we should be concerned that any effect that we observe in our regression could be unrelated to the "treatment" of Pals participation but rather just reflect differential trends between the two groups. We address this issue by performing a pre-trend analysis by bridging our main sample with 1911 Census records. Merging our sample with the 1911 Census reduces our sample, since our matching technique strains the sample across the three different time periods.

Table 9 presents our pre-trend analysis. These results suggest that there is no initial relative downward trend in social class for Pals soldiers, compared to non-Pals - if anything, there is an upward trend for Pals, contrary to the our main results. We take this as evidence for no significant pre-trends that would drive our results. However, we recognize that this pre-trend analysis is not foolproof. Here we compare a timespan of only three to five years, and so it is difficult to interpret social mobility during this timespan as compared to the timespan from WWI to 1939. Further, many of our soldiers are young in 1911: in our main sample of 1,025 soldiers, 316 (30.83%) were born in 1893 or after, and were thus 18 or younger in 1911; we suspect that occupation listings for these soldiers may not be truly good representations of their social classes.

ii Pals vs. Territorial Force

As discussed above, the Territorial Force battalions can be viewed as extreme versions of Pals battalions, as these battalions began as local home forces comprised of town members. We can repeat the analysis done above, comparing Pals versus Territorial Force soldiers, with the expectation that we should get opposite results if Granovetter (1973)'s premise holds.

First, consider the balance of means in the World War I data, with Table 10. Here, the characteristics are less balanced; in particular, Pals tend to be older than the Territorial Force soldiers. [12] Next, we again estimate the Diff-in-Diff models, both with and without controls, comparing Pals to Territorial Force soldiers. Table 11 presents these results. As we predicted, here the point estimates on the Pals indicator are negative. Despite the continued lack of significance, these results support our interpretation of Granovetter (1973), as we would expect the presence of weak ties to be even less common for Territorial Force soldiers than for Pals.

[12] Note that the number of Territorial Force soldiers is smaller than the number in Table 2, due to the restrictions that we place on the data.

Table 9: Testing for Differential Pre-Trends

	Dependent Variable: Social Class			
	12-class	12-class	7-class	7-class
Pals (=1 if Pals)	0.189	0.015	0.241	0.125
	(0.417)	(0.420)	(0.289)	(0.291)
Post (=1 if 1914)	0.583	0.583	0.322	0.322
	(0.356)	(0.356)	(0.259)	(0.259)
Pals*Post	-0.301	-0.301	-0.238	-0.238
	(0.563)	(0.557)	(0.405)	(0.401)
BirthYear		-0.005		-0.005
		(0.024)		(0.017)
Height (ft)		-2.849**		-2.097***
		(0.882)		(0.616)
Weight (lb)		0.019		0.017
		(0.016)		(0.011)
Chest Expansion (in)		0.040		0.023
		(0.224)		(0.149)
Chest Size (in)		0.038		0.019
		(0.122)		(0.086)
Mean of Dep Var	7.526	7.526	4.121	4.121
Std Dev of Dep Var	2.850	2.850	2.052	2.052
Observations	422	422	422	422

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressions of occupation-based social class (either measured in the 12- or 7-class system) on the difference-in-different covariates, demographic controls, and a constant, for observations from 1911 and 1914. There are two observations per solider. The coefficient of interest is on the interaction term $Pals * Post$; this describes the impact of serving in a Pals battalion on a soldier's social mobility between 1911 and WWI; ideally, this coefficient would equal zero, in the case of no differential pre-trends between Pals and non-Pals. A positive coefficient indicates moving down the social class ladder. Standard errors are robust.

