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HISTORY AS AN AGENT OF GROWTH: NATURAL EXPERIMENTS FROM CENTRAL EUROPE

by

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Submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy at Central European University

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Budapest, Hungary

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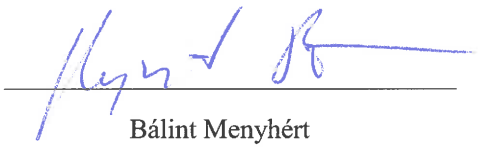

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DISCLOSURE OF CO-AUTHORS CONTRIBUTION

Title of paper:
Ideas off the Rails: Railroads and Institutional Development in the Austro-Hungarian Monarchy

Co-author: Miklós Koren

The nature of cooperation and the roles of the individual co-authors and approximate share of each co-author in the joint work are the following. The basic idea for the paper came from Miklós with the intention to make good use of the township-level data from 19th-century Hungary I had previously collected for the other two chapters in this dissertation. The collection of chapter-specific data (on railroads, cultural institutions and the telegraph network etc.) was carried out by myself and hired statistical assistants supported by the ERC Starting Grant entitled "Channels and Consequences of Knowledge Flows from Developed Economies to Central and Eastern Europe". The drafting and empirical analysis of the paper was carried out by myself, with guidance and approval from Miklós.

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Abstract

This thesis consists of two single-authored and one co-authored chapters that are independent yet related. Each chapter investigates a specific societal or cultural driver of economic development in the historical context, using a unique, hand-collected dataset of more than a 1000 townships from historical Hungary of the 1869-1910 period. My research demonstrates the persistent influence of culture on economic outcomes, and also highlights the wealth of accessible and unexplored historical data for Central Europe.

Chapter 1 is my job market paper. It studies the effects of population mixing on economic growth in the Austro-Hungarian Monarchy, the most diverse country formation in modern European history. Based on the aforementioned self-compiled dataset, I find that ethnically and religiously diverse townships grew up to 20-60% faster in the 1880-1910 period than their homogeneous neighbors. These results are based on three different methodologies. First, OLS regressions take advantage of the largely random geographical patterns in diversity as a natural experiment. Second, endogeneity concerns are addressed by a novel IV strategy based on townships' previous exposure to warfare, using self-compiled data of more than 2000 military events dating back to the 15-17th centuries. Third, to understand the mechanism through which diversity translated to higher economic growth in an era of rapid industrialization, I develop a simple growth model that highlights the potential trade-offs between comparative productivity advantages and reduced knowledge spillovers diverse communities are likely to face. Empirical tests of the model's predictions confirm that diversity led to more diversified local economies, industrial sorting along ethnic and religious lines, as well as higher employment concentration in productive industries.

Chapter 2 proposes a new explanation for the historical source of Protestant economic prosperity based on the reformed institution of marriage and the modern family. Specifically, I argue that Calvin's insistence on spousal duty to love one another, rationalize the household, and educate children for the glory of God was instrumental in the emergence of the child-centered nuclear family and subsequent economic growth. The empirical analysis of the paper, based on the referenced township-level dataset from historical Hungary, confirms the economic progressiveness of puritan Calvinists relative to their Catholic or Lutheran neighbors, and attributes it to observed differences in marriage patterns, household size and fertility rates, both before and during the demographic transition. A simple model predicts that lower exogenous fertility preference can lead to higher per capita income when factors of production are fixed, consistent with the historical evidence of less crowded and fragmented use of agricultural land in Calvinist places.

Chapter 3 is a joint work with Miklós Koren. It studies the effects of railway roll-out on the spread of ideas and institutions in 19th-century Hungary. Specifically, we find that cultural commodities such as civil organizations, libraries, press outlets, coffee houses and theaters were highly concentrated in townships that had been connected to the railway network, to a much larger degree than what economic fundamentals would imply. By employing a series of different econometric approaches, we are able to identify railroads as important capillaries of institutional development. These results can serve as a starting point for developing and testing a simple model of behavioral contagion where the spatial characteristics of the railway network are explicitly accounted for, as well as for quantifying the effects of institutional development on economic growth at the local level.

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Chapter 1
"Economic Growth Spurred by Diversity: Evidence from the Austro-Hungarian Monarchy"

Mixed populations and diverse societies are a salient yet not very well understood aspect of present-day economic development. This chapter provides valuable contributions in this regard by studying the effect of ethnic and religious diversity on economic growth in the historical context, using self-compiled data from the Austro-Hungarian Monarchy (1867-1918), the most diverse country formation in all of modern Europe.

The empirical analysis in the chapter contains three different yet closely related measurement strategies. First, I take direct advantage of the largely random geographical variation in diversity as a natural experiment and estimate the growth difference between diverse and non-diverse places with OLS. While diversity is typically endogenous to economic development, the weak statistical relationship between diversity and observable township characteristics in the pre-industrialization period suggests that the standard issue of migration-based reverse causality is of limited importance in the current context. Regression estimates suggest that diverse townships grew up to 20-60% faster during the 1880-1910 period than their homogeneous neighbors, a result corroborated by a wide range of robustness checks.

To address the issue of unobserved heterogeneity across townships, I then present diversity estimates based on two different IV strategies. The first uses past diversity as of 1720 as an instrument and thus disregards the potentially endogenous effects of mass population movements of the 18th century. The second approach is truly novel and exploits warfare as a genuine historical driver of local-level diversity. Standing at the crossroads between Western and Eastern civilizations, Hungary was exposed to continuous warfare for centuries that set off migration movements and population mixing of an unparalleled magnitude. Based on a self-compiled unique dataset of more than 2000 documented war events from 1391-1718 Hungary, I specifically use the number of military events in a township as an IV for diversity. The resulting 2SLS estimates and reduced-form coefficients confirm the important causal role of diversity in driving economic growth differences between townships.

Finally, to understand the mechanism through which diversity translated into higher growth during an era of rapid industrialization, I propose a simple model of industrial selection that features the potential trade-offs between comparative productivity advantages and reduced knowledge spillovers diverse communities are likely to face. It implies that, while individuals in diverse places tend to face higher entry costs when making their occupational choice due to non-communication between groups, they may also capitalize on group-specific productivity advantages to earn higher wages. Empirical tests of the model's predictions are based on township-level statistics on workers' distribution across economic sectors and industries from 1900 and 1910. These confirm that the benefits of diversity outweighed its costs, and diverse places developed more complex local economies due to ethnic and religious sorting, and concentrated employment in more productive industries.

These findings challenge the dominant view in the literature that social diversity is detrimental to economic development, and show that productivity differences may lead to economic gains even for antagonistic groups. My results also emphasize the previously overlooked centripetal role played by diverse communities in market integration and industrial development in the Austro-Hungarian Monarchy.

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Chapter 2
"What's Love Got to Do with It?
The Modern Family and Its Importance for Protestant Economic History"

What are the historical sources of Protestant communities' relative economic prosperity? Max Weber's thesis about the role of ascetic religiosity in the emergence of modern capitalism offers the most famous explanation, while recent studies have given prominence to literacy and public good provision. Not only are the proposed channels largely incompatible with one another, the robustness of their economic consequences is also disputed.

This chapter proposes a new, more generic explanation that can potentially accommodate several aforementioned ideas. In particular, by recognizing marriage as the most influential institutional change associated with Reformation, I argue that the prime source of Protestant progressiveness concerns the domestic, rather than the economic, sphere. I specifically claim that the insistence of early Reformers, Calvin especially, that spouses had a religious duty to love one another, rationalize family life, and educate children for the glory of God was instrumental in the emergence of the child-centered modern family, which contributed to the fertility decline and economic take-off of the 19th century. This theory has the added merit of highlighting previously overlooked but potentially relevant socio-economic differences within the Protestant faith.

The empirical analysis in this chapter takes advantage of historical Hungary as one of the very few countries with a mixed blend of Catholic and various Protestant denominations at the local level. Focusing on within-district differences in per capita income by religion as of 1910, OLS regressions reveal that Calvinist townships were, respectively, 10% and 20% richer on average than their Catholic or Lutheran neighbors, even after differences in township characteristics such as population size or literacy are accounted for. Interestingly, the income gap of Calvinists is not explained by differences in labour market performance, industrialization or access to finance, and is equally widespread in agricultural areas.

The only patterns consistent with the observed denominational differences in income concern demographics. Indeed, Calvinist places were characterized by more modern marriage and fertility patterns, as evidenced by a higher share of married, divorced and widowed population, smaller and more nucleated households, as well as lower rates of fertility and natural increase. While statistically also highly significant, it is the economic magnitude of these differences that is most striking: in some cases, they represent a residue of a full standard deviation, or several decades of development advantage. Moreover, similar marriage and birth patterns are observed for the much earlier period of 1784-1787 as well, suggesting that potential endogeneity and reverse causality considerations are unlikely drivers of these results.

To understand how exogenous variation in fertility translates into income differentials, I develop a simple theoretical model of fertility choice along the lines of the unified growth theory. This model implies that while lower child preference (or higher childrearing costs) leads to higher per capita income in the Malthusian steady-state of an agricultural economy, land ownership and increasing non-wage income of farmers may, over time, gradually eliminate these advantages at the Post-Malthusian stage of development. The model's main predictions are liable to be tested on agricultural statistics from late 19th-century Hungary, which should confirm the less fragmented and more efficient use of arable land by Calvinists.

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Chapter 3
"Ideas off the Rails: Railroads and Institutional Development in the Austro-Hungarian Monarchy" (joint with Miklós Koren)

The third chapter in my dissertation studies the effects of railway roll-out on the spread of ideas and institutions in historical Hungary. This is an important question for two reasons. First, despite the large literature emphasizing the importance of political institutions for economic growth, the role of cultural institutions that facilitate the production and exchange of ideas has received less attention. Second, while the role of European cities as seedbeds of capitalist practices and innovative institutions is widely recognized, very little is known about the spatial patterns of emergence and adoption of these.

The paper provides some new insights in this regard by linking the extensive roll-out of the railway and the rapid geographical diffusion of Western institutions in 19th-century Hungary. Specifically, it aims to identify an important cultural channel of economic growth associated with one of the most disruptive modern technologies, as distinct from the direct economic effects operating through trade or labour mobility. This poses formidable methodological challenges. First, one needs to isolate the one-way effect of railroads on institutional progress from among a complex set of simultaneous development outcomes, which prompts us to employ a variety of different econometric techniques and reckon taking a model-based approach. Second, one needs to consider institution types that were truly instrumental for the production and exchange of ideas, which made us turn to cultural historiography for focusing on institutions such as civic associations, libraries, press outlets, cafés or thermal baths.

In the empirical analysis, we work with a yearly panel of 1000+ townships covering the 1800-1910 period, rely on the minutious reconstruction of more than 20 thousand kms of railway network development, and use both cross-sectional and over-time variation in several thousands of observations by each institution type. Specifically, we find that institutional development was positively affected by railroad access: not only are institutions more concentrated in treated townships, but post-treatment outcomes tend to remain different even if pre-treatment discrepancies in trends and levels are accounted for (by event study analysis and propensity score matching). More tentative evidence also suggests that some of the estimated railroad effect persists even if exogenous variation in treatment status is used, on the basis of predicted assignment probabilities and durations associated with telegraph access and intermediary straight-line corridors as IVs.

These findings are somewhat conjectural but may serve as a starting point for developing and testing a simple model of cultural contagion where the spatial characteristics of the railway network are exploited in more detail, as well as for quantifying the effects of institutional development on economic growth at the local level. While the implementation of these ideas remains for future work, even the current version of the paper makes interesting contributions to the burgeoning literature on the economic consequences of cultural institutions, knowledge flows and infrastructural developments. For economic historians of 19th-century Central Europe, the paper is most pertinent on account of its emphasis on the dual (i.e. economic and cultural) determination of the inter- and intra-regional modernization patterns of the Austro-Hungarian Monarchy.

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On the whole, studying at the Central European University has been a wonderful experience on so many fronts. In these testing times, I stand firmly with CEU and truly hope that political greed and ignorance will not deprive other young Hungarians from having similarly formative experiences in the future.

During my PhD studies, I was lucky enough to spend two years as a research assistant at the OECD and learn from an incredible group of researchers and policy makers. For that I must thank Péter Gál and Alexander Hijzen, who made the visit possible, as well as my colleagues Paolo Falco, Andrea Garnero, Fabio Manca, Guillermo Montt and Alessandro Tondini, who showed me that good research is just the first step towards an impactful societal contribution.

My thesis was much improved by the careful reading and insightful suggestions by examiners Davide Cantoni and Álmos Telegdy. I thank them for their time, efforts and generosity.

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The utmost gratitude, respect and love I feel towards my parents and sister neither belongs nor can fit in these lines. Suffice to say that they have unconditionally trusted and wholeheartedly supported me, even against their own best judgment sometimes. The aspiration to live up to their standards and be true to their heritage remains my best resource to this day.

