

Disruptive Norms

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Title: Disruptive Norms - Assessing the impact of ethnic minority immigration on non-immigrant voter turnout using a complex model.

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Abstract

This paper explores whether introducing an external group into a population with different characteristics to the existing population may lead to behavioural change. Specifically we test whether introducing ethnic minority immigrants with varying levels of civic duty (commitment to voting) norms into a previously homogenous non-immigrant ethnic majority population influences voter turnout among the non-immigrant majority group. The findings have been produced using a complex agent based model ('The Voter Model') where the parameters and characteristics have been developed through the extensive synthesis of existing findings from real world social science research on voter turnout. The model adopts the KIDS ('Keep it Descriptive Stupid') approach to this form of modelling complex systems (Edmonds and Moss 2005). The model puts a particular emphasis on exploring the dynamic social aspects that influence turnout by focusing on the role of networks and spatial composition factors such as ethnic diversity and levels of internal and external immigration. It uses an approach based on aggregative neighbourhood dynamics to go beyond existing static models of the influence of social norms on voting similar to

the classic approach of Schelling (1971). The main findings from this paper suggest that, other factors being equal, increased levels of immigration lead to a small but significant increase in turnout among the non-immigrant population and show that higher levels of civic duty among immigrants lead to higher levels of turnout among non-immigrants over time. This challenges the popular belief that increased immigration and diversity in a specific community will always lead to lower turnout levels.

Keywords – Agent Based Modelling, Turnout, Networks, Civic Duty, Social Norms, Immigration.

1. Introduction

This paper explores whether introducing an external group into a population with different characteristics to the existing population may lead to behavioural change. Specifically we simulate whether introducing ethnic minority immigrants with varying levels of civic duty (commitment to voting) norms into a previously homogenous non-immigrant ethnic majority population influences voter turnout among the non-immigrant majority group. Within political science there is an extensive literature on how diversity influences political participation. Previous research has considered how the ethnic composition of a community can affect turnout levels of both majority and minority groups although evidence regarding the direction of these effects has been contradictory (Geys 2006, Fieldhouse and Cutts 2008). There is also evidence that population turnover within a community has disruptive effects on existing social networks and social norms that can lead to political attitude and behavioural change (Huckfeldt 1979, Fowler 2005, Cho, Gimpel and Dyck 2006).

It might therefore be expected that immigration will affect aggregate level turnout as ethnic diversity changes. Immigration will also affect turnout of different groups in different ways. For example, turnout of immigrants (where they are permitted to vote) may be higher than the non-immigrant population, but associated changes to social structure and social connectivity might have an adverse effect on turnout producing countervailing trends (Fieldhouse and Cutts 2008). These structural (as opposed to compositional) changes may, in turn, depend on a number of properties including the characteristics of immigrants, levels of homophily among the non-immigrant community, and the level of interpersonal influence within society. An agent based modelling (ABM) approach provides us with an opportunity to isolate and test for the influence of these specific effects within a dynamic

networked environment. By focusing on the turnout of the non-immigrant community (whose initial characteristics we hold constant in our models) we can assess whether an external group entering a population can influence the behaviour of the existing population through experimentally altering the composition of networks and introducing different social norms. The analysis uses an approach based on aggregative neighbourhood dynamics that go beyond existing static models of the influence of social norms on voting, similar to the classic approach of Schelling (1971). These models allow us to measure whether the dynamic network interactions between different groups in a population can influence the key underlying norms and lead to a change in voting behaviour.

The findings in this paper have been produced using a complex agent based model ('The Voter Model') where the parameters and characteristics have been developed through the extensive synthesis of existing findings from empirical research on voter turnout (Edmonds, Lessard-Phillips and Fieldhouse 2014)¹. The model adopts the KIDS ('Keep it Descriptive Stupid'²) approach to modelling complex systems (Edmonds and Moss 2005). The model puts an emphasis on exploring the dynamic social aspects that influence turnout by focusing on the role of networks and spatial composition factors such as ethnic diversity and levels of internal and external immigration. The model has been used to create a number of experimental scenarios (that can be conceptualised as thought experiments) in order to explore three primary aspects of ethnic minority immigration influence on turnout. Firstly, it tests whether immigration levels influence turnout among the non-immigrant majority population. Secondly, it tests if the norms of civic duty among ethnic minority immigrant populations influence turnout levels in the non-immigrant majority population. Civic duty is conceived here as personal normative belief in voting as an intrinsic good, and is widely

acknowledged as a strong predictor of voter turnout (Blais and Achen 2010). Thirdly, the findings assess whether, and how quickly, the level of turnout converges in the immigrant and non-immigrant groups under these different conditions.

The main findings from this paper suggest that, other things being equal, increased levels of immigration lead to a small but significant increase in turnout among the non-immigrant population and show that higher levels of civic duty among immigrants lead to higher levels of turnout among non-immigrants over time. This challenges the popular belief that increased immigration and diversity normally leads to lower turnout levels (Uhlener, Cain and Kiewiet 1989)³. It is shown here that this is contingent on the distribution of social norms and social network influence. The paper will proceed by providing a discussion of the existing literature related to the impact of immigration on turnout focusing on the role of population diversity, social norms and the influence of network effects. It will then outline the main properties of the voter model and present the findings of the simulation experiments. The paper will conclude with a discussion of the substantive implications of the findings including a brief reflection on the value of ABM research in this context.

2. Background and Literature Review

The role of social norms on voting

The subjective norm of voting (often operationalised as Civic Duty) has been established as a key motivator of turnout both at the individual and aggregate level (Knack 1992, Geys 2006). Blais and Achen (2011) have demonstrated that civic duty models perform better than other standard predictive models of turnout meaning that individuals with civic duty have a high likelihood of turning out to vote irrespective of any instrumental or partisan

benefit they will gain from doing so. Conventional wisdom from democratic theory would suggest that this strong effect can only be accounted for through the intrinsic satisfaction individuals feel when fulfilling a social norm (Meehl 1977). However, others have shown that, while intrinsic benefits undoubtedly exist, these personal normative beliefs are shaped by social pressures or injunctive norms (Fieldhouse and Cutts, 2016). Moreover, the extrinsic influence of social pressure has been shown to have a strong influence on voter turnout even in the absence of civic duty (Gerber, Green and Larimer, 2008). In other words civic duty breeds civic duty: individuals exposed to civic duty within their social networks are more likely to vote irrespective of whether they possessed the norm to start with (Gerber and Green 2008, pp.45).

This raises the question of how individuals acquire that norm through social pressure and social networks, and whether the norm may be influenced by heterogeneity and disruptions within that network due to population turnover. For example, Cho (1999) finds that immigrants entering into high civic duty environments are likely to take on these characteristics and become more politically engaged than those entering low civic duty environments. Likewise, Gidengil and Stolle (2009) suggest that having individuals who exhibit a commitment to political norms within the social networks of immigrant women results in a much higher probability of participating in elections. In short, there is evidence that norms are of particular importance to the variability in the political integration of immigrant groups (Leighley and Vedlitz 1999, Logan, Darrah and Oh 2012).

However, very little is known about the impact that the civic duty norms of immigrants have on the turnout of non-immigrants. This is an important but largely neglected aspect of the literature. An ABM approach is especially useful for addressing this issue. As large-scale

immigration is often long term, and occurs alongside other external and internal changes which affect norms, it is difficult to isolate the causal effect of immigration on those norms. The approach taken here therefore allows us to control for external influences in the model and to isolate an immigration specific effect. It is also substantively relevant because of the increasing emphasis that is being put on civic engagement norms as a measure of successful immigrant integration (Joppke 2007). Yet the extent of that integration is generally only considered from the point of view of immigrants conforming to the civic norms of the 'host' population and therefore implies a one-way transference of norms. The assumption informing our study is that integration must also involve the capacity for the immigrant group to influence the social norms of the non-immigrant group over-time through engagement in social networks based on the debates around immigration being a two way process (Joppke 2007).