Table 10: Baseline Characteristics: Territorial Force

	Territorial Force		Pals		Difference	
	Mean	Std Dev	Mean	Std Dev	Diff	T-Stat
Birth Year	1882.928	5.964	1887.708	6.295	-4.781	-12.069
Attestation Year	1915.186	0.390	1915.119	0.324	0.068	2.933
Height (ft)	5.501	0.220	5.446	0.252	0.054	3.548
Weight (lb)	129.365	15.931	127.192	16.835	2.173	2.053
Chest Expansion (in)	2.529	0.700	2.588	0.678	-0.059	-1.338
Chest Size (in)	35.497	2.141	35.372	1.956	0.125	0.950
WWI HISCLASS (12 classes)	6.667	2.775	7.471	2.873	-0.804	-4.406
WWI HISCLASS (7 classes)	3.493	1.943	4.078	2.104	-0.585	-4.468
Observations	499		463		962	

Notes: This table presents the baseline characteristics of soldiers in our alternative sample of 962 soldiers, conditional on serving either in a Pals or Territorial Force battalion. The first two columns present the mean and standard deviation of various observable characteristics, measured in the military records, for Territorial soldiers. The following two columns present similar information for Pals soldiers. The final two columns present the difference in means (Territorial Force - Pals) and the associated T-statistic. On average, Pals soldiers were five years younger, joined the army one month earlier, and were slightly shorter and lighter than Territorial Force soldiers; these differences are statistically significant but arguably not large economically. Pals soldiers were also more likely to belong to a lower WWI social class. Pals and Territorial Force soldiers had similar measures of lung health (chest expansion and size).

iii New Armies vs. Territorial Force

We can further compare Territorial Force soldiers to non-Pals New Armies ones. First, consider the balance of means in the World War I data, with Table 12. The Territorial Force and New Armies soldiers had similar heights, weights, and chest expansion and size. However, Territorial Force soldiers were on average six years older, joined the army half a month earlier, and were slightly higher class than New Armies soldiers. Next, we again estimate the Diff-in-Diff models, both with and without controls, comparing New Armies to Territorial Force soldiers. Table 13 presents these results. The coefficient of interest, on $TF * Post$ suggests that service in a Territorial Force battalion is associated with a relatively large move down the social ladder, compared to service in a New Armies battalion, across specifications. The coefficients are statistically significant. This meshes nicely with our underlying hypothesis: Territorial Force battalions were recruited purely from local men while New Army battalions of the same regiment were also active in recruiting in different parts of the country. Our theoretical model will hence predict that members of the TF make fewer new connections and fare less well on the labor market – just as we see it in the data.

We must note the caveat here, however, that, as stated above, service in a Territorial Force

Table 11: The Impact of Serving in Pals on Social Class Change, vs. Territorial Force

	Dependent Variable: Social Class			
	12-class	12-class	7-class	7-class
Pals (=1 if Pals)	0.804***	0.709***	0.585***	0.535***
	(0.182)	(0.186)	(0.131)	(0.133)
Post (=1 if 1939)	-0.140	-0.140	0.056	0.056
	(0.186)	(0.184)	(0.124)	(0.123)
Pals*Post	-0.387	-0.387	-0.341	-0.341
	(0.268)	(0.263)	(0.183)	(0.180)
Birth Year		0.002		-0.002
		(0.011)		(0.008)
Height (ft)		-1.721***		-1.214***
		(0.330)		(0.228)
Weight (lb)		-0.016*		-0.011*
		(0.007)		(0.004)
Chest Expansion (in)		-0.281**		-0.178**
		(0.104)		(0.069)
Chest Size (in)		0.222***		0.158***
		(0.046)		(0.032)
Mean of Dep Var	6.891	6.891	3.720	3.720
Std Dev of Dep Var	2.952	2.952	2.013	2.013
Observations	1924	1924	1924	1924

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressions of occupation-based social class (either measured in the 12- or 7-class system) on the difference-in-different covariates, demographic controls (in columns 2 and 4), and a constant. There are two observations per solider. The coefficient of interest is on the interaction term $Pals * Post$; this describes the impact of serving in a Pals battalion (vs. a Territorial Force battalion) on a soldier's social mobility between WWI and 1939. A positive coefficient indicates moving down the social class ladder. Standard errors are robust.