My greatest appreciation and admiration goes to my wife. Little did she know at the time of our wedding in September 2010 that our marriage would coincide with an equally encompassing solitary devotion and detachment on my part. She accepted this fate with a grace, accommodated my needs with a perseverance, and endured the resulting hardships with a cheerfulness that are beyond my comprehension. My efforts going into this dissertation certainly pale in comparison to the enormous task of repaying my outstanding debt to her in the years to come.

As for my two daughters, they are the air that I breathe and my guarding angels. It is to them that I dedicate this work.

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Chapter 1

Economic Growth Spurred by Diversity: Evidence from the Austro-Hungarian Monarchy

1.1 Introduction

Much of today's economic activity takes place in an interconnected global environment characterized by labor mobility and population mixing. To understand the economic consequences of diverse populations at a given location is therefore of prime importance. However, sound scientific evidence concerning the causal effects of diversity on growth is hard to come by, since diversity tends to be endogenous to economic performance. In the short-run, economic migration can rapidly alter the composition of the workforce in a given location, while assimilation (or the lack thereof) can have a major influence on population diversity over longer time horizons, even in the absence of labour flows. Moreover, aspects of diversity that matter most for economic outcomes may be hard to observe, correlated with other factors, and liable to change across time and space.

To address these issues and estimate the growth effects of diversity in a convincing way, this paper takes a historical approach. Specifically, I consider the most diverse country formation in modern Europe, the Austro-Hungarian Monarchy of the late 19th century, to exploit exogenous variation in population mixing and propose a model-based testable mechanism to understand how diversity influenced economic outcomes. This is made possible by the turbulent history of Central Europe that led not only to high overall diversity, in excess of present-day US levels, at all administrative levels including individual townships, but also to largely random geographical variation in diversity. Moreover, prolonged growth and rapid industrialization in the period provides an ideal setting to identify potential mechanisms and trade-offs through which diversity may operate.

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The empirical analysis in the paper is based on a new comprehensive database of more than a 1000 Hungarian townships I compiled and hand-collected from official statistical sources from the late 19th and early 20th century. My empirical results show a strong positive causal link between ethnic and religious diversity and economic growth at the local level. Diverse townships outgrew more homogenous ones by up to 20-60% on average in an economically and statistically highly significant manner during the 1880-1910 period. These economic gains were likely generated by comparative productivity differences across different population groups, which allowed diverse places to speed-up industrialization, develop more complex economies, and concentrate employment in more productive industries.

Three different approaches are used in the paper to establish these findings. First, I present plain OLS estimates that take direct advantage of the largely random geographical assignment of diversity in the form of a natural experiment. While diversity is typically endogenous to economic development, the weak statistical relationship of ethnic and religious diversity with respect to observable township attributes such as income or population, as well as the high persistence of township's social composition over time suggest that the standard issue of migration-based reverse causality is of limited importance in the current context. Specifically, I demonstrate that diverse and non-diverse places were not differentially affected by migration or the presence of non-native populations. Moreover, a wide range of additional robustness tests also confirm that strong and widespread diversity gains were realized even among relatively poor, small and provincial townships.

Second, to address the issue of unobserved heterogeneity across townships, I present estimates based on different IV strategies. The first uses data from a nationwide census of taxpayers carried out by the Habsburg administration in 1720 - following the expulsion of Ottoman forces from Hungary but before the mass population movements that characterized much of the 18th century started - that yield qualitatively similar results to the OLS. The second approach is truly novel and concerns warfare in the 15-17th centuries as a genuine historical driver of local-level diversity. Standing at the crossroads between Western and Eastern civilizations, Hungary found itself entangled in continuous warfare for centuries that set off migration movements of unparalleled frequency, magnitude and heterogeneity. Based on a self-compiled unique dataset of more than 2000 documented war events that took place on its territories between 1391 and 1718, I specifically use both the number of military events in a township and the distance to nearest military event as instruments that capture exogenous variation in township-level diversity as of 1880. The resulting IV estimates, as well as estimated coefficients from the reduced-form equation, confirm that diversity is indeed positively associated with previous war exposure, and can be considered as the causal driver of observed differences in subsequent economic growth across townships.

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Third, in order to understand the mechanism through which diversity may have operated in an era of rapid industrialization, I propose a simple testable model of industrial self-selection that features the potential trade-offs between comparative productivity advantages and reduced knowledge spillovers diverse communities are likely to face. Specifically, individuals in diverse places are set to face endogenously higher entry costs and less favorable choice sets when making their career decisions, reflecting their limited access to leading edge technology due to lack of interactions with other groups. On the other hand, they may capitalize on relative group-specific productivity advantages in specific sectors to be efficient and keep clear of wage-reducing diminishing returns in crowded industries of the local autarky. My model shows that, under reasonable parameter assumptions, these productive benefits may outweigh the costs of separatism and drive each group to self-select into different industries best suited to their abilities.

Empirical tests of the model's main predictions are based on township-level statistics on workers' distribution across 29 industries in 1900 and 1910. These confirm that diverse places were indeed more industrialized, developed more complex local economies due to ethnic and religious sorting, and had higher concentration of employment in productive industries. Moreover, this analysis suggests that the model-based mechanism constitutes not just a possible but likely the main channel of transmission from diversity to growth: industrial diversification is found to be the strongest predictor of townships' economic prosperity in 1910, and its inclusion in the regression is able to kill the diversity effect altogether in many specifications.

The paper's findings provide important contributions to the relevant economic literature. First, they challenge the controversial but dominant view that social diversity is detrimental to economic development due to coordination problems. Following the seminal cross-country study by Easterly and Levine (1997) that blames ethnic fractionalization for Africa's poor economic performance, inadequate public policies (A. Alesina and A. Devleschawuer and W. Easterly and S. Kurlat and R. Wacziarg, 2003), lower public good provision (Poterba, 1997; Alesina et al., 1999) as well as the lack of social capital and trust (Alesina and La Ferrara, 2000, 2002) have been recurrently identified as the channels through which diversity harms growth.[1] The divergence between these and my paper's conclusion may underscore the lesser role of public goods and policies in 19th century societies (Flora, 1983), but more probably highlights that

[1]This causal link between diversity and economic performance is particularly problematic in the cross-country setting where endogeneity of public policies is hard to deal with. Also, diversity is highly correlated with alternative growth factors such as geography, institutional quality, communication costs (La Porta et al., 1999; Rodrik, 1999; Arcand et al., 1999; Collier, 2000), that offer competing alternative explanations. Moreover, several other studies find no statistically strong relationship between diversity and growth across countries at all (Sachs and Warner, 1997; Arcand et al., 2000; Bhattacharyya, 2009; Bertocchi and Guerzoni, 2010). City-level studies in the US are more convincing, even though the statistical relationship between diversity is growth is not straightforward in this setting, either (Glaeser et al., 1995; Rappaport, 1999).

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diversity in a given location does not necessarily imply marked economic complementarities or even market interaction between groups (Cutler and Glaeser, 1997; Alesina and La Ferrara, 2004; Robinson, 2016). It also shows that no specific aspect of diversity is likely to be economically relevant across all communities, periods, or stages of development. In particular, the benefits of diversity may just be starting to show in industrializing Africa (McMillan et al., 2014), while increased political polarization seem to deepen racial divisions in present-day US (Giles and Hertz, 1994; Abrajano and Hajnal, 2015).[2]

Second, my results shed some new insights on the correct interpretation of the more recent strand of diversity literature focusing on urban development. These studies, beginning with Florida (2002a,b), typically take a broader, migration-centered view of diversity and identified higher wage growth in US cities with more heterogeneous populations (Ottaviano and Peri, 2005, 2006; Sparber, 2009, 2010). The causal interpretation of these results are nevertheless disputed on the grounds that wage dynamics tends to be influenced by the same factors that shape social diversity at the local level: offshoring, wage polarization, as well as the increased geographical sorting of high-skilled workers (Borjas, 1994; Autor et al., 2006; Blinder, 2006; Moretti, 2013; Diamond, 2013). Against this background, my findings lend credence to the view that some of the observed wage effects are indeed causal effects of diversity, especially given the more complex patterns of knowledge spillovers that characterize modern urban economies (Glaeser et al., 1992). Also, rather than considering geographical mobility as a zero-sum game between "creative" and "uncreative" places, this paper argues that diversity gains may materialize even at low levels of diversity, among native populations, and in the absence of labour mobility.

My paper is also relevant for economic historians of the Austro-Hungarian Monarchy, given that it emphasizes a previously ignored aspect of its economic development and industrialization. The dominant view in historiography holds that ethnic and nationality conflicts were the root cause of the Monarchy's disintegration and eventual dissolution (Jaszi, 1929; Kann, 1950; Konirsh, 1955; Taylor, 1990), while much of the observed regional convergence has been attributed to ethnocentric market integration and nationalist cooperative movements (Pasvolsky, 1928; Lorenz, 2006; Berend, 2012; Schulze and Wolf, 2012). This paper, on the other hand, argues that mixed places, rather than ethnically homogenous areas, were the cornerstones of rapid industrialization and economic development in late 19th century Hungary. Moreover, observing that industrial diversification is a strong predictor of income even in largely agrarian townships suggests that the accepted notion of agriculture-driven technological innovation and productivity gains in 1870-1910 Hungary also needs refinements (van Zanden, 1991; Kopsidis, 2009).

[2]Moreover, historical evidence also suggests that civil conflicts and tolerance themselves may be influenced by between-group complementarities and economic development (Miguel et al., 2004; Jha, 2008).

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The remainder of the paper is structured as follows. Section 1.2 provides a brief historical background to the empirical analysis, describes the data and discusses measurement issues. Section 1.3 introduces the main empirical strategy, presents OLS results and shows their robustness across a wide range of empirical settings. Section 1.4 presents a novel IV strategy based on townships' exposure to medieval warfare to sidestep potential endogeneity issues and allow for a causal interpretation of the main results. To understand the source of diversity gains, Section 1.5 proposes a simple model of industrial self-selection featuring the likely trade-offs between comparative productivity advantages and reduced knowledge spillovers in diverse locations, and considers their implications for economic growth and industrialization. Section 1.6 empirically tests the implications of the theoretical model for industrial diversification, industrial sorting and concentration in productive industries. Section 1.7 concludes.

1.2 Historical background, data and measurement

From its creation in 1867 until its dissolution in 1918, the Austro-Hungarian Monarchy was one of the largest political and economic entity in Europe. Its singularity consisted in the multiethnic and multicultural character of its population, which was preserved well into the age of 19th nationalism due to its dynastic rule and previous successionist territorial development. Specifically, its citizenry was made up of no fewer than 11 nationalities and 7 religions that made the Monarchy by far the most diverse country formation in all of modern European history (Kann, 1950; Taylor, 1990).[3] For this reason, some historians consider it less as a true state than a "mildly centripetal agglutination of bewilderingly heterogeneous elements" (Evans, 1984).[4]

The existence of the Austro-Hungarian Monarchy also coincided with rapid growth, industrialization and capitalist development. Between 1867 and 1913, per capita GDP roughly doubled in PPP terms (Good and Ma, 1998; Schulze, 2000), while real industrial output increased fivefold (Komlos, 1983; Schulze, 2000).[5] The industrial boom had an asymmetric effect on the already highly disparate economic landscape not only between rich industrialized Western and poor agrarian Eastern provinces, but also within regions (Berend, 2012).[6] The unevenness of

[3]Specifically, comparing the 1910 Austro-Hungarian Monarchy with the roughly 190 present-day countries analyzed in terms of ethnic, linguistic and religious fractionalization in A. Alesina and A. Devleschawuer and W. Easterly and S. Kurlat and R. Wacziarg (2003), it would rank 1st in ethnolinguistic diversity among developed countries (and 4th among all countries behind behind Congo, Liberia and Madagaskar). Its rank in religious diversity would be 70.

[4]Several literary figures of the time would agree. According to the famous essay *Austria and Her Future* by Andrian-Werburg, 'Austria is a purely imaginary name, which means neither a distinct people nor a land or nation. It is a conventional name for a complex of clearly differentiated nationalities'. Jaroslav Hasek's satirical character, *The Good Soldier Svejk* is more blunt in his assessment: "a monarchy as idiotic as this ought not to exist at all".

[5]See Figure A1 in the Appendix.

[6]Upper Austria and Bohemia were the most highly industrialized regions, while Galicia and Bukovina were the

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the development process was not mitigated much by the low levels of social and geographical mobility (Andorka, 1982; Tilly, 1978; Moch, 2003; Kaelble, 1986; Ferrie, 2005), as evidenced by the stability of regional differences in relative wages throughout the period (Cvrcek, 2013).[7]

The systematic relationship between social diversity and long-term economic development in the Austro-Hungarian Monarchy has not been studied before, even though social and economic historiography offer very contrasting narratives. Social historians focusing on political and nationality conflicts stress the increasing antagonism between different ethnicities, to the extent that the disintegrative forces of intra-empire divisions are frequently identified as the main factor in the Monarchy's decline and dissolution (Jaszi, 1929; Kann, 1950; Konirsh, 1955; Taylor, 1990).[8] In contrast, quantitative economic research tends to emphasize intra-empire economic integration, due to the geographical diffusion of Western resources and institutions (Berend and Ranki, 1980), market harmonization (Uebele, 2011), infrastructural development (Tominac, 1905) and growth convergence (Berend and Ranki, 1976; Schulze, 2000). These views are not mutually exclusive and centrifugal (political) and centripetal (economic) forces are likely to have been simultaneous in their effects (Jaszi, 1929; Lorenz, 2006; Schulze and Wolf, 2012).