Impact of Social Networks on Turnout

It is therefore important to consider the influence social networks have in nurturing or, potentially, disrupting these social norms. There is a substantial literature on the influence of discussion networks on political attitudes and behaviour (Huckfeldt 1979, 1986, Agnew 1987, Strait 1990, Huckfeldt and Sprague 1995, Huckfeldt Johnson and Sprague 2004, Fowler 2005, Johnston and Pattie 2006, Fieldhouse and Cutts 2008). Much of this focuses on the influence of the role of disagreement and heterogeneity within networks and how this may depress levels of political engagement or lead to attitudinal change. Huckfeldt, Johnson and Sprague (2004) show how individuals avoid political conflict by adapting their political party allegiance so that it aligns with those in their immediate social network. McClurg (2006) builds on this to argue that network disagreement has a particularly

demobilising impact on political minorities, although Nir (2005, 2011) shows that the negative affect of network disagreement is limited to highly ambivalent and politically isolated individuals. However, when it comes to the impact of networks on immigrant turnout and social norms there are findings on the influence of network heterogeneity which somewhat contradict those related to partisanship. For example, Mutz (2002) finds that cross-cutting pressures within social networks lead to ambivalence and lower norms of political engagement and therefore the more alike members of the immigrant minority group are to members of the non-immigrant majority group the more likely they will be to turnout. This is consistent with findings from the economics literature that states more homogenous communities produce higher levels of social capital and stronger commitment to social norms and behaviours (Costa and Khan 2003). However, Pantoja, Ramirez and Segura (2001) argue the opposite – that immigrant groups are more likely to vote and engage politically if individuals within their social network experience hostility and rejection from the non-immigrant group. This implies that, in some contexts, diversity rather than homogeneity may lead to increased levels of turnout as it is a site of social conflict with raised stakes. Fieldhouse and Cutts (2008), find evidence that rising levels of diversity can have a positive impact on turnout over time. This paper engages with this literature by considering the dynamic influence that varying civic duty norms within immigrant groups may have on turnout levels in other groups – in other words we provide a test of different contexts of social network engagement. Fieldhouse, Lessard-Phillips and Edmonds (2016) utilised the same ‘voter model’ to explore the influence of cascade effects on turnout through social network influence. They found that the model’s complex dynamics confounded previous linear assumptions about the relationship between cascade effects and turnout.

Impact of immigration on Turnout – bringing in Schelling

Based on the literature on social networks and turnout the expectation would be that immigration could have an impact on the norm of voting through changing patterns of network structure and influence. Firstly, in line with the findings of Fowler (2005) it would be expected that altering the homogeneity of a community disrupts existing networks and the cascade effects through which voters influence others in their network to vote such as friends and family. Secondly, it would be expected that introducing immigrant groups that have different social norms of voting to the homogenous non-immigrant population would result in a convergence in voting levels over time, as the non-immigrant groups are influenced through network effects (Huckfeldt, Johnson and Sprague 2004, Johnston and Pattie 2006). It is not suggested that this is a direct effect of immigrant or ethnic minority status but an indirect influence through a confluence of factors that are correlated with these characteristics. Bevelander and Pendakur (2009) show that it is not minority status or immigration itself that effects the turnout level of specific groups but other demographic and contextual factors related to this such as the socio-economic position of these groups, their residential concentration, and their access to political resources through institutions and, most importantly for our purposes, networks. Cho, Gimpel and Dyck (2006) demonstrate the vital importance information flows have on levels of immigrant turnout and the influence of networks in establishing information flows. It is suggested that ethnicity matters because of the role it plays in establishing these information flows within social networks. They also suggest that there are threshold effects: immigrant turnout levels will increase as more immigrants enter the community, which in itself creates new and more diverse information flows establishing a dynamic process.

This is where we believe that applying an approach drawn from the Schelling (1971) tradition based on emerging residential neighbourhood dynamics between different ethnic groups should be effective. This enables us to test for the relevance of indirect effects in moderating the impact of changes to input variables on emergent properties (or outcomes). More specifically, we can explore the impact of varying immigrant civic duty norms in a series of experimental scenarios related to changing ethnic composition of the population in our model. Large scale second order effects were not observed in the complex voter model when applied to turnout cascades (Fieldhouse, Lessard-Phillips and Edmonds 2016). This runs counter to the implication of more simple models such as those adopted by Schelling (1971) where small changes to input variables can have large effects on the outcome via unfettered second (and nth order) influences. . Although in the case of our model we are not making as strong an assumption around segregation – we are merely testing if immigration can lead to a change of behaviour among the non-immigrant population through network effects. To the best of our knowledge prior research addressing the social context of immigration and voting has focused almost exclusively on immigrant turnout. It has a primary focus on considering the extent to which social and political norms embedded in the social networks of the ethnic majority non-immigrant group are transferred to the ethnic-minority immigrant group. Our paper contributes to this literature by reversing that focus and using a complex ABM voter model to look at how the norms of the immigrant group may impact the political behaviours of the non-immigrant group.

3. The Voter Model

The Voter Model builds on a social-relational theory of turnout developed by Fieldhouse and Cutts (2016) that puts emphasis on stressing the importance of social norms and inter-

personal mobilisation in motivating individuals to vote (Edmonds, Lessard-Phillips and Fieldhouse 2014, Fieldhouse, Lessard-Phillips and Edmonds 2016). It explores the interaction of the social and dynamic processes using agent-based simulations that allows us to capture complex dynamic behavioural processes including interpersonal influence and habit. The model has been developed utilising the 'KIDS' methodology which emphasises the importance of agent based simulations being guided by the available evidence rather than simplicity (Edmonds and Moss 2005). The 'KIDS' approach was adopted primarily because of the advantages it offers when modelling the complexity of the turnout decision, which is a dynamic and relational process (Fieldhouse and Cutts, 2016). Operationalising the complexity of the dynamic social network interactions (and other influences) related to turnout involved the application of a descriptively complex modelling approach that is based on a comprehensive synthesis of the existing empirical social science research on turnout. The approach allows us to experimentally manipulate population characteristics and model assumptions, whilst observing how these affect the emergent properties from the model (e.g. levels of turnout among different subgroups. In short, KIDS was used in order to replicate the complexity of real world social processes and to establish external validity while retaining the benefits of the simulation through the capacity to experiment⁴.

The main focus of the voter model is to explore the social processes that drive voter turnout including household size and composition; social influence via social networks that individuals are embedded in; wider social norms such as civic duty, personal habit and political identity; and the wider ethnic diversity of the community (Edmonds, Lessard-Phillips and Fieldhouse 2014; Fieldhouse, Lessard-Phillips and Edmonds 2016). The model therefore allows for the estimate of direct and indirect effects of mobilisation accounting for

both specific campaign effects and the more long-term dynamic social network processes that influence voting intentions. It is this dynamic characteristic of the ABM approach that differs from the more standard 'top-down' approaches in the social science literature, and allows us to consider non-linear, path dependent and self-organisational aspects of turnout. The existing political science literature on turnout is extensive and this has been used to define the parameters of the model and characteristics of the agents who interact within it – the model is therefore entirely defined by empirical assumptions based on real world data (Loughran, Lessard-Phillips, Fieldhouse and Edmonds 2015⁵). The model has the capacity to add to that existing literature by revealing the influence of the interaction of these factors on turnout.

The Voter Model is run in *Netlogo* (Wilensky 1999). When the model is initialised *Netlogo* produces a population grid which is a system representing an electoral constituency that holds single candidate ('First Past the Post') elections (Loughran, Lessard-Phillips, Fieldhouse and Edmonds 2015). This system includes approximately 1200 individual agents who are nested within households that are situated in specific locations on the population grid. The grid contains a defined number of squares which can be occupied by a household, a workplace, a school, an activity or can remain empty. The main population unit is the household. Agents can enter or leave the model through internal migration processes and immigration processes but this only happens at the household level. When new households enter the model through the immigration process they occupy an empty square on the grid. The characteristics of these agents are initiated from composite data developed from the 1992 wave of the British Household Panel Survey (University of Essex, Institute for Social and Economic Research 2010). The BHPS was chosen for this purpose because it represents

the most comprehensive measure of household that is available within a representative survey. The 1992 wave was selected because it is one of the earliest examples of a longitudinal survey that has consistent demographic and ethnicity data combined with election-related variables. The BHPS is used to assign the agents a large number of relevant personal demographic characteristics such as age, class, ethnicity and educational status. It is also used to initialise their political characteristics such as party preference, strength of preference, political interest and civic duty. Agents are also embedded within networks developing friendship links with other agents through their institutional association with schools (if they are in a household with agents under 18), workplaces and activities as well as direct links with neighbours and family members. These links and associations define the social and political discussion networks in which their political characteristics can be influenced.