Table 12: Baseline Characteristics: Territorial Force (vs. New Armies)

	New Armies		Territorial Force		Difference	
	Mean	Std Dev	Mean	Std Dev	Diff	T-Stat
Birth Year	1888.795	6.055	1883.048	5.920	5.748	15.804
Attestation Year	1915.237	0.425	1915.185	0.389	0.051	2.070
Height (ft)	5.490	0.203	5.508	0.221	-0.018	-1.368
Weight (lb)	129.136	14.203	129.960	16.194	-0.824	-0.888
Chest Expansion (in)	2.575	0.676	2.538	0.725	0.037	0.867
Chest Size (in)	35.324	1.885	35.535	2.133	-0.211	-1.722
WWI HISCLASS (12 classes)	7.692	2.689	6.585	2.771	1.107	6.670
WWI HISCLASS (7 classes)	4.181	1.994	3.440	1.928	0.742	6.227
Observations	562		523		1085	

Notes: This table presents the baseline characteristics of soldiers in our alternative sample of 1085 soldiers, conditional on serving either in a non-Pals New Armies or Territorial Force battalion. The first two columns present the mean and standard deviation of various observable characteristics, measured in the military records, for New Armies soldiers. The following two columns present similar information for Territorial Force soldiers. The final two columns present the difference in means (New Armies - Territorial Force) and the associated T-statistic. On average, Territorial Force soldiers were on average six years older, joined the army half a month earlier, and were slightly higher class than New Armies soldiers. The Territorial Force and New Armies soldiers had similar heights, weights, and chest expansion and size.

battalion is arguably less exogenous than service in a Pals or New Armies battalion. Almost every single regiment had an associated locally raised Territorial Force battalion, meaning that the "supply" of enlistment opportunities for these battalions does not vary as exogenously across geographies as the supply of Pals Battalions. It therefore seems likely that soldiers who volunteered for these units had an even stronger motive to do so and hence may have selected on unobservable but relevant characteristics more so than Pals. For example, it may be that soldiers with otherwise stronger local connections or otherwise strong desire to not relocate geographically enlisted in these units instead of the less geographically bound New Army battalions of the same regiment. Such a lack of desire to relocate may have reduced their job market success after the war as they may hence have been less able to pursue opportunities elsewhere. Thus, while the sign and significance of our results are promising in support of Granovetter (1973)'s theory, we recommend caution in interpreting them too strongly.

iv Selection of 1939 Matches

In order to test our matching system, we compare the characteristics of some "extra" soldiers from our Surrey sample who we could not match cleanly to 1939 records. These extra soldiers were

Table 13: The Impact of Serving in Pals on Social Class Change, Territorial Force vs. New Armies

	Dependent Variable: Social Class			
	12-class	12-class	7-class	7-class
Territorial Force (=1 if TF)	-1.107***	-1.094***	-0.742***	-0.733***
	(0.166)	(0.173)	(0.119)	(0.124)
Post (=1 if 1939)	-0.687***	-0.687***	-0.381**	-0.381**
	(0.168)	(0.167)	(0.117)	(0.116)
TF*Post	0.582*	0.582*	0.467**	0.467**
	(0.247)	(0.245)	(0.168)	(0.166)
Birth Year		0.004		0.002
		(0.010)		(0.007)
Height (ft)		-1.558***		-1.169***
		(0.333)		(0.230)
Weight (lb)		0.000		0.002
		(0.006)		(0.004)
Chest Expansion (in)		-0.280**		-0.193**
		(0.093)		(0.062)
Chest Size (in)		0.114*		0.078*
		(0.045)		(0.031)
Mean of Dep Var	6.955	6.955	3.746	3.746
Std Dev of Dep Var	2.912	2.912	1.976	1.976
Observations	2170	2170	2170	2170

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table presents point estimates from regressions of occupation-based social class (either measured in the 12- or 7-class system) on the difference-in-different covariates, demographic controls (in columns 2 and 4), and a constant. There are two observations per solider. The coefficient of interest is on the interaction term $TF * Post$; this describes the impact of serving in a Territorial Force battalion (vs. a non-Pals New Armies battalion) on a soldier's social mobility between WWI and 1939. A positive coefficient indicates moving down the social class ladder. Standard errors are robust.