Focusing on the local-level provides a great setting for the study of the interrelations between the political (cultural) and economic spheres. This is because, contrary to multiethnic European countries such as 19th century France or Switzerland where different ethnicities were geographically separated, the Austro-Hungarian Monarchy - and the Hungarian territories in particular - was characterized by high diversity not only between and within regions, but also at the level of individual townships. Moreover, the geographic patterns of local-level diversity had been established long before the formation of the Austro-Hungarian Monarchy, principally on non-economic grounds. Indeed, the convolution of different identities at the local and regional levels in the Hungarian territories had started with the advancement of the Ottoman Empire in the late 14th century. Its incursions into the Carpathian basin forced great segments of population to flee and set off migratory movements of unparalleled frequency, magnitude and directional heterogeneity for centuries in the region (Sokal, 1997). As will be explored in the paper, much of this was directly related to the continuous warfare that accompanied the Ot-

poorest and least developed. For more information on the regional disparities in the Austro-Hungarian Monarchy, see Good (1984); Komlos (1983); Berend and Ranki (1976).

[7]Cvrcek (2013) also shows that, despite the differences in economic development, the gold standard based monetary regime of the Monarchy ensured relative price stability and highly correlated price movements, which makes it possible to compare the long-term development of different locations with a fair degree of accuracy, even based on current-price measures. For example, the nominal cost of living between 1880 and 1910 in central Hungary grew only by around 15 %, at much the same rate as in other parts of the country and the Monarchy.

[8]Religious conflicts feature less prominently in these accounts, even though they were also manifest. Anti-semitism was particularly wide-spread and virulent, effectively hindering any representation of particular Jewish interests in the political scene (Kovacs, 1998). Confrontations between other religions were also commonplace, especially between the privileged and powerful Catholic Church and other confession groups (Fazekas, 2008).

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toman and Habsburg rule in the 16-17th centuries, but the subsequent re-population of war-torn areas in the 18th century was equally important in this regard (O'Reilly, 2003). The resulting degree of social mixing at the local level rendered Hungary's population as heterogenous as traditional pre-modern societies were (Weber, 1976).

1.2.1 Data sources and measurement

To study the economic effects of diversity, the empirical analysis in the paper is based on a new dataset of Hungarian townships I hand-collected and compiled from official statistical sources of three different types from the 1869-1910 period. First, decennial censuses contain information on townships' area, population size, ethnic and religious profiles, labour market characteristics, literacy and legal status. Second, thematic periodical publications detail the historical development of transportation networks and exploitation of natural resources. Third, occasional statistical reports cover certain demographic or economic aspects of townships (such as their budgetary situation, vital statistics or access to finance) at given points in time.[9] Specifically, my dataset contains all townships of which the population exceeded 2000 at the time of the earliest census in 1869.[10] The resulting sample comprises altogether 1689 townships in 72 counties and 517 administrative districts, and covers more than half of Hungary's total population and around 10% of all townships in the period.

The main variables of interest are the measures of diversity and economic development. Diversity is defined separately along ethnic and religious lines, and is measured in the customary way by 1 minus the Herfindahl-Hirschman index (HHI). Formally,

$$\text{Diversity} = 1 - \sum_{q} s_q^2$$

where s_q denotes the relative share of ethnic or religious group q in a township. As such, the level of diversity in a township corresponds to the probability that two randomly drawn individuals belong to different ethnic or religious groups, respectively. Diversity thus equals 0 in completely homogeneous places, corresponds to 0.5 in townships with two equally sized groups, and converges to 1 in truly mixed locations.

The main measure of economic development is less conventional and concerns townships' direct tax base in per capita terms. This corresponds to local residents' average contribution to the central government's budget through uniform tax payments on land, personal income, housing, corporate profits as well as capital gains and interest, among others. The direct tax

[9] See the Data Appendix for a comprehensive list of data sources used in the paper.

[10] To ensure appropriate geographical coverage, in the few cases where no township reached the aforementioned population threshold in a given district, I selected the most populous township regardless of its size. In the couple of cases where townships merged or disintegrated between 1869 and 1910, I consistently treat the totality of constituents as a single observation.

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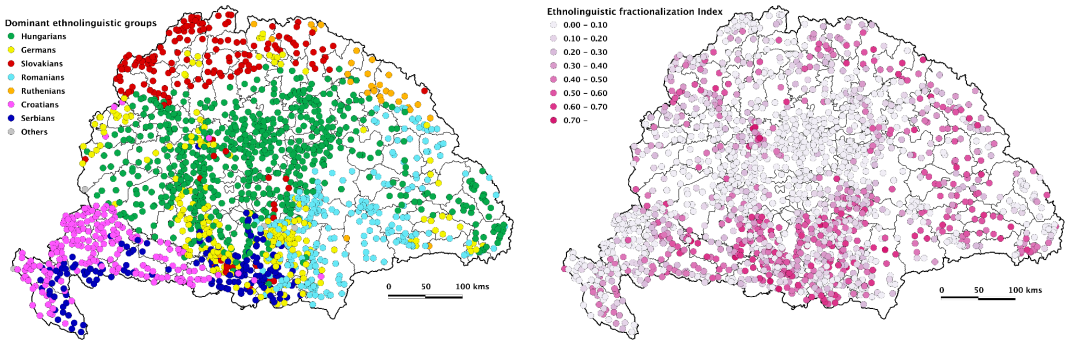

Figure 1.1: Ethnic diversity between and within townships in 1880 Hungary

base therefore represents a fairly nuanced and accurate indicator of the totality of economic activity at the local level.[11] However, there are some notable caveats: not only did the overall financing share of direct taxes drop from around 35% in 1880 to 23% in 1910, the relative importance of certain types of these taxes also underwent important changes. This has the potential to create systematic heterogeneity across townships, which I address by exploring more traditional measures of the dependent variable as well.[12]

To account for potential confounding factors, I also collected data on wide range of township attributes. These include townships' geographical area, population size and density, and literacy; their access to navigable waterways and railways; the location of mines, mountains and financial institutions; their geographical position relative to Monarchy capitals; as well as their administrative and legislative status.[13]

1.2.2 Stylized facts

Before the main analysis, I review the most important stylized facts about the data. Figure 1.1 shows the position and main characteristics of sampled townships on geocoded maps of 19th century Hungary. The left panel shows the dominant ethnic group in each location and paints an ethnically highly diverse society characterized by many different groups, overlapping geographical domains and scattered "outposts" in faraway areas. The Southern regions

[11] Comparable historical studies often have to make do with less comprehensive or refined measures of economic activity at the local level, such as the relative share of labor in non-agriculture, average wage in well-defined professions (Becker and Woessmann, 2009), land values or agricultural income (Donaldson and Hornbeck, 2012; Donaldson, 2013). As far as studies of contemporary focus are concerned, average wage constitutes the main measure of economic activity in most cases (Ottaviano and Peri, 2006; Sparber, 2009), but cruder measures such as population growth are also used (Glaeser et al., 1995).

[12] Direct taxes remained an importance source of government revenues throughout the existence of the Monarchy, even though state finances were increasingly based on indirect revenue sources (such as sales and consumption taxes, fees, customs and concessions) over time. As far as the composition of direct tax revenues are concerned, it is not observed at the township level and can only be obtained from aggregate financial statistics of the central budget. These reveal the following relative shares by category as of 1880 (1910): land taxes 41.1% (24.8%), income taxes 29.4% (32.6%), property and housing taxes 9.9% (14.5%), corporate taxes 7.8% (18.0%), capital gains and interest taxes 4.0% (6.8%), other taxes 7.8% (3.3%).

[13] See the Data Appendix for a detailed description and source of all variables used in the analysis.

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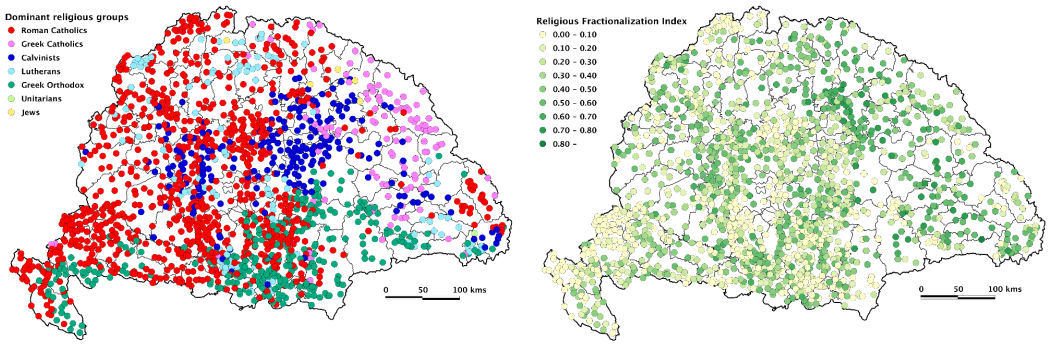

Figure 1.2: Religious diversity between and within townships in 1880 Hungary

of Vojvodina and Banat (in present-day Serbia and Romania, respectively) were particularly diverse in this regard. The right panel of Figure 1.1 displays diversity levels within townships and shows that most sampled locations were indeed multiethnic (e.g. one in three had a minority share of 20% or more), especially in the peripheral areas outside of present-day Hungary.

Figure 1.2 shows the analogous maps for the religious aspect of diversity. The left panel reveals that the level of religious mixing between townships is comparable to what was observed in the ethnic domain. However, it also shows that religious fault-lines do not correspond to ethnic boundaries in most cases, as evidenced by the different color patterns and the highly mixed regions in the Central part of the country in particular.[14] The right panel of Figure 1.2 shows that religious diversity is equally high within townships (e.g. roughly half of them had a minority share of 20% or more), especially in the Eastern regions of Transcarpathia (bordering on present-day Romania, Slovakia and Ukraine) and Transylvania (in present-day Romania).

It is important to note that the large cross-sectional variation observed with respect to diversity is also present in the economic domain. Figure A5a in the Appendix shows the per capita tax base of townships in 1910 and documents differences of up to an order of magnitude, both between and within regions.[15]

However, before analyzing what share of this variation is explained by differences in diversity, let us also numerically describe the main variables of interest. Table 1.1 shows the summary statistics for the sample of 1008 townships that is used in the main analysis, for 1880

[14]Ethnic and religious divisions are most identical in Croatia (split between Catholic Croats and Orthodox Serbs) and several parts of Transylvania in the East (as populated by largely Catholic Hungarians, Protestant Germans and Orthodox Romanians).

[15]Similarly large disparities existed in relation to employment shares in non-agriculture. (See Figure A5b in the Appendix.) Interestingly, the cross-correlation between (log) per capita tax base and the employment share in non-agriculture is only 0.36 in 1910. This may reflect the degree to which a more complex measure of economic development (such as the direct tax base) outperforms a more singular measure (such as employment shares in industry) in capturing the true state of the economy. Indeed, historical evidence based on crop yields and the comparison of land cultivation techniques suggests that some primarily agricultural territories (such as Vojvodina and Banat in the South) managed to attain higher living standards than some more industrialized regions in the north of the country (Berend and Ranki, 1967).

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and 1910.[16] As far as social diversity is concerned, Panel A shows the relative share of ethnic and religious groups in decreasing order and documents their supreme stability over time. The resulting average diversity is .22 and .31 in the ethnic and religious domains, respectively, which is comparable to diversity levels observed in present-day US metropolitan areas.[17] Panel B describes the different measures of economic development used in the paper. Somewhat paradoxically, the per capita tax base is shown to have decreased on average over the period, as a result of the gradual curtailment of direct revenue sources described earlier. Alternative measures show that the mean employment share in industry across the sample was only 16% even in 1910, and that out-migration (i.e. negative net immigration share) was more dominant in most townships than in-migration. Panel C and D contain a set of potentially important control variables and document a strong increase in population, literacy rates and access to railway during the period.

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[16]Note that 681 of the 1689 sampled townships do not feature in the main analysis, for two reasons. First, 361 townships belonged to the semi-autonomous lands of Croatia in the south-west part of the country, and details of their finances were not contained in the relevant official statistics. Second, information on the direct tax base was effectively missing for another 309 township, due to their lack of local tax revenues in 1880. While this may introduce endogenous selection bias in theory, this does not seem to be the case in practice: (unreported) probit estimates show that townships with missing tax information are not systematically different from the rest of the sample, and the main statistical relationship between diversity and economic performance presented in the paper (based on proxies such as population growth) hold in this sub-sample too.

[17]Alesina et al. (1999) calculates mean present-day ethnic diversity to be .26 across 300 US metropolitan areas and .20 across 1400 US counties, with standard deviations of .14 and .16, respectively. For comparison, corresponding county-level diversity in 1880 Hungary amounted to .45 and .53 in the ethnic and religious dimensions, respectively.