After the initialisation period the model then proceeds in discrete time steps with each step representing a month within a year. It is up to the user to set the time parameters for the model but the 'burn in' period before the model reaches a stable equilibrium is roughly 15 years and the models presented in this paper have been run for 100 years. The model was designed to run for this length of time (with 1200 periods in total) in order to take advantage of its capacity to measure the impact of several immigrant generation lifecycles and measure long-run emergent properties. A number of stages occur in each step that evolve the model and influence the agents within it. These range from demographic changes such as births, deaths and migration in and out of the area to interactions between agents which can lead them to updating their political attitudes and intentions. The demographic settings for processes such as birth-rate, death rate and new household

formation through marriage are defined according to the 1991 UK census data (Office of Population Censuses and Surveys 1997). The social and political discussion networks are therefore evolving along with the model and agents create new links with specific schools, workplaces and activities and break old ones at different stages of their life course. There are three types of migration process; immigration, internal migration and external migration. Those households entering the social environment through the immigration process are drawn from a composite sample of immigrant agents created using the BHPS sample. All agents entering the model through this process are assigned immigrant status. Households entering the social environment through the internal migration process are drawn from the composite sample of non-immigrant agents created using the BHPS sample. The external migration process refers to households exiting the social environment, which occurs on a randomised basis. It is possible to control the annual percentage of households entering and leaving the model through these processes.

Networks are the key influence on the political characteristics of the agents through political discussions and are therefore the most critical aspect of the voter model. The intensity, location, and content of these discussions can lead agents to gain an intention to vote, civic duty, a party preference and increased levels of political interest. Based on assumptions from the findings of Huckfeldt, Johnston and Sprague (2004) the influence of the network effects on agent characteristics is designed to be auto-regressive meaning that 'the influence due to a particular discussant's viewpoint depends on the distribution of political viewpoints among discussants in the remainder of the network' (Huckfeldt, Johnston and Sprague 2004, p.46). Information and norms can therefore be passed along the discussant network and agents can pass on (or be influenced by) political content being defined by

their levels of political interest. Elections occur annually in the model and the model parameters can be set to recognise the difference between major and minor (second order) elections through varying the length and intensity of the campaign period⁶. During the campaign period, the amount of political discussion substantially increases and an agent can be 'mobilised' to vote by a party campaigner. These settings can be varied but the default setting is for a major election to occur every four years to replicate a standard duration between general elections. At each step the model updates itself and provides a comprehensive range of aggregative descriptive statistics which can be exported for analysis – it is these data that our findings are based on (Edmonds, Lessard-Phillips and Fieldhouse 2014).

The rules and settings for network interactions and their influence on political characteristics are drawn from the extensive literature associated with social influence on turnout and have several key assumptions. Agents are likely to share the political views of others within their network so party preference can be influenced by the network through political discussions (Huckfeldt, Johnson and Sprague 2004). Agents will only vote if they have an 'intention to vote' and for this they must have a party preference (Campbell et al 1960). The primary assumptions of the network dynamics within the model are that they are capturing core discussion networks and that political characteristics (civic duty, political interest, party preference etc.) can be established and updated at the individual level via political discussions. Party preference is often acquired early in life through interactions within the household, although some agents will not acquire party preference this way if agents within their household lack party preference themselves. If an agent has a large

number of political discussions within their network they are likely to change their party preference so that it aligns with that of their network. The likelihood of engaging in political discussion is influenced by levels of political interest and this is increased through acquiring higher levels of education and through political discussions. Agents with the highest levels of political interest are considered experts who have a stronger influence on other agents in political discussion – in other words agents are more likely to change characteristics if they have political discussions with these expert agents within their networks. Agents without civic duty acquire this through engaging in political discussions with agents who do hold the norm. In addition agents can also vote out of habit; because they care about the result; or because they have been mobilised by family, friends or political parties. In addition, voters can become less likely to vote if they are unsatisfied with the result, or if a personal shock hinders them from doing so. The probabilities that govern the influence of all of the above factors on turnout within the model have been defined from existing parameters identified from previous empirical political science results (Loughran, Lessard-Phillips, Fieldhouse and Edmonds 2015). *Figure 1* shows a visual representation of the factors and dynamic relationships that influence agents voting behaviour in the model.

(Figure 1 about here)

4. Testing immigration effects

The Voter Model allows us to simulate a series of scenarios measuring the effect of turnout on varying both the levels of immigration into a community and the norms of those immigrants. This can be done through amending a single parameter of the voter model while holding all other parameters constant, so that even in the context of exploring a dynamic complex ABM we can still isolate the influence of a single factor. By using the KIDS approach we can be confident that we have captured the descriptive complexity of the network influences on turnout, so any variation in influence we observe between simulation settings and our expectations reflects an emerging property of the model which can potentially shed light on real world processes. The main focus of the analysis is measuring the indirect network effects of immigration on the turnout levels of the non-immigrant population. . In all but one of the scenarios being tested the dependent variable is turnout level among non-immigrants. Elections are held each year and, for the purposes of this paper, no distinction is made between major and minor elections. For all models the simulations are run over a 100 year period and the population of the model system grid is around 1200 agents. The world size and density of the grid was held constant for all of the models as were all the primary demographic indicators at the initialisation stage. Each simulation was run 30 times and the presented findings represent an average of the aggregated results across all 30 of the simulation runs⁷. In all models the non-immigrant population represents a homogenous ethnic majority group and the immigrant population represents a homogenous ethnic minority group. At the initialisation stage the model is therefore always populated entirely by the non-immigrant ethnic majority group and (for some of the scenarios) a level of ethnic minority immigration is added yearly to the model so that the population becomes increasingly diverse as the model evolves. Immigrant households entering the model occupy a vacant square on the grid and have a small

preference for homophily (i.e. they are slightly more likely to choose a vacant square next to other immigrant households).

There are four experimental scenarios that are considered in this analysis. The first tests the influence of immigration levels on turnout in the non-immigrant population, and the only model parameters that are amended are those related to the migration processes. When immigration is turned on within the model it operates at a rate of 1% a year (compared with an internal migration rate of 1% a year and an emigration rate of 1% a year)⁸. The other three stages of the analysis focus on the impact of amending the civic duty levels among the immigrant population. Stage 2 is descriptive and shows the different rates of turnout among the immigrant community according to varying levels of civic duty. The model parameters that were amended at this stage relate to the civic duty levels of immigrants. The characteristic of civic duty for immigrants is defined probabilistically within the model – a setting of zero meant that immigrants had the same probability of acquiring civic duty as non-immigrants. For our high civic duty immigrant models we set the probability parameter at 1 and for our low civic duty immigrant models we set the probability parameter at -1. Stage 3 uses the same parameters as Stage 2 but presents the dependent variable as non-immigrant turnout in order to measure the network effects of different immigrants civic duty levels on non-immigrants. For comparison these results also include the results of the baseline model with no immigration and the model with internal migration. Stage 4 tests convergence effects of the civic duty models by subtracting turnout rates of the immigrant community from those of the non-immigrant community where a score of zero would represent convergence.⁹

5a. Analysis Stage 1 – Non Immigrant Turnout

(Figure 2 about here)

Figure 2 presents the findings from Stage 1 of the analysis testing the influence of varying the level of immigration on non-immigrant turnout. The graph shows average turnout across the 30 simulations for years 20-80 in the 100 year cycle of the model¹⁰. The models shows a comparison between a base model (with no immigration – the solid line) with a model that includes 1% internal migration (the dotted line) and one that includes 1% external immigration (the dashed line). The base model therefore represents a stable, homogenous ethnic majority population, while the 1% internal migration model introduces churn but maintain the ethnically homogenous make-up of the population. It is important to note that in the internal migration model there is no diversification being introduced – only population turnover. The agents entering the model in the internal migration progress have exactly the same distribution of characteristics as the population at the initialisation stage. Crucially they are also all ethnic majority agents so the population remains ethnically homogenous in this model. It is only the external immigration model that represents the introduction of diversification into the population with a homogenous visible ethnic minority population entering the model.