Table 14: Baseline Characteristics: Extras

	Main Sample		Extras		Difference	
	Mean	Std Dev	Mean	Std Dev	Diff	T-Stat
Birth Year	1888.304	6.186	1886.247	6.956	2.057	6.679
Attestation Year	1915.183	0.387	1915.151	0.371	0.032	1.840
Height (ft)	5.470	0.227	5.499	0.238	-0.029	-2.638
Weight (lb)	128.258	15.470	131.084	16.864	-2.826	-3.738
Chest Expansion (in)	2.581	0.676	2.569	0.694	0.011	0.359
Chest Size (in)	35.346	1.917	35.734	1.976	-0.388	-4.279
WWI HISCLASS (12 classes)	7.592	2.774	7.439	2.823	0.153	1.170
WWI HISCLASS (7 classes)	4.135	2.044	4.037	2.069	0.097	1.013
Observations	1025		841		1866	

Notes: This table presents the baseline characteristics of soldiers in our larger sample of soldiers that includes soldiers who could not be uniquely matched with 1939 data, in order to check the external validity of the sample produced by our matching scheme. The first two columns present the mean and standard deviation of various observable characteristics, measured in the military records, for our main sample of 1,025 soldiers. The following two columns present similar information for the "extra" unmatched soldiers. The final two columns present the difference in means (Main Sample - Extras) and the associated T-statistic. On average, our main sample soldiers were two years younger, were slightly shorter and lighter than the extra soldiers and had smaller chests; these differences are statistically significant but arguably not large economically. Notably, our main sample soldiers and the extra soldiers had similar WWI social classes.

not matched either because they died before 1939, were not recorded in the 1939 Register for some reason, or did not have a "unique enough" name-birth year-location combination. We might think that our matching system results in a sample that is, for instance, more well-off during WWI; i.e. a higher-class soldier in WWI might be more likely both to have a more unique name and to live longer than a lower-class solider.

Table 14 presents these differences, and shows that our main sample is relatively similar to a large selection of Surrey soldiers who did not, for some reason, match with the 1939 records. That is, while some variables (birth year, height, weight, and chest size) are different at a statistically significant level, the differences appear to be economically small. Our sample tends to be a little older, shorter, lighter, and smaller than the extra soldiers. We take these results as evidence that our matching system does not suffer from obvious selection bias.

v Service of Pals vs. Non-Pals

We might worry that, even though our Pals and non-Pals all served in World War I, they experienced very different wars. One proxy for the trauma of battle is casualty rates. We recognize

that casualty rates are imperfect proxies, as casualty rates can differ for a number of reasons, including skill level, luck, social cohesiveness, and location. We assume death rates proxy sufficiently for trauma and compare the death rates between Pals and non-Pals, for soldiers in our 8,542 sample of observations with sufficient military unit information (see Table 3), for whom we found death records in the Surrey data. We find 407 viable death records, and we combine these with the 3,539 sample of soldiers matched with 1939 records.

For this data, Pals battalions suffer a 8.52% death rate, while non-Pals battalions have a 10.64% death rate. These rates are quite similar, and their difference is not statistically significant (p-value = .114). From this result, we conclude that the death rates for Pals and non-Pals are relatively similar, and thus we do not find evidence of the war experiences of Pals and non-Pals being drastically different.