	1880				1910			
	Mean	Stdev	Min	Max	Mean	Stdev	Min	Max
A. ASPECTS OF DIVERSITY								
Ethnic shares								
Hungarians	.47	.43	0	1	.52	.42	0	1
Romanians	.17	.32	0	1	.16	.32	0	1
Germans	.16	.28	0	1	.14	.26	0	.97
Slovakians	.11	.28	0	1	.10	.26	0	1
Serbians	.05	.16	0	.98	.04	.14	0	.96
Ruthenians	.03	.14	0	1	.02	.12	0	.95
Croatians	.00	.05	0	.97	.00	.03	0	.98
Others	.01	.04	0	.92	.02	.07	0	.99
Ethnic diversity	.22	.21	0	.75	.22	.22	0	.76
Religious shares								
Roman Catholics	.49	.37	0	1	.51	.37	0	1
Orthodox Catholics	.16	.31	0	1	.16	.30	0	1
Calvinists	.14	.26	0	.97	.14	.24	0	.93
Greek Catholics	.09	.22	0	.99	.09	.21	0	.99
Lutherans	.06	.18	0	1	.06	.17	0	.97
Jews	.05	.07	0	.45	.05	.07	0	.44
Unitarians	.00	.01	0	.24	.00	.01	0	.23
Others	.00	.01	0	.27	.00	.00	0	.06
Religious diversity	.31	.22	0	.79	.32	.22	0	.80
B. MEASURES OF ECONOMIC DEVELOPMENT								
Per capita tax base (in krones)	4.69	2.41	.31	19.15	8.31	4.80	.73	65.97
Employment share in industry	-	-	-	-	.16	.12	.00	.74
Net share of immigration (1900-1910)	-	-	-	-	-.05	.10	-.46	.43
C. CONTINUOUS CONTROLS								
Population size (in 1000s)	4.98	12.67	.82	360.55	7.12	28.53	.84	863.74
Literacy rate	.38	.19	.01	.79	.58	.17	.03	.84
Area (in 100 sqkms)	.74	.81	.02	9.74	.74	.81	.02	9.74
Population density (1000 per sqkm)	.08	.12	.01	1.86	.12	.32	.01	8.17
D. CATEGORICAL CONTROLS								
Railway access	.18	.39	0	1	.51	.50	0	1
Access to navigable waterway	.09	.29	0	1	-	-	-	-
Bank	.29	.45	0	1	-	-	-	-
Mining	.12	.32	0	1	.12	.32 .32	0	1
Mountain	.16	.37	0	1	.16	.37	0	1
Township council	.06	.23	0	1	.06	.24	0	1
Township jurisdiction	.02	.15	0	1	.02	.15	0	1

Table 1.1: Summary statistics of main variables in 1880 and 1910

1.3 OLS results

To understand the relationship between diversity and economic growth, I first take direct advantage of the historical landscape in the form of a natural experiment, and estimate the statistical relationship between diversity and growth with plain OLS. The resulting estimates identify the one-way effect of diversity on growth only if the diversity is exogenous to growth. While this is typically not the case, there are key patterns in the data suggesting that the the typical migration-based endogeneity issues are of limited importance in the current context. First, the two aspects of diversity are only moderately correlated with each other ($\rho = .44$). Second, diversity is very loosely related to townships' population size, per capita tax revenue or any other observable characteristics ($\rho \leq .15$). Third, diversity is very highly persistent over time in both dimensions ($\rho \geq .90$). (See Figures A2, A3 and A4 in the Appendix for graphical illustration.) If diversity was the result of endogenous labour flows in the first place, one would possibly observe a closer relationship between ethnicity and religion, a higher concentration of diverse population in larger and richer places, and less persistence in diversity over long periods of time.

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	Ethnic dimension		Religious dimension	
	Without controls	With controls	Without controls	With controls
Diversity	**.403*** (.072)**	**.204*** (.065)**	**.604*** (.065)**	**.310*** (.060)**
1880 log tax base (p.c.)	-.356*** (.049)	-.510*** (.046)	-.409*** (.049)	-.532*** (.046)
Literacy share		.675*** (.088)		.606*** (.086)
Population size (in logs)		.005 (.027)		.009 (.026)
Population density		.014 (.013)		.013 (.014)
District seat		.178*** (.030)		.168*** (.029)
County seat		.099 (.063)		.101 (.063)
Capital city		.523** (.253)		.576** (.267)
City council		.195*** (.061)		.183*** (.059)
City legislation		.127 (.090)		.110 (.088)
Distance to Budapest		-.054 (.060)		-.052 (.061)
Distance to Vienna		.033 (.061)		.014 (.061)
Bank		.047 (.030)		.045 (.030)
Railway		.018 (.028)		.022 (.028)
Navigable waterway		.042 (.028)		.042 (.027)
Mountain		-.235*** (.066)		-.228*** (.066)
Mining		.004 (.048)		.019 (.047)
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008
R squared	.296	.485	.335	.494

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively.

Table 1.2: OLS regression results for the growth effects of diversity

Exploiting the aforementioned features of the data, the main empirical analysis focuses on growth differentials across townships during the 1880-1910 period, as explained by township characteristics as of 1880:

$$\Delta y_{i,1910/1880} = \alpha + \beta \text{Diversity}_{i,1880} + X'_{i,1880}\delta + \gamma y_{i,1880} + \epsilon_i \tag{1.1}$$

where subscript i denotes individual townships, the dependent variable $\Delta y_{i,1910/1880}$ stands for economic development between 1880 and 1910, while the right-hand side features initial levels of ethnic and religious diversity, economic development $y_{i,1880}$ as well as a vector of control variables $X_{i,1880}$ as of 1880. Equation (2.1) is therefore a standard growth regression of the conditional convergence type (Barro, 1991; Barro and Sala-i-Martin, 1992; Sala-i-Martin, 1996), where β measures the growth difference between more and less diverse townships. As such, this setup can also be interpreted as a generalized difference-in-differences estimation with diversity as a continuous treatment variable.

Table 1.2 shows OLS estimates of the model with county fixed effects separately for the ethnic and religious dimensions. Estimated diversity coefficients from specifications without control variables show that the growth in per capita tax base between 1880 and 1910 was 40% (60%) higher in ethnically (religiously) very heterogeneous townships ($DIV \approx 1$) than in completely homogeneous ones ($DIV = 0$) within the same county. Alternatively, one standard deviation (.21-.22) increase in ethnic or religious diversity is associated with around 8-12 per-

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cent higher growth on average, while moving from the 25th to the 75th percentile in the diversity distribution corresponds to an average growth advantage of around 14-25 percent.

These estimates are not only highly significant statistically, but their economic magnitude is also very large. Considering that per capita tax base increased by 77% between 1880 and 1910 on average (see Table 1.1), reported diversity estimates suggest that mixed townships with two even ethnic or religious groups ($DIV = 0.5$) developed a growth advantage in excess of 30% (i.e. a full percentage point annually) over their homogenous neighbors in absolute terms. For comparison, this wedge corresponds to the difference between the fastest-growing (Transdanubia) and slowest-growing (Dalmatia) regions of the Austro-Hungarian Monarchy in the 1870-1910 period (Schulze, 2007). Moreover, it is considerably larger than diversity gains predicted for present-day US: growth regressions based on the IPUMS Census data, for example, yield a coefficient estimate of .16 for racial diversity during 1980-2000 across large metropolitan areas.[18]

Since different types of localities had potentially divergent growth outlook, Table 1.2 also features specifications that control for a wide range of township attributes in addition to the initial level of development. Coefficient estimates for diversity remain positive and significant both economically and statistically, but around half of the associated gains are absorbed by the additional controls. Differences in literacy shares, legal and administrative status and geography (e.g. mountains) are the main factors explaining residual variation in growth rates, while infrastructural access to railways, navigable waterways or finance are found to have very little predictive power. To a certain degree, this is due to their effect being absorbed by spatial controls and the 1880 tax base, but the inability of the model to account for post-1880 infrastructural development also plays a part.

Finally, a crucial aspect of growth regressions concerns the coefficient estimate associated with the initial level of economic development. Table 1.2 shows that $\hat{\gamma}$ is consistently negative and large in magnitude across all specifications, which signals considerable β-convergence in the conditional sense (Sala-i-Martin, 1996). Interpreting the coefficient on the 1880 tax base as the speed of convergence towards a steady-state, a rate of 1.2-1.8% per year is implied depending on the specification, which is in line with standard cross-country estimates (Barro and Sala-i-Martin, 1992) but well below the rate observed across US cities (Crihfield and Panggabean, 1995). To see whether mixed townships are catching up faster or converg-

[18]The referenced IPUMS data is a 10-yearly panel of about a 100 US cities and contains, among others, information on wages and standard racial diversity scores based on five large categories. (Cross-sectional average diversity is .26 and .37 in 1980 and 2000, respectively.) This data was used by Sparber (2010), and I am grateful to him for sharing it with me. The referenced diversity estimate is based on the same specification as Equation 2.1 without control variables. The coefficient is statistically significant only in absence of additional controls or state fixed-effects.

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ing to a higher steady state, it is useful to look at the relationship between diversity and the level of economic development in the cross-section.[19] Table A1 in the Appendix presents the main estimates from level regressions as of 1880 and 1910, respectively. These show that (1) diverse townships were considerably more developed in both periods, (2) their income advantage increased significantly from 1880 to 1910, and (3) a growing part of the cross-sectional variation in income is explained by covariates, literacy in particular, over time. These findings suggest that social diversity is a basic determinant of growth that can place townships on a higher growth trajectory. They also indicate that cross-sectional analysis alone does not fully capture the cumulated growth effects of diversity, which seem to lie within a range defined by $\hat{\beta}$ estimates shown in Table 1.2 for specifications with and without controls, respectively.[20]

1.3.1 Robustness of results

The baseline regression results presented in the previous section are based on specific measurement choices that may give a one-sided view about the true statistical relationship between diversity and growth. In this section, I test whether the main parameter estimates are robust to a wide range of alternative specifications.

First, I look at whether results are driven by regional differences or correlations. For example, if diversity was concentrated in areas with relatively high growth-potential due to some systematic underlying factor, the baseline specification may wrongly associate growth differentials with differences in diversity. Table A2 in the Appendix shows this is not the case: diversity estimates remain qualitatively the same no matter which administrative level spatial dummies and the clustering of standard errors are set up at. Second, I test whether results are sensitive to the way diversity is measured. In particular, I consider two alternative measures that focus on different ends of the diversity spectrum in each dimension: the first of these is a concentration-ratio based index that captures the relative population share outside of the largest group, while the second simply counts the number of groups with at least 1% population share. Table A3 in the Appendix shows that diversity estimates are positive and highly significant across all mea-

[19] Assuming that diversity is a determinant of the steady state in the standard β-convergence setup, a 40-150% higher level of equilibrium income is implied by $\hat{\beta}$/-$\hat{\gamma}$ for very mixed townships (see various specifications in Table 1.2). Note, however, that $\hat{\gamma} < 0$ only implies mean reversion in the strict sense, which is not equivalent to convergence: depending on assumptions about the data generating process, the latter may be either independent of the former or contingent on additional assumptions with respect to the noisiness of the process (Lichtenberg, 1994). Indeed, rather than shrinking, the cross-sectional standard deviation in log per capita tax base increased from .53 in 1880 to .63 in 1910.

[20] A closely connected and highly relevant debate in the literature concerns the role of institutions for economic development and growth. Cross-sectional estimates seem to support the institutionalist view (Hall and Jones, 1998; Acemoglu et al., 2005), while growth regressions generally dispute this notion and emphasize the primacy of more fundamental factors such as human capital in the cross-country setting (Glaeser et al., 2004). Against this backdrop, diversity seems like another alternative to institutional quality as "deep" determinant of growth.

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sures considered.[21] Third, I investigate whether results are robust to using alternative dependent variables, given that diverse townships may have been affected differentially by incoming tax changes (e.g. due composition effects stemming from specialization in different activities) or have faced different effective tax burden (e.g. due to communication or cooperation issues surrounding tax collection or tax evasion) than homogenous places. Specifically, I consider more traditional measures of urban development such as population growth, employment share in industry or in-migration. Table A4 in the Appendix shows that diversity was associated not only with higher tax growth, but also 8-14% higher population growth and 5-12% higher industrialization (as measured by employment shares) in the 1880-1910 period.[22] Interestingly, the estimates for net immigration are economically and statistically insignificant, which lends further credence to the assertion that diversity gains are not driven by endogenous economic migration in the first place.

I also compare results across various sub-samples in order to learn how wide-spread diversity gains are in the cross-section of townships and delimit the potential bias caused by omitted variables. Focusing on the least vibrant places to minimize the effect of idiosyncratic factors, Table A5 in the Appendix reports diversity estimates based on the sample of townships with below-median population, income and diversity in 1880. To ascertain that diversity gains are not caused by the presence of potentially more industrious or productive migrant populations, estimates based on the subset of townships that are least dissimilar to their social environment are also reported.[23] Results reveal that diversity gains were equally present in smaller, poorer, more homogeneous and less distinctive places, potentially in even higher degree than in the respective excluded sub-samples.