The graph suggests that the influence of immigration on non-immigrant turnout is small but consistent. The model that includes immigration shows a consistently higher level of turnout among non-immigrants than both the base model and the model that includes only internal migration. The effects are small – it is only producing a higher aggregate turnout of one or two percentage points for most of the duration of the model. However, from the 50 year point this gap starts to widen so that by the end of the 100 year period the immigration

model is producing 4-5% higher turnout rates among non-immigrants than the base or internal migration model. By including the internal migration model we are able to discount the possibility that we are merely observing the effects of population churn¹¹. With 1% internal migration the turnout rate among non-immigrants (which amounts to all agents in the model) is consistently less than the base model with no immigration at all until the last 40 years of the model when they show evidence of converging. This suggests that if the characteristics of the agents remain similar then the migration process disrupts voting behaviour and leads to lower turnout than in a community with very little population churn which is consistent with findings that show lower levels of turnout in more transient communities (Denver and Hands 1987).

However, in the immigration model the effects of that churn appear to be mitigated. The addition of an immigrant group with different ethnic characteristics (at this stage only ethnicity is varied) produced a clear increase in the turnout levels of non-immigrants. We can therefore conclude that, within the voter model, ethnic minority immigration leads to increased turnout among the ethnic majority non-immigrant population. While the effects are small the mechanisms that produce these results are indirect and related to the autoregressive influence of networks that is built into the model. Considering that the graph is highlighting the aggregate influence of those indirect network effects these findings are substantively relevant. They suggest that the introduction of ethnic minority immigrants influences the political discussion networks non-immigrant groups in such a way as to increase their propensity to vote. Some support for this can be found in the findings of Fieldhouse and Cutts (2008) and, to a lesser extent Cho, Gimpel and Dyck (2006). In this

sense our model supports the empirical literature that has found a positive effect of immigration on turnout levels.

5b. Analysis Stage 2 –Immigrant Turnout Amending Civic Duty

(Figure 3 about here)

The second stage of the analysis begins to assess the impact of varying the level of the civic duty social norms of the ethnic minority immigrants entering the model. *Figure 3* highlights the varying levels of aggregate turnout among ethnic minority immigrants when civic duty is set at different levels within the immigrant group. The solid line represents external ethnic minority immigration set at 1% a year with all other model parameters held constant (the equivalent model of the dashed line in *Figure 2*). In these simulations the probability of an immigrant entering the model with civic duty was set at the same level as a non-immigrant being assigned civic duty at the initialisation stage. The top trend line represents the high immigrant civic duty models where the probability of immigrants acquiring civic duty was set at 1, while the bottom trend line represents the low civic duty models in which the probability of acquiring civic duty is set at -1. In other words nearly all immigrants entering the model have the civic duty norm (agents do not acquire civic duty until they reach the age of 18) in the high civic duty model and no immigrants entering the low civic duty model have the norm. Given that civic duty is one of the main characteristics that leads to an agent having an intention to vote it is unsurprising that turnout among immigrants in the high civic duty model is initially very high and turnout in the low civic duty is very low. However, over the course of the models some level of convergence occurs between the three immigrant civic duty regimes which suggests the contextual social environments and processes within the model does exert significant impact on turnout.

There is a precipitous drop in turnout in high civic duty regime during the burn in period but this levels out around the 30 year mark where the turnout seems to stabilise at around 45-50%. For the equal and low civic duty immigrant models turnout starts low but steadily increases as the model evolves without hitting a stable equilibrium within the 100 year period of the model. This would be expected due to the increased number of immigrants entering the model without civic duty and then gaining it through the dynamic social network discussion processes. In short, there is a pool of immigrants without the duty norm who steadily gain it as time passes, whereas in the high civic duty model turnout decreases among immigrant groups from the initialisation point as other factors interfere with the civic duty and intention to vote. For example, agents who lose the intention to vote or who miss several elections can lose civic duty. As civic duty is an almost universal characteristic of immigrants entering the model in the high civic duty regime, the turnout rate among immigrants can only go down. This is because the immigrant community develops more diverse characteristics with the evolution of the model as older immigrants have been exposed to the social and political discussion influences for a longer period.

Overall, these findings are what we might expect to see: that there are substantial differences in the level of immigrant turnout across the three civic duty settings, but these differences are partially ameliorated by the social processes within the voter model as they evolve. Fieldhouse, Lessard-Phillips and Edmonds (2016) demonstrated that the voter model creates echo chambers in which those agents who have specific characteristics are likely to be clustered in social networks with other agents who have those characteristics limiting their capacity to have a wider influence or to be influenced. This is consistent with empirical findings based on social network influence that demonstrate these clustering

effects (MCclurg 2003, Johnston and Pattie 2006). This would suggest that there would probably be a relatively low ceiling effect for the ability of immigrants to influence political characteristics of the non-immigrant community once they have become embedded in political discussion networks.

Table 1 highlights this by showing the percentage distributions of civic duty in the immigrant and non-immigrant populations over the first 50 years of the model. The civic duty levels of the immigrants in Year 1 (the initialisation point) represent the levels of civic duty among all immigrants at the point they enter the model¹². It shows that as the models evolve, and the immigrant community becomes more diverse the differences between the relative civic duty levels of the communities narrow substantially but do not completely close. It is also worth observing that the immigrant community as a whole becomes more similar to the non-immigrant over-time than the newly arriving immigrants (the civic duty figure in Year 1). The differences in civic duty levels between the models may be relatively small but they are consistent with expectations and, at the aggregate level, considering the role of civic duty has within social networks in the model, they should still show an impact on non-immigrant turnout levels especially as immigrants with the civic duty characteristics in Year 1 are being added annually to the population. None of these results are surprising and are consistent with what we would expect to generate through amending the key parameters in our simulations. However, they do give us confidence that the individual level mechanisms within the model are working according to our theoretical expectations related to network influence (Huckfeldt, Johnson and Sprague 2004).

(Table 1 about here)

5c. Analysis Stage 3 – Non Immigrant Turnout Civic Duty

(Figure 4 about here)

Figure 4 presents the findings from Stage 3 of the analysis where we return the focus to the turnout of the non-immigrant groups. The graph presents the non-immigrant turnout for the 3 models that were included in Stage 1 – a baseline model with no immigration (solid line), a model with only internal migration of 1% a year (dotted line) and a model that includes immigration of an ethnic minority group of 1% a year (dashed line). This 1% immigration model has the civic duty set at the same level as the ethnic majority non-immigrant population (labelled 'equal' civic duty level). Two models are then added to these results – a model that sets the probability of immigrants entering the model with civic duty at 1 (dash dot line labelled as a 'high level' of civic duty) and a model that sets the probability of immigrants entering the model with civic duty at -1 (long dash line-labelled as low civic duty).

The results have some interesting substantive implications but also highlight the properties of the voter model. Beyond a slight uptick in turnout at the end of this period the turnout levels are stable throughout this 60 year duration. As might be expected from stage 1, which demonstrated the influence of immigration on non-immigrant turnout, the model in which immigrant civic duty is set high produces a higher turnout among the non-immigrant community. The top trend line representing high civic duty consistently displays non-immigrant turnout rates that are 5% points higher than in the model in which civic duty levels of immigrants and non-immigrants are equal. This is consistent with expectations that varying ethnic immigrant civic duty norms have an influence on the voting behaviour of the non-immigrant ethnic majority population through social influence in dynamic networks within the model. However, these expectations are confounded when we look at the

findings for the low civic duty simulations (the long dash line). Under these conditions we would expect lower rates of immigrant civic duty to produce lower rates of non-immigrant turnout. Instead, the low civic immigrant duty models produce similar rates of non-immigrant turnout to the baseline model and the internal migration model in which there is no immigration. The most likely explanation for this is based on the property of the voter model itself. Civic Duty is a characteristic which can be acquired through political discussions in networks but it can only be lost through random effects (not through the discussion process). Therefore it is much easier in the model to acquire civic duty than it is to lose it. Agents with civic duty are more likely to change the characteristics of other agents than those without. In this case, when nearly all immigrants have civic duty they will enter the model and create a higher probability of non-immigrants in their networks acquiring it but when nearly all immigrants lack civic duty the reverse is true: they are the ones who will be influenced by the non-immigrants.