VII Measuring Mobility Using the Altham Statistic

Regressions and difference-in-difference analysis may, however, obscure more general differences in dynamics between Pals and non-Pals. Vertical improvement in a soldier's occupational class may be similar for Pals and non-Pals on average, and yet mobility patterns may be very different. This may occur for two reasons. Firstly, the ordering of occupations along one vertical dimension is a simplification that may not be innocuous for some soldiers - a move from a low level clerical job to a very highly skilled manual labor profession will be counted as a decrease in occupational status despite potentially higher earnings and better life chances. Secondly, the regression analysis does not utilize all the information present in the transition matrix of soldiers' class movements: it does not take into account which soldiers in which classes are most likely to transition into which other class, nor systematic differences along this dimension between two transition matrices. This means that the finer differences between which classes allow mobility into which other classes may be lost in the regression analysis. Hence, we supplement the main analysis with an analysis of the overall mobility patterns of Pals and non-Pals, Territorial Force soldiers and non-Territorial Force soldiers, without a judgment on which moves are improving and which ones are deteriorating a soldier's standing. The outcome will be an understanding which military unit membership leads to higher (respectively lower) occupational *mobility*, regardless in which direction.

We follow the methodology of Long and Ferrie (2013). Long and Ferrie use the Altham

distance measure (as introduced by (Altham and Ferrie, 2007)) to assess differences in mobility between the US and the UK in the 19th century. The Altham distance measure is a metric in the space of transition matrices (also called 'contingency tables'). It takes two transition matrices and computes a summary statistic of the log-likelihood of all possible cross products (i.e., of all possible transitions, e.g., it compares the likelihood of a unskilled worker in WWI to transition to semi-skilled in 1939 versus that same transition for a farmer in a Pals battalion versus the same ratio of transition probabilities in a non-pals battalion). This then summarizes all systematic differences in the pattern of mobility between two types of soldier groups. Because the Altham distance is a metric one can order transition (or contingency) matrices using it and relate their distance to a perfectly mobile matrix (as would arise, e.g., if class in WWI did not affect class in 1939). Hence, the Altham metric is a natural measure of distance in "mobility space." We adapt the method of analysis for the comparison of father-son mobility between time periods and countries to the analysis of differences of class mobility of a *single* person over their life. Instead of countries, we compare types of military unit in which a the person served. Instead of class transition between father and son, we analyze the contingency table that maps occupation at the beginning of WWI to occupation in 1939 of individuals.

We use this methodology to compare soldiers that served in Pals battalions to those who served in other New Armies battalions, as well as to those who served in the Territorial Force battalions, paralleling the analysis in the main regression-based sections. Further, we compare Pals and Territorial Force members to a joint dataset containing soldiers who enlisted in reserve battalions of the Regular Army and New Armies battalions. We believe this extension of our sample may be appropriate as the reserves were mostly composed of new soldiers and hence were similar to the other newly formed battalions. We employ a four class breakdown in our analysis that excludes farmers and fishermen (but does include low and unskilled farmworkers under low and unskilled manual workers, respectively). We exclude farmers because there are very few farmers in the dataset, and contingency table tests are potentially overly sensitive to sparsely populated cells. Hence, our samples are marginally smaller than in the analysis above. The four transition tables can be found below: Table 15 for the Pals, Table 16 for the reservists and New Armies, Table 17 for the New Armies, and Table 18 for the Territorial Force.

The Altham distance is given by

Table 15: Transition Table Pals Battalions

		1939 Occupation				
		Non-manual	Manual Medium Skill	Manual Low Skill	Manual Unskilled	Row Sum
WWI Occupation	Non-manual	103	19	43	14	179
	Manual – Medium	16	20	15	9	60
	Manual – Low	40	12	37	15	104
	Manual – Unskilled	27	19	33	40	119
	Column Sum	186	70	128	78	462

Notes: This table displays the specific class transitions that occur in our data set for the group of Pals we observe from WW1 to 1939. Here, we omit farmers, as there are too few farmers in the data set to draw any conclusions on their class transitions, and aggregate the remaining six classes into four by combining all three Non-manual groups (i.e., high-skilled, medium-skilled, lower-skilled). Each row lists how many Pals were in one of the four resulting classes at the beginning of WW1 and transitioned into the class associated with the respective column by 1939.