In principle, it is also possible that diversity is associated with higher economic growth only because of certain highly productive minority groups, such as German industrialists or Jewish financiers. To check this, I have separately estimated a set of extended regressions, each featuring the population share of an ethnic or religious group alongside the diversity measure. Results in Table A6a in the Appendix show that diversity estimates remain robust even in the presence of large and statistically significant group-specific growth-effects.[24]

[21] Specifically, a 10 percentage point increase in the relative share of non-majority groups is associated with 2-6% higher growth in the tax base, depending on the diversity aspect considered and the control structure. Similarly, the presence of each additional group corresponds to an estimated 6-13% growth advantage over the same period.

[22] Note that the level of industrialization in 1880 is not observed in the data. My previous conclusion therefore depends on the somewhat exaggerated assumption that industrial employment was zero in 1880. This is not very far from the truth, though: estimates by Komlos (1983) presented in Figure A1 in the Appendix show that real industrial production in 1880 was less than third of its 1910 level.

[23] Dissimilarity of a township was calculated by comparing the closeness of its ethnic and religious profile to that of the whole population in the county it belongs to. For more methodological details, consider the index of dissimilarity presented in Equation **??** later in the paper.

[24] Interestingly, each percentage point increase in the share of Jewish population in a township is associated with a 1% statistically significant increase in taxes, but no such strong relationship is observed with respect to Germans or any other ethnic or religious group. To better isolate this potential "Jewish effect", I also estimated

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As a final robustness check, I explore the spatial characteristics of the township network to consider the potentially important role of local geographical differences in shaping economic development in the historical context (Klein and Crafts, 2012; Ploeckl, 2012). In particular, I implement a simple matching procedure which assigns townships to their nearest neighbor based on geographical distance. Estimating the baseline model with a separate dummy for each matched pair should help isolate diversity effects from other location-specific factors such as market access, agricultural land quality or institutional differences. The main parameter estimates are presented in Table A7 in the Appendix for the total sample as well as for the subsample of townships located at most 5 and 10 kms away from one another. Results indicate that diversity estimates are not qualitatively different from the baseline estimates, even though their economic and statistical significance decreases, and eventually disappears, as only the least distance pairs are focused upon. These findings are consistent with limited location-specific differences in growth (once initial levels are harmonized) but non-negligible positive spillover effects in the immediate surroundings of diverse townships.

1.4 IV estimations

In the previous section, I argued that the OLS estimates presented in Table 1.2 largely capture the causal effect of diversity on growth. However, with potential unobserved heterogeneity across townships, this may be far from the truth. In particular, if better location-specific growth fundamentals were the very reason why certain townships became ethnically or religiously diverse, then OLS would overstate the true economic effects of diversity. A similar bias would arise if predominantly those places remained mixed where the benefits of diversity surpassed its potential pitfalls. Therefore, to establish causality in a fully convincing way, a sound identification strategy is needed that relies on exogenous variation in diversity. In this section, I explore two different IV approaches that focus directly on the emergence and evolution of ethnic and religious mixing at the local level in historical Hungary.

1.4.1 Past level of diversity as instrument

The first approach consists of re-estimating the main regression specification using the past level of diversity as an instrument for diversity in 1880. This is made possible by a nationwide assessment of the number and nationality of taxable population by each location the Habsburg administration carried out after the expulsion of the Ottomans from the Hungarian lands in 1720-1721. This census, despite its numerous limitations and specific focus, provides a detailed look into Hungary's social landscape at a unique point in time, right before the mass

the baseline model on a sample of "non-Jewish" townships and found that parameter estimates for diversity are not qualitatively different from their original values in either dimension.

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re-population movements that characterized much of the 18th century got under way.[25] Ethnic diversity in 1720 turns out to be somewhat lower on average than in 1880 ($\bar{\mu} = .13$), but relatively stable over time within townships: the relevant auto-correlation is higher than 40%, with the dominant ethnicity being the same in more than 80% of the cases.[26] Figure A7 in the Appendix also shows that while diversity remained more or less stable in the (relatively homogeneous) territories of present-day Hungary, it typically increased in the surrounding periphery, albeit with a considerable degree of local-level variation.

Using the 1720 level of diversity as an instrument allows focusing on more traditional geographical patterns of diversity and reduce the likely estimation bias caused by the potentially endogenous migration process that took place between 1720 and 1880. Two-stage least-squares (2SLS) estimates are presented in Panel A of Table 1.3 and show estimated diversity coefficients to be positive, highly significant, and not statistically different from the OLS ones across the main specifications.[27] Panel A also features important statistics related to instrument relevance and validity in the first stage and the reduced-form equation, corroborating diversity as a veritable growth driver in late 19th-century Hungary.

1.4.2 Previous exposure to warfare as instrument

However, it is quite possible that even 1720 diversity is correlated with unobserved township characteristics that are important for growth. As long as their effect on growth is continuous in time or potentially enhanced by the rapid process of industrialization after 1880, using lagged value of diversity as an IV does not offer full-fledged solution. My second identification strategy therefore goes further and explores a genuine historical driver of local-level diversity in Hungary during the early modern period. This concerns warfare, which has widely been considered as one of the most important drivers of long-term migration and population mixing in European historiography (Kulischer, 1932; Tilly, 1978). This was particularly true of specific regions where the political and military ambitions of sovereign rulers were consistently focused (Tallett, 1992; Anderson, 1998), and the Habsburg-Ottoman frontier crossing historical Hungary was indeed beset with constant and desperate warfare during the 15th and 17th centuries. Tellingly, first-hand experience in these wars prompted James Fitzjames, the illegitimate son

[25]The 1720-1721 census includes only those household heads that had either earnings or property and thus excluded 20-50% of the total population. The geographical coverage extended to the whole of the country, even though some regions (e.g. parts of Banat in the south-east) were left out while in others (e.g parts of Transylvania) taxpayers' names were missing which prevented the identification of their nationalities. As far as these latter are concerned, Croatians and Serbians, as well as Slovakians and Ruthenians, were considered as one, which implies that the resulting measure of ethnic diversity is somewhat less granular that the one used for the main analysis.

[26]See the scatterplot in Figure A6 in the Appendix for further information.

[27]Note that the respective 2SLS point estimates are more than double in magnitude compared to the OLS ones. Part of it has to do with the presence of stronger diversity gains in the relevant sub-sample (with OLS point estimates of .484 and .248, respectively), but most of it stems from the relatively little cross-sectional variation captured by exogenous regressors in the first stage, and the considerably flatter predicted diversity profile used in the second stage.

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of King James II of England to describe Hungary in 1686 as "the miserablest country in the world, for it is plundered every day or else by the Christians or by the Turks or sometimes by both" (Tallett, 1992, p. 149).

How did warfare lead to higher diversity? In an era characterized by greatly increased size and scale of warfare and profuse civilian involvement (Roberts, 1956; Davies, 1998; Howard, 2009), three potential channels are worth highlighting. First, the continuous deployment of enormous land armies created intense logistical and financial needs, and often led to the devastation of entire civilian areas, triggering population movements and mixing even in absence of actual fighting (Hale, 1998). Second, the immediate consequences of war (e.g. diseases, food-shortages, casualties, captives, temporary migration) often drastically changed the size and composition of local population. Third, the long-term consequences of war (e.g. relocation, re-population) typically involved mass migration movements of a permanent kind and had wide-ranging ramifications in both time and space (Tallett, 1992). The significance of each of these channels can be verified in the case of individual townships as well as from a regional standpoint. Figure A8 in the Appendix takes the example of the Translyvanian town of Broos, the chronological history of which is a veritable microcosm of war-induced population changes. The juxtaposition of local military events and demographic information from 1200 to 1900 reveals that most major war-induced shocks preceded the arrival of new migrants and thereby made the local populace more diverse. Figure A9 in the Appendix, on the other, takes a broader focus and presents how the ethnic landscape of historical Hungary changed from 1495 through 1795 to 1880 and 1910. It reveals that much of the demographic transformation since medieval times took place before 1795 as a direct and indirect result of continuous warfare (Szekfu, 1942; Acs, 1984; Romsics, 2011), and that the country's ethnic profile remained largely unperturbed during the warless 19th century.

Assuming that the long-term societal consequences of warfare are the strongest at and around the site of former battlefields, I hand-collected and digitized all known military events that took place in and around Hungary between the first Ottoman raid (1391) and the overthrow of Ottoman rule by the Habsburgs (1718). The source of this data is the monumental monograph entitled *Military history of the Hungarian nation* by Banlaky (1928) that offers a detailed narrative account of more than a thousand years of military history in the region. The resulting sample contains information on the time, place and outcome of 2048 battles or sieges, as well as the participating armies.[28] To mitigate potential historiographical biases, I designated all 342 affairs with at least 1000 known participants on each side as major ones to have

[28] Altogether, I identified 2418 individual military events in the 1391-1718 period. To avoid double-counting military campaigns involving back-to-back incidents, the compiled sample is nevertheless restricted to include at most one (possibly major) event for a township in a given year. For the same reason, consecutive military events in a township that span successive years were equally considered as one.

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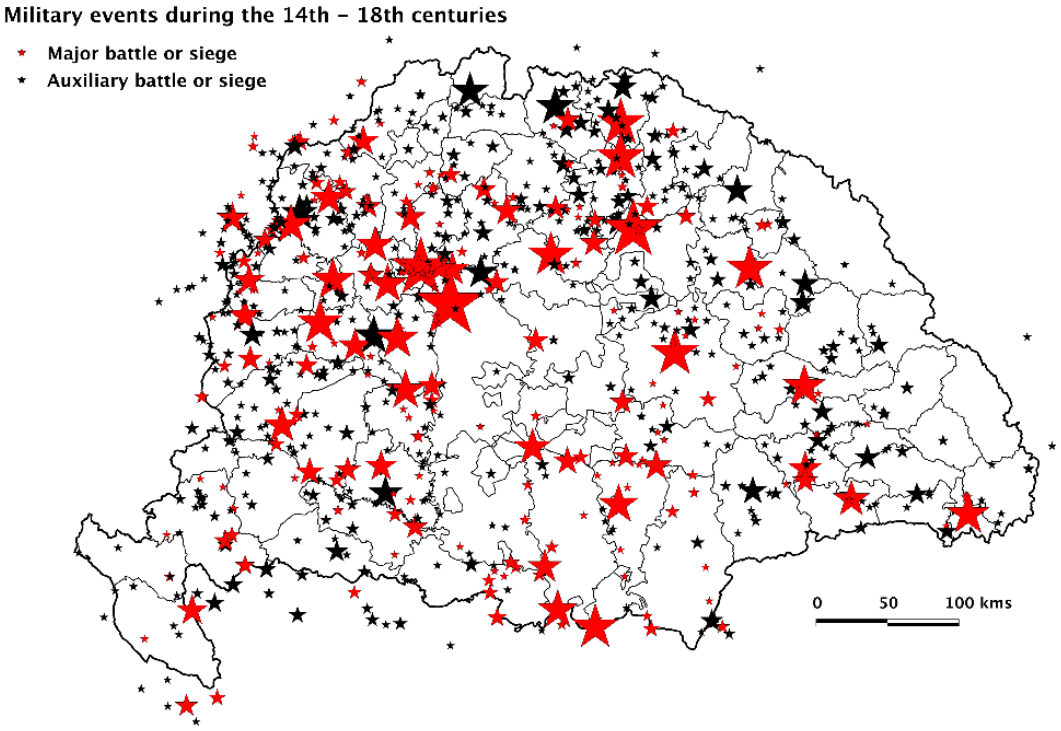

Notes: All known military events between 1391 and 1718 in and in close proximity of Hungary is marked. The number of military events at each location is proportional to the marker's size. Major battles and sieges are those with at least 1000 known participants on each side. If both major and auxiliary events took place at a given location, it is featured as a major military location.

Figure 1.3: Military events in and close to Hungary during the 14-18th centuries

a potentially more balanced and representative sub-sample for robustness purposes.[29] Sampled military locations are illustrated in Figure 1.3, with the markers' size and color corresponding, respectively, to the number and type of military events that took place at each location. Exposure to warfare shows considerable variation across regions: most military events are scattered along the (inverted U-shaped) historical border between the Habsburg and Ottoman Empires and the principality of Transylvania. Armed conflicts are also concentrated at the local level: only one in four military events took place in geographical isolation, while only 15% of sampled townships were directly exposed to warfare.

Using this data, I consider the number of military events in a township as instrument and exploit exogenous differences in diversity across townships that had previously been exposed to warfare. For this identification strategy to work, the requirements of instrument relevance, instrument validity and exclusion restrictions need to be satisfied. First, it is required that past war exposure is statistically related to the 1880 level of diversity. Figure 1.4 shows that ethnic and religious diversity are indeed positively correlated with the number of military events in a township ($\rho_{ED} = 0.167$ and $\rho_{RD} = 0.229$). Second, instrument validity requires that military

[29]It is evident that more recent, easy-to-categorize, and ideologically representative events are, perhaps unavoidably, heavily over-represented in Banlaky (1928). For example, while more than 500 military event are documented about Rakoczi's War of Independence (1703-1711), some Ottoman or Tatar raids of the 15th century that wiped out entire regions are only mentioned passingly.