5d. Analysis Stage 4 – Convergence

(Figure 5 about here)

Figure 5 shows the results from the final stage of the analysis which highlights the convergence of immigrant and non-immigrant turnout across the three different civic duty conditions. Each line on the graph represents the difference between the average turnout of the two groups at each time point (with immigrant turnout levels subtracted from non-immigrant turnout). A negative score therefore represents higher levels of immigrant turnout, and a positive score represents higher levels of non-immigrant turnout with zero on the X axis representing the convergence point. We would expect turnout levels in the model to converge over-time as the immigrant community becomes more embedded within

social networks and therefore being exposed to the same political environment as the non-immigrant community. The solid line in this instance represents the 1% immigration models with civic duty levels held constant in the immigrant and non-immigrant population, the dotted line represents the models which had high levels of immigrant civic duty and the dashed line represents the models which had low levels of immigrant civic duty.

Interestingly it is only in the high immigrant civic duty models that turnout between immigrants and non-immigrants achieves some level of convergence at the zero point. In the models in which civic duty is held at the same level as the non-immigrants community and in which immigrants have low levels of civic duty, non-immigrant turnout remains higher than immigrant turnout throughout the model. The graph also suggests that most of the social influence transferred by the immigrant population in the high civic duty models occurs in the burn-in period and up to the 60 year point. It is during this period that there is a sharp convergence in turnout rates as the immigrant community becomes more diverse in terms of the varied exposure to network effects and political influence in the model over time depending on when they entered it. It is perhaps not surprising that convergence is not achieved in the equal immigrant civic duty and low immigrant civic duty models as these are being topped up yearly with at least some immigrants who will enter the model with no civic duty. However, overall the findings would appear to confirm the findings from Stage 3 which looked at the influence of civic duty norms. High levels of civic duty among the ethnic minority immigrant population have a larger influence within the dynamic networks than lower levels of immigrant civic duty. This is likely due to a bias in the model towards the positive acquisition of characteristics within the discussion networks. However, it also reflects the finding in the literature that civic duty is a social norm that is acquired through

socialisation processes and retained throughout the life course (Knack 1992, Blais and Aachen 2011).

We attempted to test the underlying mechanisms through which the socialisation processes may be working to transfer the civic duty norms by testing for saturation effects, homophily levels, party identification, external shocks and class. As stated above, we are confident that the differences in turnout between the models are not simply a result of the saturation of the population grid. We were surprised that altering the levels of homophily within the model also had little effect on our results. Changing levels of party preference or introducing one off sharp increases in immigration to the system also had very little effect. The properties of the voter model assign civic duty a very strong stabilising influence that produces equilibrium in aggregate level turnout among the population and sub-groups within the population. Civic duty norms are consistently reinforced within the dynamic networks and this proves robust to influence from varying the levels of second order network effects and agent characteristics.

6. Discussion

The findings in our simulations are consistent with real-world evidence that immigration and ethnic minority status influences turnout through disrupting homogenous social network dynamics and introducing competing social norms (Fowler 2005, Cho 1999). Both ethnic minority immigration and variation in immigrant norms of voting have a small but significant influence on the turnout of non-immigrants. It is clear that immigrants have an influence on

the behavioural norms of non-immigrants through the social network effects in the model. However, the direction and impact of these effects is not always what would be expected. Our findings from *Figure 2* suggest that it is the ethnic diversity (compared with the non-immigrant community) of the immigrant group that has the effect of producing a higher rate of turnout in the non-immigrant community. This has mixed support in existing empirical research. In general the literature suggests that increasing diversity within a community has a polarising effect on political behaviour although this can be mitigated by contingent social network influences (Cho, Gimpel and Dyck 2006).

The expectation would be that introducing more diversity into a networked environment would disrupt these networks. Previous findings suggest that the influence of disruption is to depress turnout, not to increase it (Huckfelt, Johnson and Sprague 2004). Yet our simulations consistently show higher turnout among the non-immigrant group in models that include immigration compared to models that have no immigration. This is not simply a function of introducing population churn into the model as our internal migration model (which has the same level of population turnover and new household formation as the immigration model) produces a very similar level of turnout to the simulations that include no migration at all. Neither is this obviously a function of generational effects within the model which does not account for these differences either. The findings therefore suggest that there is something specific about the impact of introducing ethnic minority immigrants into the model that results in higher levels of turnout in the non-immigrant population. This provides a potential challenge to popular assumptions about the impact of immigration but the substantive implications are more unclear. Fieldhouse and Cutts (2008) suggest that diversity itself may have a positive impact on turnout of minority groups through contextual

social capital influences, but this does not account for increase in the majority population. Pantoja, Ramirez and Segura (2001) might suggest that this is evidence to support conflict effect – that introducing ethnic minority groups into a previously homogenously ethnic majority environment is likely to stimulate the majority group to compete politically. The current specification of the voter model is unable to test this but future research could explore these dynamics in more detail.

Findings from our social norm models would suggest immigration may have a positive impact on turnout (other factors being equal) because of increasing social connectivity (Fieldhouse and Cutts 2008). It is clear that there is a contagion influence occurring within the model: when immigrants are more likely to have civic duty non-immigrants are more likely to vote. *Figure 4* provides support for the social influences suggested in Cho's (1999) finding that immigrants are more likely to vote when they enter social environments in which there is a high level of civic duty. Cho demonstrates that immigrants will acquire those civic duty norms and therefore be more likely to participate. Our model suggests that immigrants may be capable of exerting the same influence on non-immigrants. A high civic duty ethnic minority immigrant group entering into a homogenous majority non-immigrant community can influence the levels of civic duty within the non-immigrant community both directly and indirectly through increasing exposure to those norms in political discussion networks. This is evidence of the dynamic influence of our social network voter model working as expected. However, it is also important to note that, unlike Cho, we did not observe a negative effect of introducing low duty immigrants on non-immigrant turnout. We believe this may be related to a limitation in the voter model which is discussed below. It is the final graph in *Figure 5* that makes possibly the most interesting contribution: the

fact that we fail to find convergence between the immigrant and non-immigrant groups (except in the high civic duty immigration model) is consistent with Schelling's (1971) finding of low level homophily effects. If inequality persists despite the normal process of contagion and convergence then this is likely due to the residual influence of homophily in the model. Despite levels of homophily being set to be low within the voter model we see that differences in social norms persist between groups, even though these are emergent properties of the modelling process and are not simply determined by the initial characteristics of new immigrants. This is consistent with Schelling's finding that even low levels of homophily can produce relatively large effects and that these effects endure within our complex model despite the influence of many intervening factors.

There are some significant caveats to the above findings based on the properties of the voter model and the KIDS modelling strategy itself. We are confident that our analysis can be linked to and, at least partially supported by, real world data. We are also convinced that the modelling approach has allowed us to isolate social norms and immigration effects that establish substantively relevant findings. This is because the underlying assumptions in the model are entirely rooted in the comprehensive real world empirical literature related to turnout influences and social networks. However, the complexity of the model has made it difficult to establish the precise mechanisms through which these influences are occurring as they are embedded within the social processes themselves. The fundamental equilibrium of the discussion network effects within the model were extremely strong which made testing for the influence of second order mechanisms (such as age, class, higher levels of homophily, party identification) challenging as amending these effects had a negligible influence at the aggregate level even when set at extreme values. It is also possible that we

have been overly positive in our conceptualisation of the influence of social networks in developing the parameters of the voter model. Our failure to observe a countervailing negative influence on non-immigrant turnout when the immigrant group has low levels of civic duty may highlight that our model is arguably biased towards the positive acquisition of political characteristics through discussion networks. Work by Partheymüller and Schmitt-Beck (2012) shows the capacity of social networks to have demobilising effects in which individuals can lose key participatory norms as well as acquire them. The negative effects (i.e. the capacity for agents to lose political characteristics such as civic duty) built into the voter model were largely exogenous to the social network processes. Future applications of the voter model should consider this limitation.

Ultimately the findings from the simulations add to the literature by suggesting that immigrant social norms can influence the norms and voting behaviours of non-immigrants. This process occurs in a similar manner to the way in which non-immigrant norms impact immigrant voting behaviour through social network contagion influence (Cho 1999). Our findings also suggest that this may be contingent on homophily influences that are consistent with Schelling's (1971) classic work. However, we cannot explain the findings of our simulations purely with reference to contradictions that exist within the existing empirical literature on immigration and turnout and therefore we have also highlighted how these findings contribute to our understanding of the properties of the voter model itself.