Table 16: Transition Table Regular Army Reserves and New Armies Battalions

		1939 Occupation				
		Non-manual	Manual Medium Skill	Manual Low Skill	Manual Unskilled	Row Sum
WWI Occupation	Non-manual	301	73	147	52	573
	Manual – Medium	54	84	68	34	240
	Manual – Low	109	65	180	61	415
	Manual – Unskilled	104	42	95	104	345
	Column Sum	568	264	490	251	1573

Notes: This table displays the specific class transitions that occur in our data set for the group of Regular Army Reserves and New Army soldiers we observe from WW1 to 1939. Here, we omit farmers, as there are too few farmers in the data set to draw any conclusions on their class transitions, and aggregate the remaining six classes into four by combining all three Non-manual groups (i.e., high-skilled, medium-skilled, lower-skilled). Each row lists how many New Army or Reserves members were in one of the four resulting classes at the beginning of WW1 and transitioned into the class associated with the respective column by 1939.

Table 17: Transition Table New Armies Battalions

		1939 Occupation				
		Non-manual	Manual Medium Skill	Manual Low Skill	Manual Unskilled	Row Sum
WWI Occupation	Non-manual	100	28	46	10	184
	Manual – Medium	17	39	20	9	85
	Manual – Low	44	29	66	24	163
	Manual – Unskilled	42	14	35	38	129
	Column Sum	203	110	167	81	561

Notes: This table displays the specific class transitions that occur in our data set for the group of New Army soldiers we observe from WW1 to 1939. Here, we omit farmers, as there are too few farmers in the data set to draw any conclusions on their class transitions, and aggregate the remaining six classes into four by combining all three Non-manual groups (i.e., high-skilled, medium-skilled, lower-skilled). Each row lists how many New Army members were in one of the four resulting classes at the beginning of WW1 and transitioned into the class associated with the respective column by 1939.

Table 18: Transition Table Territorial Force Battalions

		1939 Occupation				
		Non-manual	Manual Medium Skill	Manual Low Skill	Manual Unskilled	Row Sum
WWI Occupation	Non-manual	182	26	48	26	282
	Manual – Medium	16	27	16	8	67
	Manual – Low	26	13	57	20	116
	Manual – Unskilled	25	14	9	23	71
	Column Sum	249	80	130	77	536

Notes: This table displays the specific class transitions that occur in our data set for the group of Territorial Force soldiers we observe from WW1 to 1939. Here, we omit farmers, as there are too few farmers in the data set to draw any conclusions on their class transitions, and aggregate the remaining six classes into four by combining all three Non-manual groups (i.e., high-skilled, medium-skilled, lower-skilled). Each row lists how many TF members were in one of the four resulting classes at the beginning of WW1 and transitioned into the class associated with the respective column by 1939.

$$d(P,Q) = \left[\sum_{i=1}^{r} \sum_{j=1}^{s} \sum_{l=1}^{r} \sum_{m=1}^{s} \left| \log\left(\frac{p_{ij}p_{lm}}{p_{im}p_{lj}}\right) - \log\left(\frac{q_{ij}q_{lm}}{q_{im}q_{lj}}\right) \right|^2 \right]^{\frac{1}{2}}$$

where P and Q are contingency tables. As described above, this is the ratio of the log-likelihoods of the ratio of any two transition probabilities between any two classes between the two matrices. Hence, this summarizes the total difference in transition probabilities. A regression would, for example, not pick up on there being a systematically "better" outcome for skilled workers in a Pals battalion versus a non-Pals battalion if the same advantage is compensated by a correspondingly "worse" outcome for white collar workers. Two identical matrices (in terms of the ratio of the log-likelihood – two matrices with different marginal distributions may still be identical on this dimension!) will have an Altham distance of zero. The larger the distance metric, the more different are the two matrices in terms of their relative transition probabilities.