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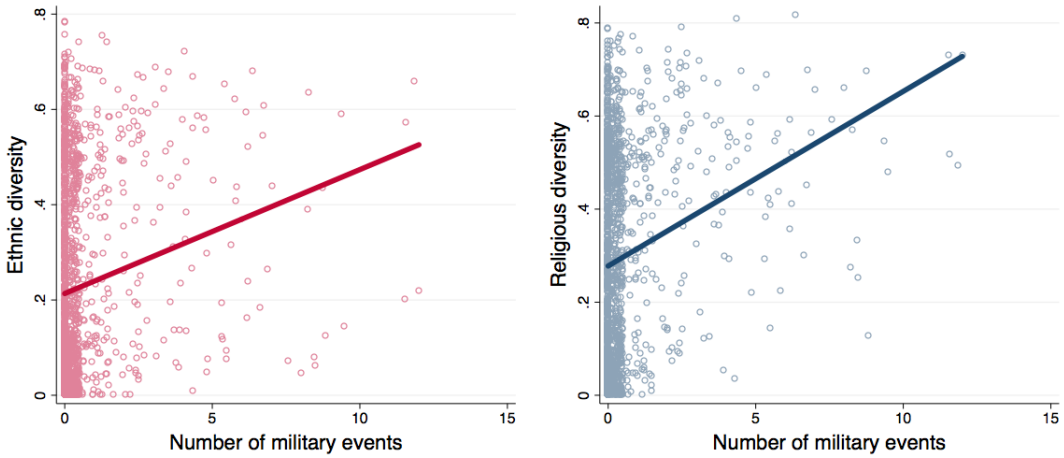

Figure 1.4: Relationship between township diversity and previous war exposure

locations are not determined by strategic economic considerations and are (conditionally) exogenous to townships' growth fundamentals. While directly testable, the data strongly suggest that this is indeed the case: most military events (1360 in total and 181 major ones) took place outside of sampled township, and there is a very weak statistical relationship between past military exposure and observable township characteristics in 1880 (see Table A8 in the Appendix). Moreover, even if military events were strategically located, controlling for the initial level of income and other important township characteristics in both stages of the estimations ensures the soundness of this strategy.[30] Finally, the exclusion restriction requires that past warfare has no direct effect on townships' 1880-1910 growth other than through diversity, which is assured by the centuries-long time lag between military events and the main period of interest.[31]

Main IV results based on the 2SLS estimator for both ethnic and religious diversity are presented in Panel B of Table 1.3. Specifications without control variables yield positive and statistically highly significant diversity estimates in both dimensions that are much larger than the corresponding OLS ones. The presented first-stage F-statistics are large enough to formally avoid weak instrument problems (Staiger and Stock, 1997), the low partial R-squared values nevertheless indicate that military exposure is a relatively poor predictor of diversity. Indeed, as Figure A10 in the Appendix shows, diversity is consistently overestimated (underestimated) in relatively homogeneous (heterogeneous) places, with the resulting flat diversity profile being the main reason why 2SLS diversity coefficients are several times larger than the corresponding

[30]Hhistorical studies also show that, in the early modern period, military and logistical considerations were clearly more important than economic ones in selecting the location military activity (Tallett, 1992). The *Mémoires* by Francis II Rakoczi, for example, makes one truly wonder at the importance of idiosyncratic factors (e.g. a flooded stream or frozen swamp, disrupted communication lines, bitterness among the troops) in determining battle locations and outcomes.

[31]Both the event study on the town of Broos (see Figure A8 in the Appendix) and widespread evidence from European historiography suggest that recovery from physical destruction and population loss was often very swift in the early modern period (Tallett, 1992).

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	Ethnic dimension		Religious dimension	
	Without controls	With controls	Without controls	With controls
PANEL A. 1720 LEVEL OF ETHNIC DIVERSITY AS INSTRUMENT				
Diversity	**1.072*** **	**.614** **		
	(.285)	(.306)		
County dummies	Yes	Yes		
Nr. of observations	631	631		
First-stage $\hat{\beta}$	.351***	.306***		
First-stage R-squared	.448	.475		
First-stage partial R-squared	.117	.089		
First-stage F-statistic	71.07***	48.61***		
PANEL B. NUMBER OF PAST MILITARY EVENTS AS INSTRUMENT				
Diversity	**2.670*** **	**1.368** **	**2.816*** **	**1.925** *
	(.474)	(.678)	(.515)	(1.059)
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008
First-stage R-squared	.302	.339	.314	.367
First-stage partial R-squared	.034	.008	.026	.004
First-stage F-statistic	11.72***	2.33*	9.42***	1.51

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively. Extended specifications feature the standard set of control variables. For added flexibility, regressions in Panel B are based on a polynomial instrument set that includes the number of military events as well as its squared and cubed values.

Table 1.3: 2SLS estimates based on different identification strategies

OLS ones in Table 1.2. This scale effect can be mitigated by accounting for observable differences across townships: indeed, once the usual set of control variables are included, diversity point estimates become much smaller in magnitude. This way, however, so little residual variation is captured by military factors in the first stage that not only do inflated standard errors put the statistical significance of $\hat{\beta}$ on the line, but they also make statistical inference in general rather unreliable.[32]

To ascertain the statistical significance of the 2SLS diversity estimates, the reduced-form equation can be particularly helpful. Specifically, the exclusion restriction implies that coefficients on the instrument in absence of diversity should equal zero. Checking this is equivalent to testing $H_0 : \beta = 0$ in the second stage, and involves unbiased standard errors even in the presence of week instruments (Chernozhukov and Hansen, 2008). I therefore estimated the 1880-1910 growth advantage associated with each level of military exposure, based on the identifying assumption that all deviations are caused indirectly by diversity.[33] Figure A11 in the Appendix shows that, indeed, townships with limited war exposure grew significantly

[32]The same general patterns emerge on the basis of alternative specifications featuring (1) a unit instrument set, (2) no spatial controls, (3) only major military events, (4) a 5-km wide distance band to account for adjoining events around townships. See Table A9 in the Appendix for more details.

[33]The estimated regression specification, featuring the standard set of control variables and spatial dummies, is

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faster ($\hat{\beta}_1 = .06$, $\hat{\beta}_2 = .13$) than their spared neighbors. That this pattern is not manifest among highly exposed townships not only suggests that there were limits to warfare-induced social mixing, but also dispels potential endogeneity concerns associated with the geographical clustering of military activity. Taken together, these findings confirm past warfare as an important driver of ethnic and religious diversity, and consequently of township growth.

1.5 Understanding diversity gains: A model

To understand how diversity may translate into higher economic growth in times of industrialization, I propose a simple model of urban development. In line with the accepted economic theories of diversity, the model emphasizes the potential trade-offs between comparative productivity advantages and coordination problems diverse communities are likely to face (Alesina and La Ferrara, 2004). In particular, it focuses on the self-selection of individuals into different industries, the costs and benefits of which are endogenously determined by the number and mixture of workers in each specific industry. As long as there are productivity differences between industries, townships can enter different growth trajectories depending on how efficiently they progress up the productivity ladder of industries.

Setup

The model has overlapping generations. At any time t, townships indexed i have adult residents N_{it}^k and young residents $\tilde{N}_{it}^k$, as determined by exogenous birth and death rates ρ_b and ρ_d, respectively. Importantly, each agent belongs to one of the potentially many (ethnic) group k that populate each township. These ethnic groups do not communicate with one another and are only affected by each others' presence through market outcomes. In the first period of each generation's life, agents are young, inactive and prepare for their subsequent adult life by learning a profession. In subsequent periods until their death, agents are grown-up and work in their chosen profession j, without further education.

Production

Production takes place in local autarkies characterized by an exogenous number of different sectors including agriculture and various industries. Each sector j of the local economy produces a homogenous consumption good that is imperfectly substitutable with products from other industries. Production technology in each sector j uses only labour as factor input and

given by:

$$\Delta y_{i,1910/1880} = \alpha + \sum_k \beta_k D_{i,k} + X'_{i,1880}\delta + \gamma y_{i,1880} + \epsilon_i$$

where the dummy variables $D_{i,k}$ take the value of 1 if the number of military events in a township is exactly k and zero otherwise.

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exhibits decreasing returns to scale. Output in a given sector is determined by the sum of effective labour of employed individuals:

$$Y_{jt} = \left[\sum_i A_{ijt}^k \right]^{\alpha} \tag{1.2}$$

where $\alpha < 1$. A_{ijt}^k denotes labour productivity of each individual i and is characterized in the following way:

$$\log \left(A_{ijt}^k \right) = \log \left(A_{ij}^k \right) = \theta_j + \epsilon_{ij}^k \tag{1.3}$$

where θ_j captures the generic productivity of each sector. Without loss of generality, θ_j is set to one in agriculture while drawn from a uniform distribution $\theta_j \sim U(1, \Theta)$ for all industrial sectors. The idiosyncratic term ϵ_{ij}^k captures normally distributed productivity differences between and within groups:

$$\epsilon_{ij}^k \sim N(\theta_j^k, \sigma_i^2) \qquad \text{where} \qquad \theta_j^k \sim N(0, \sigma_j^2)$$

As such, θ_j^k represents comparative productivity advantages (disadvantages) between groups while σ_i^2 introduces orthogonal productivity differences between individuals.[34] These latter may originate from personal differences in general skills or ability, and act as a shifter on individual productivity under all circumstances. Between-group productivity differences, on the other hand, are sector-specific and allow the typical group members to be uncharacteristically productive (unproductive) in a specific industry.[35] Overall, this way of setting up stochastic productivity differences implies that each industry is more productive than agriculture on average, even though this will not generally be true for all groups and industries.

Entry costs

The development of this stylized model economy hinges on the way young agents are constrained in their occupation choice. While there are no formal entry restrictions, taking up work in an industrial sector outside of agriculture requires mastering the relevant sector-specific skills beforehand.[36] Training is costly: its costs ψ are 1) proportional to the generic productivity e^{θ_j} of the relevant sector, and 2) inversely proportional to the relative productivity advantage of the

[34] This is of course a gross simplification, as much more elaborate dependence structures between individual, group- and sector-specific productivities are conceivable. They are, however, not needed to generate the model's main predications and would only stand in the way of understanding its basic intuition.

[35] The source of these group-specific differences is not of immediate relevance to the paper, and many different stories are possible. Most superficially, they may stem from certain physical or psychological factors that render one group superior in exercising a given task efficiently. Religious norms may also spring to mind that can crucially influence whether adherents can engage efficiently in certain activities. Alternatively, group differences may also capture the effect of differentiated access to sector-specific financial, physical or human capital.

[36] It is assumed that working in agriculture does not require any specific expertise or previous education.

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most efficient in-group worker. Formally,

$$\psi_{jt}^{k} = c\,\mathrm{e}^{\theta_j}/M_{jt}^{k} \quad \text{where} \quad M_{jt}^{k} = \max_{m,n\,\in\,k}\left\{1, \mathrm{e}^{\epsilon_{mj}^{k}} : \epsilon_{mj}^{k} \geq \epsilon_{nj}^{k}\ \forall n\right\} \tag{1.4}$$

where c is the cost coefficient making sure that generically more productive industries are proportionally more costly to enter. The relative productivity advantage M_{jt}^{k}, on the other hand, is responsible for stochastically differentiating between entry cost between groups and over time also, depending on the size and worker composition of each industry. This formulation of entry costs may be motivated on the ground that learning from more productive workers is more efficient, which is in line with modeling assumptions emphasizing the public-good nature of technology (Grossman and Helpman, 1991).[37] As a result, it follows that smaller groups are at a disadvantage in their occupation choice as they tend to face higher entry costs even to popular industries.[38]

Dynamic sorting

For simplicity, let us assume that parents make the career choice for their offsprings based on preferences over their own current consumption and their child's (expected) future consumption. Given that all income is consumed, the Cobb-Douglas utility function of parent P working in sector J of group K can be written as follows:

$$U = \log\left(w_{PJt}^{K} - \psi_{jt}^{K}\right) + \beta E\left[\log\left(w_{Ij(t+1)}^{K}\right)\right] \tag{1.5}$$

where w_{PJt}^{K} is the current realized wage for the parent working at time t, $w_{Ij(t+1)}^{K}$ is the potential future wage her child I would earn in sector j in the next period, and $\beta > 0$ measures the relative preference for the well-being of one's child.[39,40]

Assuming perfect competition and profit maximization, the wage corresponds to the marginal product of labour, and parents' optimization problem can therefore be written as

$$\begin{aligned}\underset{j}{\operatorname{argmax}}\Bigg\{ &\log\left[\alpha\Big(\sum_{i} A_{iJ}^{k}\Big)^{\alpha-1} A_{PJ}^{K} - \frac{c\,\mathrm{e}^{\theta_j}}{M_{j}^{K}}\right] + \\ &+\beta\left[\log\alpha + \left(\alpha\theta_j + \epsilon_{Ij}^{K}\right) + (\alpha-1)\log\left(\sum_{i} e^{\epsilon_{ij}^{k}} + e^{\epsilon_{Ij}^{K}}\right)\right]\Bigg\}\end{aligned} \tag{1.6}$$

[37] As will be evident from the optimization problem agents face, lower entry costs also represent partial productivity enhancements.