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Data Availability

The model can be accessed at <https://www.openabm.org/model/4368/version/2/view>. All parameters that have been changed from their default settings are outlined in the article above. For a complete list of parameter settings and for the composite BHPS dataset that was used to initialise the model please e-mail the authors (t.i.loughran@hud.ac.uk, ed.fieldhouse@manchester.ac.uk, l.lessard-phillips@bham.ac.uk, Lee.Bentley@liverpool.ac.uk).

Software Information

All findings in this paper were produced using *NetLogo*, a multi-agent programmable modelling environment. The version of the software used was *Netlogo 5.2.1*. Full details of the software code can be viewed in *Netlogo* when downloaded from <https://www.openabm.org/model/4368/version/2/view>.

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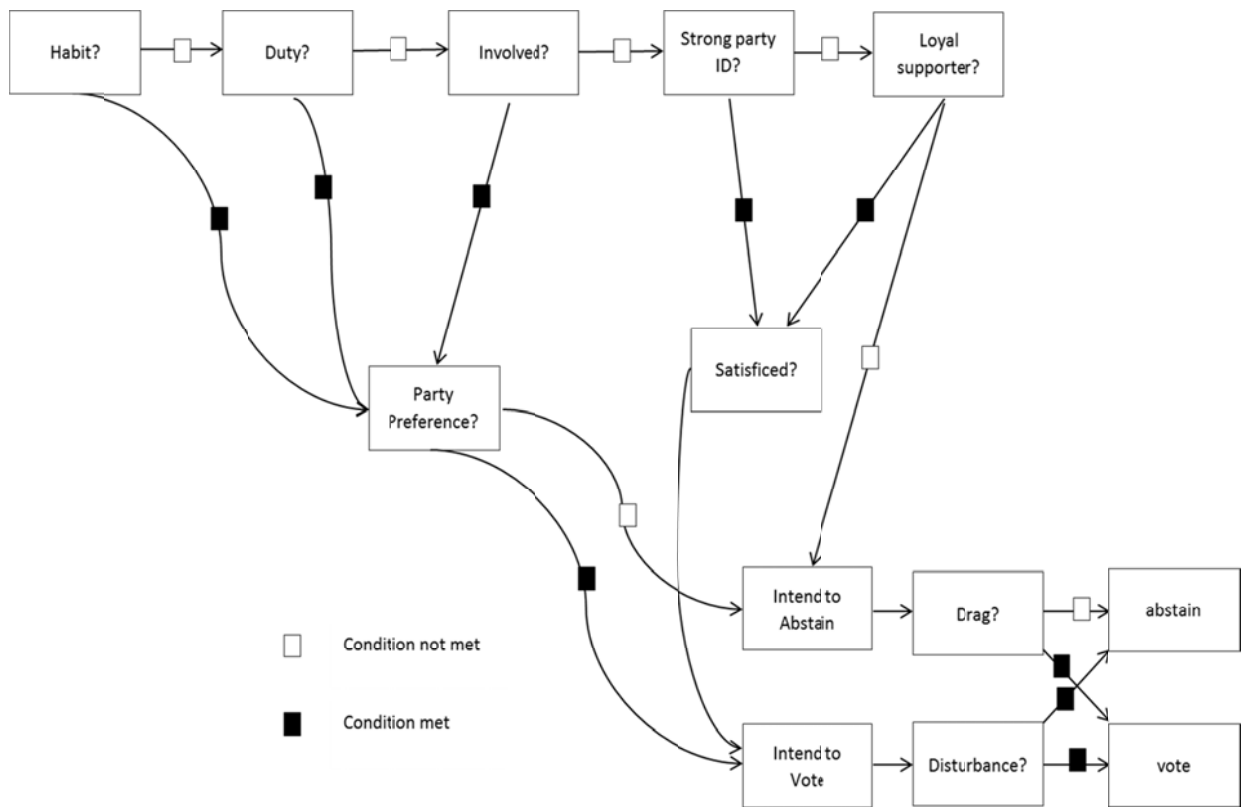


Figure 1 – Voting Intention Criteria.

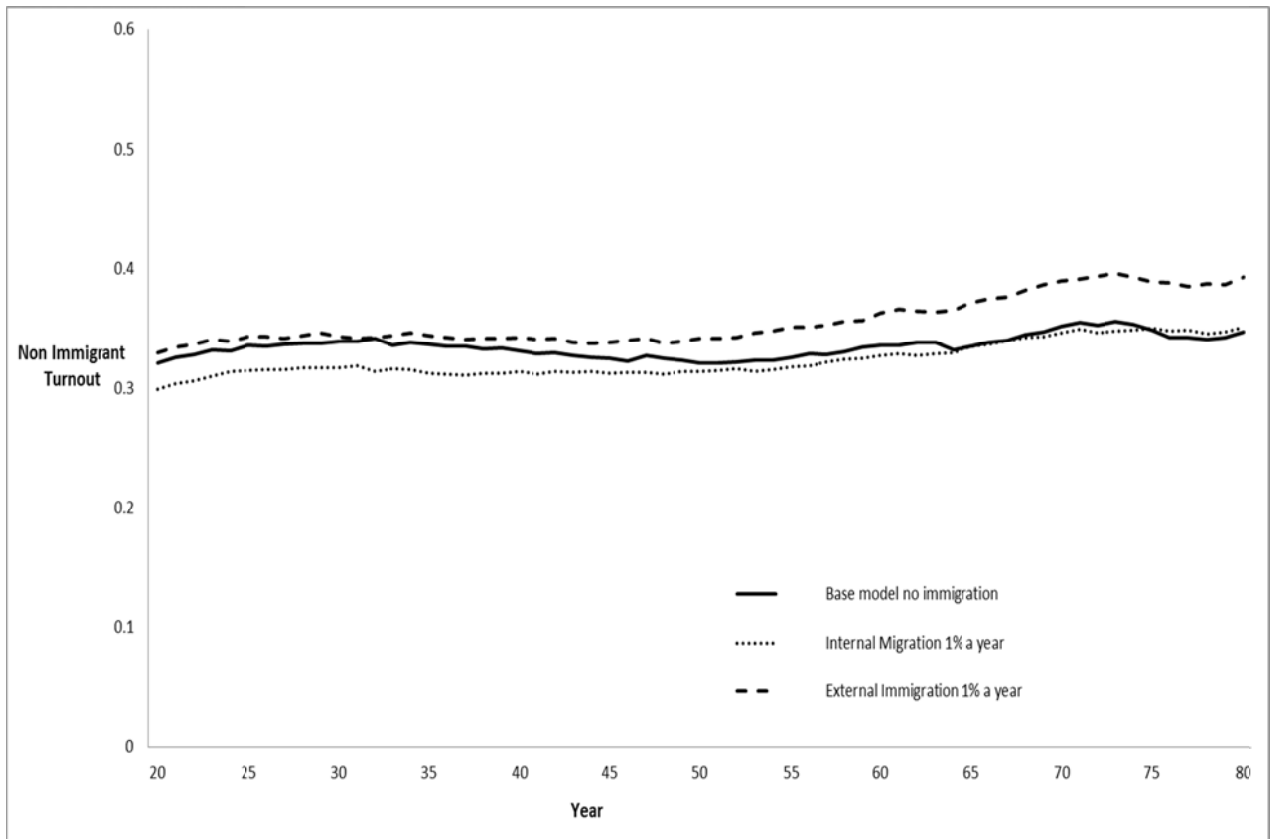


Figure 2 – Influence of immigration levels on turnout levels in ethnic majority non-immigrant population

1 = Base Model with no Immigration (Solid Line). A Homogenous non-immigrant ethnic Majority Population very little churn beyond attrition.

2 = A Model with 1% internal migration (Dotted Line). A homogenous non-immigrant Majority Population with a regular churn in population with agents entering and leaving the model through an internal migration process.

3 = A model 1% external migration (Dashed Line). An increasingly mixed population in which a homogenous non-immigrant Majority population at the start of the models is supplemented with 1% external immigration a year from a visible minority immigrant group.