The Altham statistic tells us whether two transition matrices are significantly different in their mobility patterns but does not tell us whether one is generally less mobile than the other. Fortunately, as the Altham statistic is a metric in contingency table space, we can simply compare each table to the perfectly mobile table that has the same number of individuals in each cell. Denote this perfectly mobility transition matrix by J. Then, we can compare $d(P,J)$ to $d(Q,J)$ and thereby order Q and P in immobility space: if $d(P,J)$ is larger than $d(Q,J)$, we know that the P-matrix is further away from perfect mobility than the Q-matrix. If further $d(P,Q)$ is statistically different from zero, we can conclude that the P-matrix is *statistically significantly* less mobile the Q-matrix.[13]

Translated to our context, if $d(P,J) > d(Q,J)$, (and $d(P,Q)$ significantly different from zero), we conclude that soldiers who belonged to army unit P experienced statistically significantly less occupational mobility than soldiers who belonged to army unit Q. In other words, class origin in WWI has a stronger impact on class destination in 1939 for soldiers of transition matrix P than it has for soldiers of transition matrix Q. This comparison will pick up on more subtle systematic differences in mobility than the regression analysis. However, the draw back is that we cannot directly see what causes these differences and which classes are more or less mobile than others.

First, we can sort the four unit types by their absolute distance to perfect occupational mobility, by examining columns $d(P,J)$ and $d(Q,J)$ in Table 19. As would be expected given the

[13]To test whether the measured difference between any two tables is statistically significant, we perform a ^{2} on the deviance of $d(P,Q)$, $d(P,J)$, and $d(Q,J)$ respectively, following Agresti (2003).

Table 19: Altham Distance Results

		Altham Statistic		
		$d(P,Q)$	$d(P,J)$	$d(Q,J)$
Comparison	Pals (P) versus	7.26	12.14^{***}	
	New Armies (Q)			14.29^{***}
	Pals (P) versus	5.37	12.14^{***}	
	New Armies and Reservists (Q)			11.2^{***}
	Pals (P) versus	9.33^{*}	12.14^{***}	
	Territorial Force (Q)			15.46^{***}
	Territorial Force (P) versus	9.8^{+}	15.46^{***}	
	New Armies (Q)			14.29^{***}
	Territorial Force (P) versus	8.05^{*}	15.46^{***}	
	New Armies and Reservists (Q)			11.2^{***}

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: This table displays the pairwise distance in the space of transition tables between each of the groups in our data-set (Pals vs New Armies, Pals vs New Armies with Reservists, Pals vs TF, TF vs New Armies, TF vs New Armies with Reservists) in the first column ($d(P,Q)$). This distance between any two groups is calculated using the Altham Statistic or Altham distance metric. The larger the statistic, the more different are the transition dynamics captured by the transition tables of the two groups. Columns two and three ($d(P,J)$ and $d(Q,J)$) display the Altham distance metric between each of the four groups and a "perfectly mobile" transition table (i.e., a transition table with the same number in each cell, capturing perfectly random transition between classes). The larger this statistic, the less mobile is the transition matrix in question, i.e., the less class mobility is observed for this group in our data set.

theoretical case for greater occupational and geographical diversity within a military unit for greater post-war occupational mobility, the Territorial Force is furthest from perfect mobility – $d(P, J)$ for matrix-P being the Territorial Force contingency table is the largest of the four values observed in our data at 15.46 (significantly different from 0 at $p < 0.001\%$ level). Next, the regular new Army Battalions are second furthest from perfect mobility with a statistic of 14.29 (also significant at $p < 0.001\%$ level). The Pals Battalions are more mobile with a statistic of 12.14 (significant at $p < 0.001\%$ level); the enlarged dataset of New Army members *plus* reservists appears most mobile as measured by the Altham statistic of 11.20 (but still significantly less mobile than perfect mobility at $p < 0.001\%$). Thus, we confirm the results of the previous sections in general ranking of mobilities – the Territorial Force is least conducive to occupational mobility.