[38] Note that the role of these entry costs are somewhat similar to the minimum size requirements for industry entry under uncertainty(Acemoglu and Zilibotti, 1997), in the sense that they make investment in larger sectors safer or more profitable.

[39] It is implicitly assumed that parent and child belong to the same group.

[40] This formulation seems to imply that parents care only about the first period of their children adult life. One may, however, interpret β as the parameter that simultaneously represents the appropriate discount factor for a steady stream of future income flows for the child, even though her future wage changes are unforeseen.

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where the wage relationship $w_{Ijt}^K = \alpha \left(\sum_i A_{ij}^k\right)^{\alpha-1} A_{Ij}^K$ was used. Assuming limited foresight and sufficiently high periodicity further yields that

$$E[N_{j(t+1)}] = N_{jt} + 1 \,,$$

which eliminates all uncertainty surrounding optimization. Parents earning a given wage, therefore, choose the sector that offers the best combination of training costs and future wage for their children, as determined by the current distribution of workers across industries and their (known) productivity draws.[41]

At this point, it is worth asking the question how utility in a given sector change depending on the number of in-group and out-group workers. Differentiating sectoral utility with respect to the number of in-group workers yields

$$\frac{\partial U}{\partial N_j^K} = \left(\frac{c\, e^{\theta_j}}{w_{PJ}^K}\right) \frac{1}{M_j^K \left(M_j^K - 1\right)} \frac{\partial M_j^K}{\partial N_j^K} + \beta(\alpha - 1) \frac{e^{\epsilon_{Ij}^K}}{\sum_i e^{\epsilon_{ij}^k} + e^{\epsilon_{Ij}^K}} \tag{1.7}$$

Since $M_j^K \geq 1$ and $\partial M_j^K / \partial N_j^K \geq 0$, the first term of Equation 1.7 is positive, while the second term is negative due to $\alpha < 1$. The opposite sign of the two terms indicates that agents have mixed feelings about in-group workers in a sector: while they welcome them due to their potential to decrease training costs (especially if parental wage is relatively low), they dislike them at the same time for dragging down the wage level (especially if the potential entrant's productivity is relatively high). Since the second term in Equation 1.7 is symmetric with respect to all ethnic groups, agents are equally unwelcome towards all other groups in their sector of choice.

Case 1: Diversity without Productivity Differences

To consider the each channel of the model separately, let us first review how diversity affects development if there are no systematic productivity differences between groups. In this case,

$$\theta_j^k = \theta_j \qquad \forall\, k$$

which implies that all individual productivities are drawn from the same distribution and everyone has the same unconditional preference ranking of industries. In this case, there are only disadvantages to diversity: relative to homogeneous places, diverse communities will face higher entry costs and a limited choice set when making their occupational choice. This is

[41] Note that the conditionality of the occupation choice on parents' current wage is the only benefit of working with overlapping generations relative to the static case. Specifically, it allows career choices to be dependent on current payoffs, which can make transitions to high-productivity industries more gradual. To achieve this, it is of course necessary to assume financial markets are imperfect and future expected gains cannot be monetized or insured.

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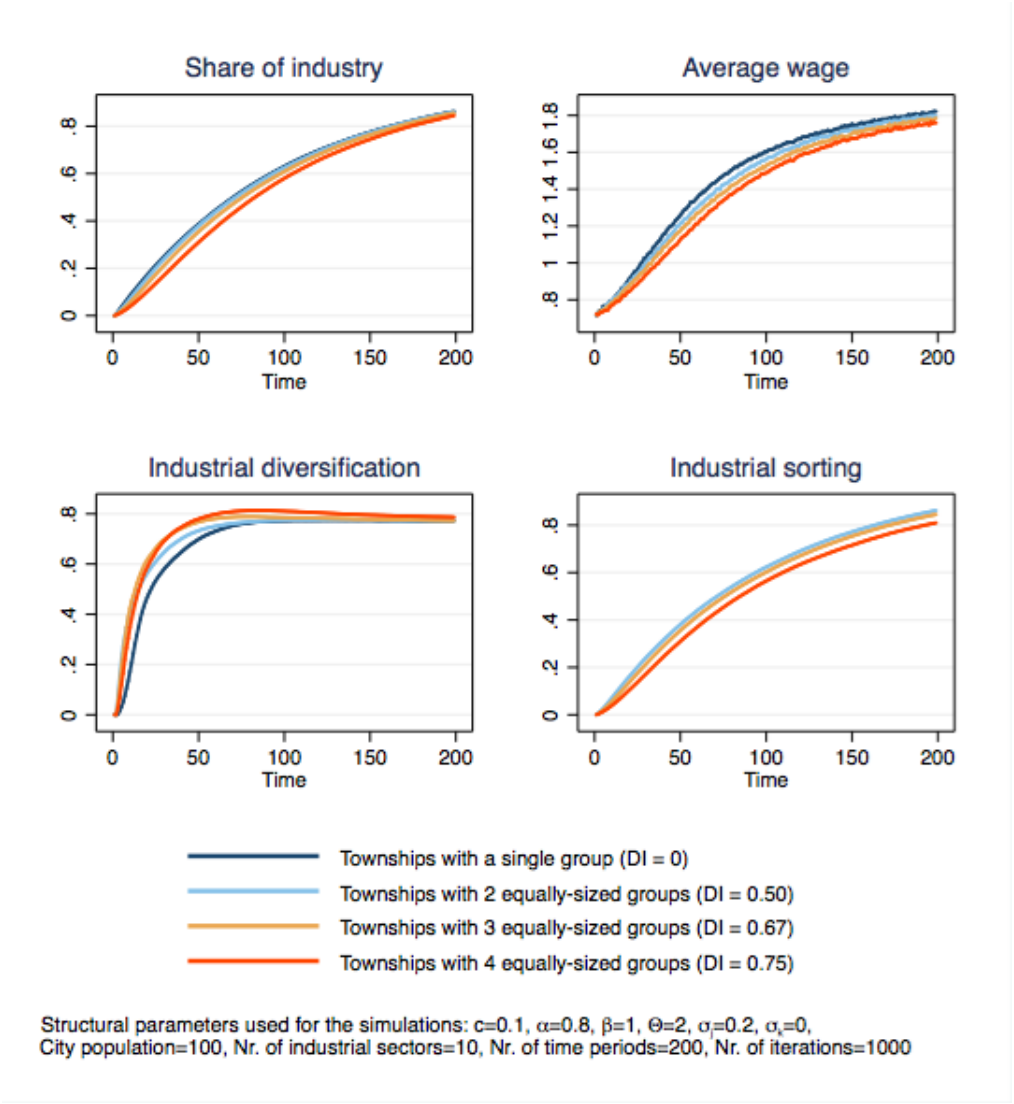

Figure 1.5: Proposed mechanism between diversity and economic growth

because knowledge spillovers are inhibited, and a comparatively smaller number of in-group worker at all stages of development implies higher costs. Indeed, the left panel of Figure A12 in the Appendix shows that the smaller a group's relative share among workers, proportionately higher are the cost they face when entering a given industry. The sorting of groups by industry would gradually eliminate these differences, but the scope for it is limited as not all industries are equally productive.

Against this background, simulating the dynamic process of industrialization starting from an entirely agricultural community yields the results presented below in Figure 1.5. The upper-left panel shows the relatively slow rate of industrialization in more diverse places, while the upper-right panel indicates an even larger wage penalty. The lower panels of Figure 1.5 focus on the distribution of workers across industries. Industrial diversification is shown to be much higher in diverse places in the early part of development (see lower left panel), while an

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increasing concentration of ethnicities in specific industries are observed over time (see lower right panel).[42]

Intuitively, what is going on in the model is that positive scale-externalities (stemming from lower training costs and knowledge spillovers) are much reduced in diverse places, which introduces efficiency losses in two ways: 1) some cannot afford to leave agriculture for industry, and even among those who can, 2) some cannot afford to choose the most productive industry. As a result, diversity in this case implies lower average productivity and wage as well as a more diversified local industry. However, as negative scale-externalities (arising from crowding within an industry) begin to dominate over time, the industrial and wage profiles of townships begin to look more and more similar in all but one aspect: industrial sorting. This latter keeps increasing as the effect of initial frictions that make different groups start and concentrate in different industries persists throughout the development process. Therefore, one may conclude that, in absence of comparative productive advantages across groups, diversity leads slower industrialization and distorted industry choices along the way, but does not ultimately change the outcome of the development process relative to homogeneous places.[43]

Case 2: Diversity with Productivity Differences

In the presence of exogenous (and imperfectly correlated) productivity differences across groups, the illustrative description above will capture only one side of the story. The other side will be characterized by the shifting out of the technology frontier that makes higher average productivity and wages possible. The basic idea comes from order statistics: as the number of different groups increases, the likelihood that there will be at least one highly productive group in each industry also grows.[44] Indeed, the right panel of Figure A12 in the Appendix shows that if a sector is populated by the group with the highest productivity θ_j^k through self-selection, then expected productivity will go up as diversity increases.

[42]Industrial diversification is measured by the same Herfindahl-index as is used for measuring social diversity throughout the paper. Industrial sorting is measured as 1 minus the weighted average of within industry diversity divided by the level of diversity in the overall population, or $1 - \sum_j DI_{ij}/DI_i$. Consequently, if workers' relative group shares in each industry is very similar to that in the overall population, industry sorting is close to zero. On the other hand, if each group is highly concentrated in a given industry, sector-specific diversity will be low and the degree of industrial sorting will converge to one. (A natural alternative measure for industrial sorting, in theory, would have been to use the p-value associated with Pearson's chi-squared test of independence across groups and sectors. However, in practice, the respective p-values converge to zero at such a high rate that they exhibit no qualitative variation after a dozen or so periods.)

[43]Note that diversity in this case may also potentially create ethnic inequalities as long as not all groups are of the same size, given that larger groups will typically be more successful in populating the most productive industries.

[44]This is the same idea that was introduced by Kortum (1997) in relation to technological innovation and used also for measuring the fraction of goods a country produces in a Ricardian trade model (Eaton and Kortum, 2002). These studies use the family of extreme value distributions for analytical tractability but this is not a relevant consideration for the purpose of this paper.

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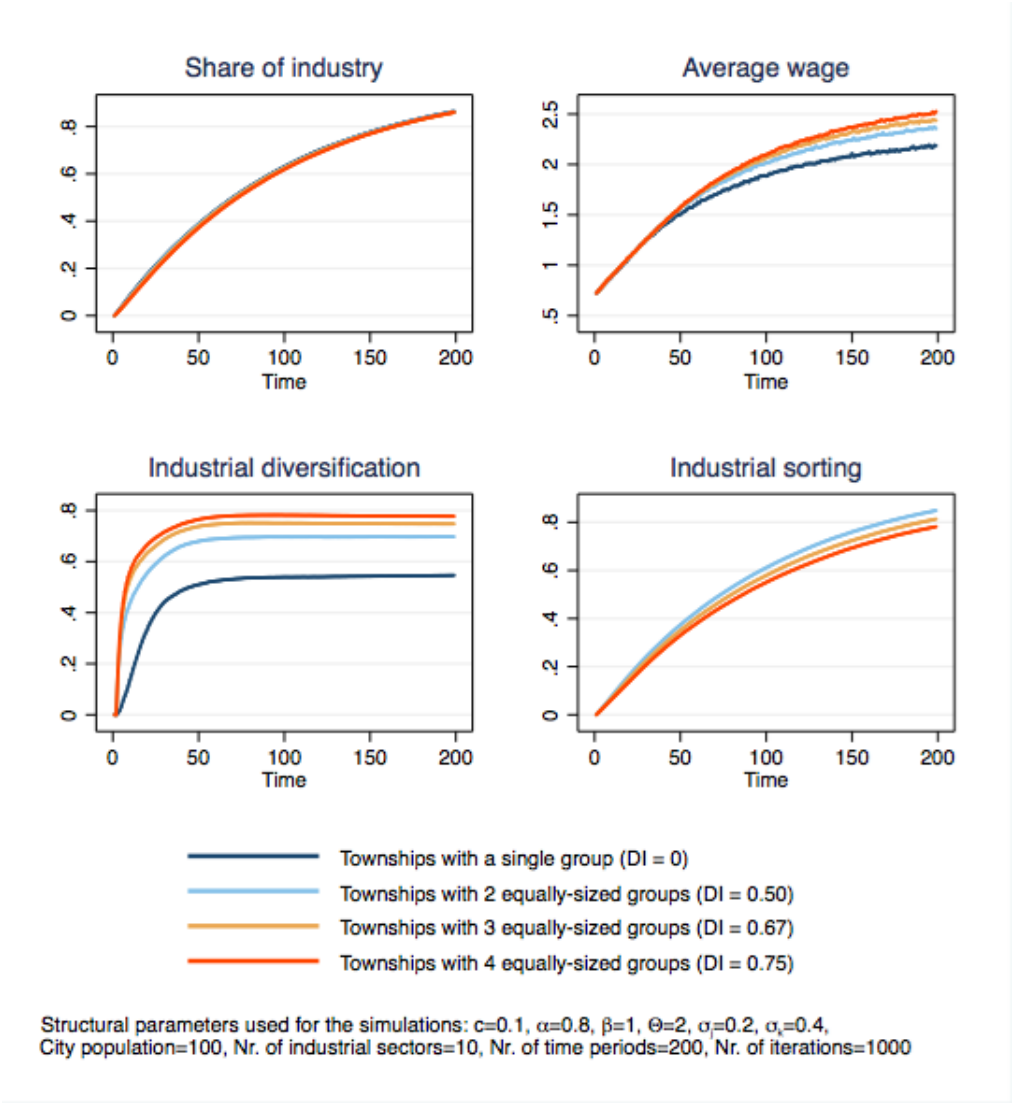