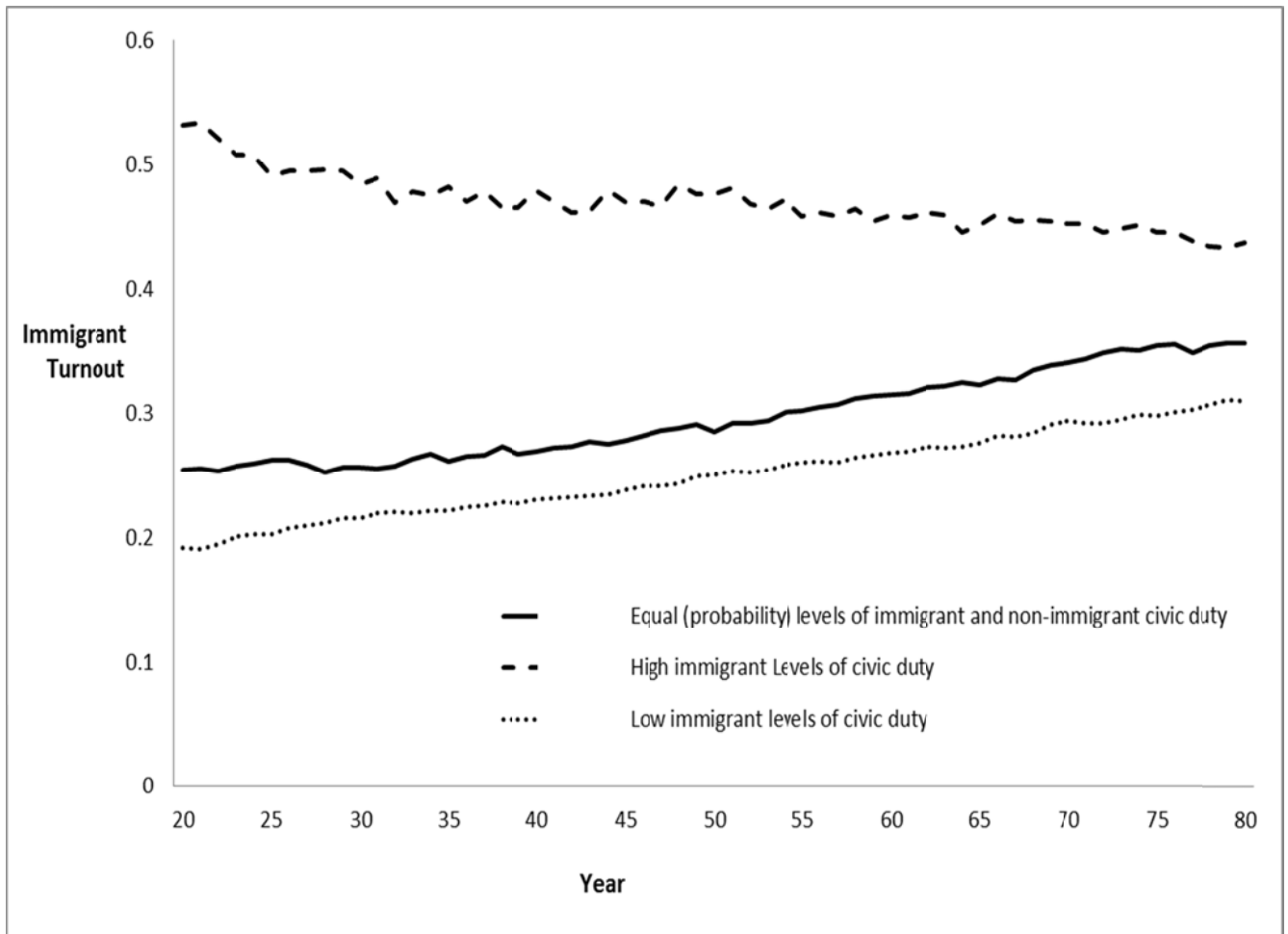


Figure 3 – Turnout of Ethnic Minority Immigrants at different levels of Civic Duty

1 = A model 1% external migration (Dashed Line). An increasingly mixed population in which a homogenous non-immigrant Majority population at the start of the models is supplemented with 1% external immigration a year from a visible minority immigrant group. Equal civic duty Levels.

2 = Identical Model to 1 but with Immigrants having higher probability of acquiring civic duty than Non-Immigrants (Dash Dot Line).

3 = Identical Model to 1 but with Immigrants having higher probability of acquiring civic duty than Non-Immigrants (Dash Double Dot Line).

	Year 1 (Initialised Properties)		Year 15		Year 30		Year 50	
Equal Civic Duty Model	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants
Civic Duty	14.12	16.19	13.74	23.6	24.41	29.67	28.03	32.59
High Civic Duty Model	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants
Civic Duty	72.46	16.16	39.64	24.89	34.62	29.92	35.22	33.22
Low Civic Duty Model	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants	Immigrants	Non-Immigrants
Civic Duty	0	16.17	9.96	22.98	15.68	27.71	23.27	28.77

Table 1 – % of Immigrants and Non-Immigrants who have Civic Duty by Model Year

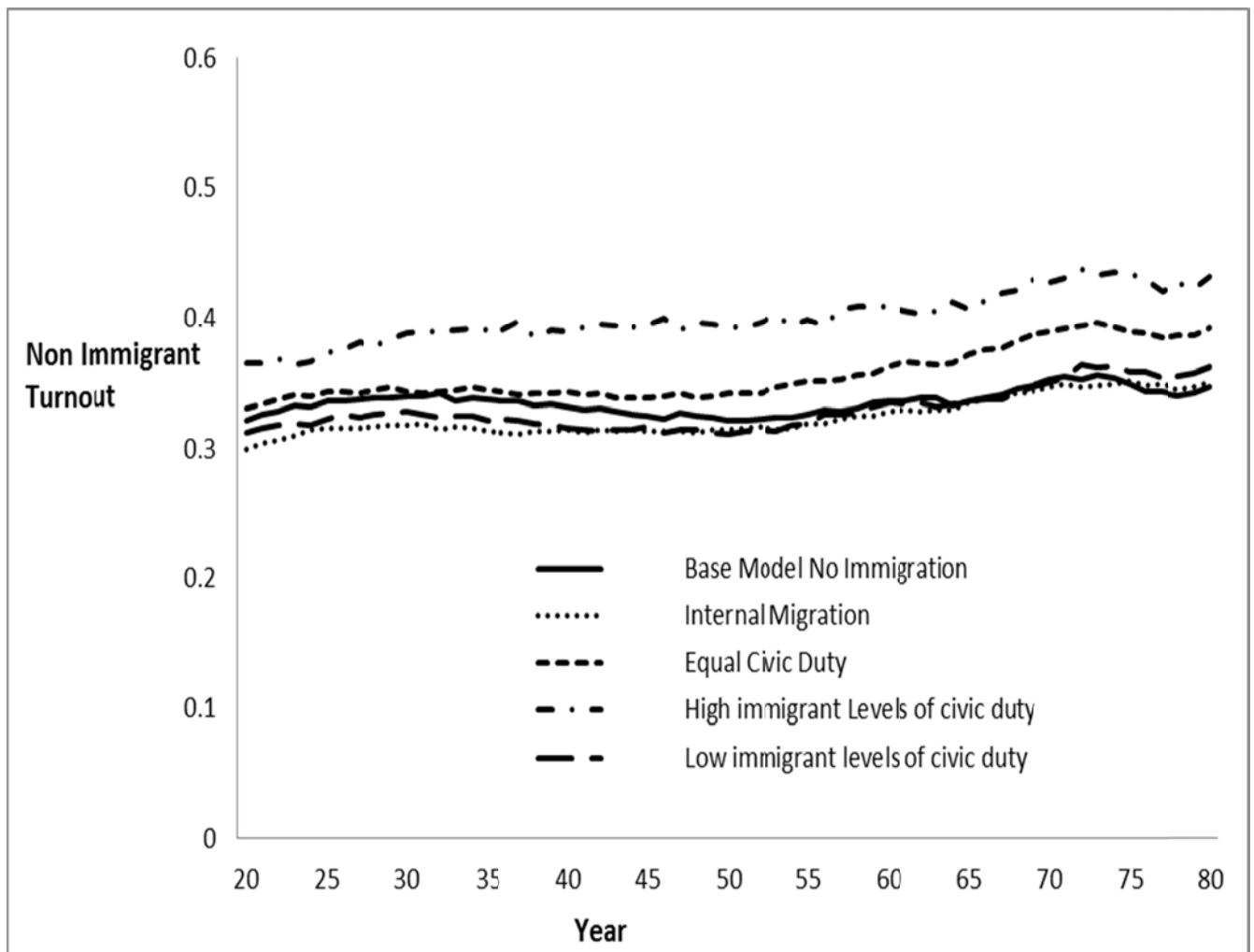


Figure 4 – Influence of varying ethnic minority immigrant Civic Duty levels on ethnic majority non-immigrant turnout

1 = Base Model with no Immigration (Solid Line). A Homogenous non-immigrant ethnic Majority Population very little churn beyond attrition. Equal civic duty Levels.