Moving on to assessing the pairwise *differences* in mobility between military units, we see that the Pals Battalions and the New Armies (with or without reservists) are not observing significantly different occupational mobility patterns – the statistics displayed in column $d(P, Q)$ for Pals versus New Armies and New Armies with Reservists are not significantly different from zero. This is in accordance with the results above, where we similarly find no strong evidence of Pals battalions showing a different pattern of occupational mobility than New Armies battalions. However, and also in accordance with the above, membership in Territorial Force battalions does seem to reduce the occupational mobility of first world war soldiers quite significantly, regardless of comparison group. The difference between Pals and TF battalions' mobility is significant at the 5$-level, as is the difference between TF and New Armies with Reservists. The difference between TF battalions and New Armies battalions is significant at the 10% level (p-value=5.3%). Given the ordering of the TF battalions as furthest from perfect mobility, these significant differences confirm earlier results that the TF battalion soldiers experienced least occupational mobility post-WW1. We thus confirm the prediction of the importance of weak ties. Territorial Force soldiers only interacted with men from their very own home region or even home village. New Armies soldiers and Pals Battaliosn members, too, benefited from a much richer set of new acquaintances.

VIII Conclusion

In this paper, we have explored the relative roles of "strong" vs. "weak" ties in determining social mobility à la Granovetter (1973), by comparing British WWI soldiers who served in partic-

ularly homogeneous military units with other soldiers. While few of our results are statistically significant, we find empirical patterns that suggest that the strong ties of homogeneous military units (Pals and, to a greater extent, Territorial Force battalions) may have contributed to relatively suppressed post-war social mobility for soldiers. Further, the downward pressure of strong ties on social mobility does not appear to be linear or monotone in either skill or initial social class. Instead, for instance, Pals participation appears to be most deleterious for unskilled, and to a lesser degree medium-skilled, soldiers' mobility prospects.

Overall, it is unsurprising that we lack major statistical significance for our results, as we are constrained by both a small sample size and sparse and detail-lacking data. Further, the "treatment" of Pals participation did not span the whole war. Rather, when conscription began in Spring 1916, the Pals battalions were either filled in with non-Pals or disbanded, with the soldiers transferred to other battalions. Thus, presuming they were not discharged before conscription began, Pals soldiers served in a mix of homogeneous and heterogeneous units, and therefore we would expect any effect of Pals participation to be attenuated towards zero.

Nonetheless, we believe that we have presented suggestive evidence that the participation in Pals, and Territorial Force, battalions, as opposed to New Armies battalions, may have restricted the network gains for soldiers. While soldiers in Pals battalions may have strengthened their bonds with their friends, family members, and coworkers from before the war, they consequently may have lost out on the opportunity to meet new connections from whom they may have had an occupation and social mobility boost after the war.

This analysis would likely benefit from a larger and denser dataset of soldiers, as well as connection to more datasets. Further, more outcomes could be studied. It may be interesting to compare marriage rates (and potentially the social class of soldiers' spouses) between Pals and non-Pals. Here it is unclear whether a strong or a weak tie is more advantageous: knowledge about potential partners may travel in the same way that knowledge about potential jobs travels between clusters of tightly linked social groups; alternatively, stronger and deeper bonds to a smaller group of people may prove more advantageous. A different outcome measure that is more in line with the analysis above is migration; namely, are Pals more or less likely than non-Pals to change county between World War I and 1939? If Pals had fewer connections especially outside of their hometown, they may have been less able to learn about jobs in towns and areas further away from home. This effect should be even stronger for members of the Territorial Force.

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