2 = A Model with 1% internal migration (Dotted Line). A homogenous non-immigrant Majority Population with a regular churn in population with agents entering and leaving the model through an internal migration process. Equal civic duty Levels.

3 = A model 1% external migration (Dashed Line). An increasingly mixed population in which a homogenous non-immigrant Majority population at the start of the models is supplemented with 1% external immigration a year from a visible minority immigrant group. Equal civic duty Levels.

4 = Identical Model to 3 but with Immigrants having higher probability of acquiring civic duty than Non-Immigrants (Dash Dot Line).

5 = Identical Model to 3 but with Immigrants having higher probability of acquiring civic duty than Non-Immigrants (Long Dash Line).

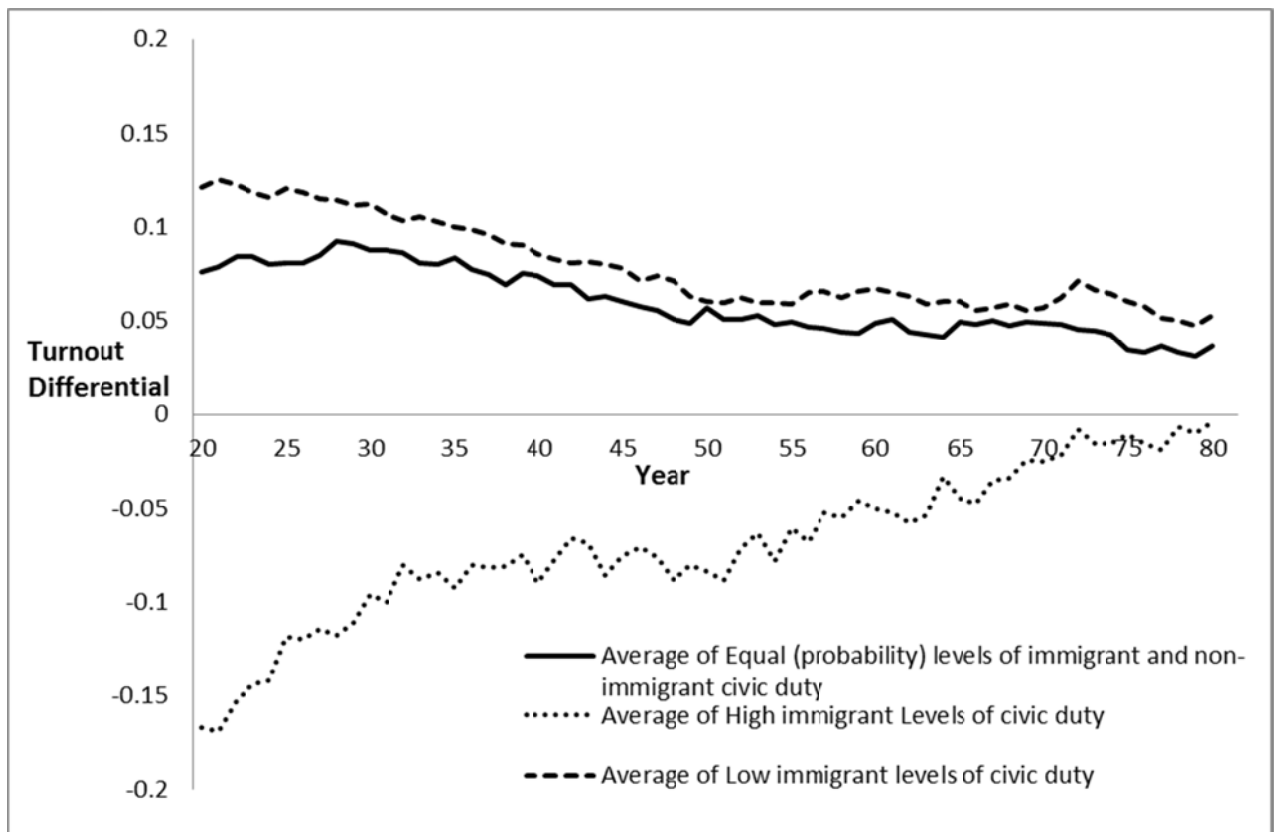


Figure 5 – Comparing rate of turnout between Ethnic Majority Non-Immigrants and Ethnic Minority Immigrants at different levels of immigrant Civic Duty

1 = A model 1% external migration (Solid Line). An increasingly mixed population in which a homogenous non-immigrant Majority population at the start of the models is supplemented with 1% external immigration a year from a visible minority immigrant group. Equal civic duty Levels.

2 = Identical Model to 3 but with Immigrants having higher probability of acquiring civic duty than Non-Immigrants (Dotted Line).

3 = Identical Model to 3 but with Immigrants having higher probability of acquiring civic duty than Non-Immigrants (Dashed Line).

¹ <https://www.openabm.org/model/4368/version/1>. The Model was developed as part of the Social Complexity of Immigration and Diversity Project (SCID). The SCID project ran for 5 years from September 2010-February 2016 and was funded by the UK research council EPSRC (grant number EP/H02171X) as part of the Complexity Science for the Real World initiative. .

² As opposed to the KISS ('Keep It Simple Stupid') approach which emphasises a more bottom up model building approach focused on the primary dynamic influences in an agent based system.

³ This is the earliest paper we identified that referred to this assumption.

⁴ Note that Edmonds and Moss (2005) state that the validity of the KIDS model is primarily derived from the comprehensive replication of the social processes in building the model.

⁵ This is a reference to the technical document which includes the extensive synthesis of real world empirical findings that informed the voter model. It includes evidence which defined the descriptive characteristics of the agents, the interactions between these characteristics, the election effects on agents, the population demographics and the levels of social network influence that occur in the model.

⁶ Although this was not applied for the models run in this paper as it was not relevant to our research problem.

⁷ Each 30 run simulation was replicated at least once to ensure findings were consistent and not an artefact of a particular cluster of simulations. Replication produced identical findings.

⁸ To assist comparison and address saturation effects internal migration is not enabled in any of the models that include immigration. It therefore used primarily as a control in this instance to assess if the immigration process has a specific influence beyond simply population turnover.

⁹ For replication purposes the voter model can be found here

<https://www.openabm.org/model/4368/version/2/view>. Due to the complexity of the model there is insufficient space to outline all of the original parameter settings in the article. However, the above description is an accurate outline of all the parameters which were changed from their default settings. For full parameter settings please contact the authors as outlined in the Data Availability section.

¹⁰ It is presented in this way for clarity of interpretation. All graphs show the average turnout findings between years 20 and 80. This is the period at which the model attains an equilibrium. The first 15-20 years represent a 'burn in' period in which the social network dynamics reach stability.

¹¹ 'Internal migration' is a reference to the process whereby agents with the characteristics of the Ethnic Majority group enter and leave the model. In this case of this experiment it acts as a proxy for measuring the impact of population turnover being driven by homogenous agents vs the impact of turnover being driven by heterogeneous agents.

¹² The reason that the High Civic Duty Model does not have 100% of immigrants coming into the model with Civic Duty is because the count from the model here (although not in the voting %s) includes under 18's. Agents do not have Civic Duty until that point. Unfortunately, this discrepancy cannot be corrected for in the figures because of limitations regarding the format in which the individual level data could be produced from the model using *netlogo*.