Figure 1.6: Proposed mechanism between diversity and economic growth

These productivity gains associated with diversity have the capacity to potentially offset or even upstage the negative effects of fractionalization on knowledge spillovers and industry entry. Figure 1.6 below shows that it indeed happens under reasonable parameter assumptions: once group-specific random shocks are introduced, the industrialization and wage disadvantage of diverse places are overturned. Moreover, the higher level of industrial diversification observed in diverse localities becomes permanent, without qualitatively changing the patterns of industrial sorting.[45]

Naturally, these results are driven by the reduced negative scale-externalities that stem from comparative productivity advantages. Entry costs become less binding both because they 1) represent a proportionately lower fraction of worker output in sectors where a group has com-

[45]The same findings are observed on the "intensive" margin of diversity, i.e. when the asymmetry of worker's distribution across the same given number of groups is considered. See the results in Figure **??** in the Appendix for the case of three different groups.

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parative advantage, and also because 2) knowledge spillovers are valued less anyways. The same applies to decreasing returns to labour: since different groups tend to engage in different activities, crowding in an industry becomes much less relevant than in places with homogenous productivity profiles.

It is worth asking the question how results would change if the assumption of separatism was dropped and groups were allowed, capable and willing to interact with one another. Specifically, this would imply that the cost of entry into an industry, conditional on the present number of workers, is uniform and not determined along ethnic lines. Figure A14 in the Appendix compares this scenario to the baseline one and reveals that, with no separatism, industrialization and average wage increase. This is no surprise: as the uniform cost function represents the infimum of all possible cost functions in an industry of a given size, the choice set of feasible careers cannot be smaller and will generally be larger than in case of separatism, which is evident in the observed higher industrialization and wage rates (see upper panels). Interestingly, no separatism also implies lower levels of industrial diversification and sorting, as some hitherto unattainable popular sectors become feasible also for those groups that would each choose different industries otherwise. Figure A14 in the Appendix also shows that while cost reduction and communication have the same impact on industrialization and wages, they have different implications as far as industrial diversification and sorting are concerned: lower absolute costs tend to increase industrial variety and ethnic concentration.

1.6 Understanding diversity gains: Empirics

This section examines the extent to which the main predictions of the theoretical model are supported by the data. Specifically, the 1900 and 1910 censuses contain the distribution of the local workforce across 11 economic sectors and 29 industries in each township. Figures A15a and A15b in the Appendix show the total number of workers in the sample by sector and industry, as well as the share of townships with positive employment in each of these cases. They reveal that Hungary in 1910 was still a predominantly agrarian country, with only about a 25% relative share of industrial employment. The biggest industries were shoemaking, clothing and machinery, even tough the majority of industrial employment took place in variously concentrated lesser industries.

In Section 1.3, I already showed that diverse places were richer and more industrialized than their homogenous neighbors. Now I test the predictions of the model with respect to economic diversification, group-based occupational sorting and employment concentration in productive activities.

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	Ethnic dimension			Religious dimension		
	(1)	(2)	(3)	(4)	(5)	(6)
PANEL A. SECTORAL DIVERSIFICATION						
Diversity	**.089*** **	**.091*** **	**.058*** **	**.062*** **	**.068*** **	**.048*** **
	(.017)	**(.018)**	**(.018)**	**(.017)**	**(.017)**	**(.017)**
Per capita tax base		-.007	-.010		-.011	-.014
		(.010)	(.009)		(.009)	(.009)
Employment share in non-agriculture			.132***			.143***
			(.021)			(.020)
County FEs	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1007	1007	1007	1007	1007	1007
R squared	.387	.388	.409	.380	.381	.408
PANEL B. INDUSTRIAL DIVERSIFICATION						
Diversity	**.384*** **	**.362*** **	**.283*** **	**.342*** **	**.306*** **	**.268*** **
	(.044)	**(.043)**	**(.043)**	**(.043)**	**(.044)**	**(.043)**
Per capita tax base		.091***	.086***		.072***	.067***
		(.026)	(.024)		(.025)	(.025)
Employment share in industry			.651***			.740***
			(.124)			(.120)
County FEs	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1007	1007	1007	1007	1007	1007
R squared	.713	.719	.732	.711	.714	.732

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively. Sectoral and industrial diversification is measured by the (log) number of active sectors and industries, respectively, that provide employment for at least one local resident.

Table 1.4: Statistical relationship between diversity and industrial diversification

Economic diversification

Due to potential comparative productivity advantages and reduced knowledge spillovers that would favor economic specialization, diverse places are expected to develop more diversified local economies. A straightforward econometric test of this concerns regressing the level of economic diversification on ethnic and religious diversity in the 1910 cross-section. Specifically, I estimate the standard regression model

$$\begin{aligned}\text{Economic diversification}_{i,1910} = \\ \alpha + \beta\text{Diversity}_{i,1910} + X'_{i,1910}\delta + \gamma y_{i,1910} + \epsilon_i\end{aligned} \tag{1.8}$$

where economic diversification is measured, respectively, by the (log) number of active sectors and industries with non-zero employment in each township.[46]

The resulting parameter estimates for ethnic and religious diversity are presented in Ta-

[46] As an alternative, I also consider the standard HHI and concentration-ratio based indicators that deliver qualitatively similar results. The choice of using the (log) number of active spheres as the main dependent measure is motivated by the increased power, accuracy and variability it displays in the presence of large category sets.

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ble 1.4 based on specifications that include the standard set of control variables and spatial dummies. Results in Panel A suggest that diversity is associated with a statistically highly significant sectoral diversification advantage of 5-9 percent on average that is also robust to the inclusion of per capita tax base and non-agricultural employment share among the controls. Panel B shows that differences in industrial diversification were even more pronounced: diverse townships, at all levels of development and industrialization, had up to a 27-40% higher number of active industries than otherwise similar but ethnically or religiously homogenous places.

Moreover, to make sure that diversity is not simply cross-correlated with industrial diversification but is actually its source, I also regressed 1910 diversification (measured by the number of active industries) on its 1900 lagged value and diversity in a dynamic specification. The resulting estimates are presented in Panel A of Table A10 in the Appendix and confirm that the number of industries grew, in a statistically highly significant manner, up to 8-11% more during 1900-1910 in diverse places, even if the initial level of diversification and industrialization is accounted for. Moreover, Panel B shows that this is equally true of industrialization itself: industrial employment shares increased by up to 2-4 percentage points more in diverse townships relative to more homogenous ones. These findings strongly suggest that diversity had a positive causal effect not only on growth (as measured by tax revenues) but also on the level of industrialization and industrial diversification in particular.

Occupational sorting along ethnic and religious lines

In the theoretical model, industrial diversification and industrial sorting are intimately related: both are the result of comparative productivity advantages that drive each group to self-select into different industries. While there is a considerable degree of sporadic anecdotal, folkloric and ethnographic evidence of occupational sorting along ethnic and religious lines (Acs, 1984; Veres and Vigas, 2006), this paper is the first that takes a systematic look at the statistical relationship between cultural and economic status in historical Hungary. Starting from aggregate cross-tabulations based on the entire Hungarian population in the 1910 census, Figure A16 in the Appendix presents the employment distribution across 11 economic sectors by ethnicity and religion. It reveals considerable variation in group employment shares both within and between sectors, despite the relative stability of both group and sector rankings.[47] Specifically, disproportionate employment concentration is observed for example by Hungarians in transportation and the public sector, Germans in the military and among pensioners, and Ruthenians in agriculture, along with remarkably intense industrial and commercial activity among Jews. Qualitatively similar patterns are noticeable in relation to specific industries as well: Figure

[47]In other words, larger groups were more numerous in most sectors, while larger sectors employed more worker by most groups. The corresponding average Spearman rank correlation is .73 and .76 for sectors, and .79 and .80 for groups in the respective ethnic and religious dimensions.

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A17 of the Appendix reveals widely different employment profiles by both ethnicity (e.g. concentration of Slovakians in shoemaking and weaving, Serbians in clothing and among barbers) and religion (e.g. dominance of Jews in innkeeping, butchery and clothing, Greek Catholics in milling). Most importantly, these aggregate statistics imply that the null hypothesis of no association between social and economic status is firmly rejected for sectors and industries alike. Cramer's V, the standard measure of the strength of association, suggest a moderate relationship ($CV_S^E = .13, CV_S^R = .18, CV_I^E = .10, CV_I^R = .13$) that is nevertheless comparable with the observed degree of separation across occupational status by race and gender in present-day US (McNeely et al., 1993).

To test whether the model's predictions are also supported at the level of individual townships, the joint distribution of social and economic status for each locality would need to be known. This information, unfortunately, is only available at the sector level for a small subset of townships that enjoyed municipal autonomy in 1910.[48] The townships in question are listed in Table A11 of the Appendix along with their population, employment distribution across sectors, as well as measures of association between the social and economic status of their workforce. Among these latter, the large and highly significant Pearson's χ^2 test statistics indicate a substantive relationship between ethnic and religious background and sectoral choice in all townships. The respective Cramer's V statistics average .16 and .18 across townships, and suggest that local patterns of association are not qualitatively different from the aggregate one. Finally, the implied very low values for the Goodman-Kruskal λ signal limited potential for ethnicity and religion in reducing prediction errors, in line with the observed robustness of sectoral rankings.

For a formal test of systematic differences, I also run a seemingly unrelated regression model composed of simultaneous linear probability model by ethnic and religious categories for each sector:

$$P_{iks} = \Pr(n \in s \mid n \in i, k) = \alpha_{is} + \sum_k \beta_{ks} \mathrm{D}_{ik} + \epsilon_{iks} \tag{1.9}$$

where P_{iks} denotes the probability that members of group k in township i are employed in sector s, while D_{ik} represents categorical variables associated with these groups. The corresponding β_{ks} measures the average probability difference relative to a reference group (α_{is}) in each sector across townships. Table 1.5 below shows the results of this estimation for (non-collinear) non-agricultural sectors separately for the ethnic and religious dimensions, relative to the dominant group (Hungarians, and Roman Catholics, respectively) as reference groups. Panel are statistically significant in one-third of the cases, with the estimated differences corresponding

[48] This concerns 31 among the largest townships that together make up more than 20 percent of the total resident population across the sample.

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	Mining & metal-lurgy	In-dustry	Commerce & finance	Trans-porta-tion	Public sector	Mili-tary	Day labor	Pen-sioner	Do-mestic service	Aux-iliary
PANEL A. EMPLOYMENT SHARES BY ETHNICITY (RELATIVE TO HUNGARIANS)										
Germans	.01	.00	-.00	-.07***	-.02	.09*	-.01	.03**	-.00	-.00
	(.01)	(.03)	(.02)	(.01)	(.01)	(.05)	(.01)	(.02)	(.02)	(.01)
Slovakians	.01	-.03	-.02	-.07***	-.05***	.14***	.02*	-.01	.03*	.00
	(.01)	(.03)	(.02)	(.01)	(.01)	(.05)	(.01)	(.02)	(.02)	(.01)
Romanians	-.00	-.12***	-.05**	-.04***	-.03	.27***	.01	.01	-.04***	.01
	(.01)	(.03)	(.02)	(.01)	(.01)	(.05)	(.01)	(.02)	(.02)	(.01)
Ruthenians	-.00	-.12***	-.03	-.08***	-.07***	.32***	.00	-.02	.03	.02**
	(.01)	(.03)	(.02)	(.01)	(.02)	(.05)	(.01)	(.02)	(.02)	(.01)
Croatians	.00	.03	.02	-.04***	-.03*	.13***	-.02*	-.00	-.01	-.01
	(.01)	(.03)	(.02)	(.01)	(.01)	(.05)	(.01)	(.02)	(.02)	(.01)
Serbians	-.00	-.00	.03	-.06***	-.02	.15***	-.01	-.01	-.09***	-.01
	(.01)	(.03)	(.02)	(.01)	(.01)	(.05)	(.01)	(.02)	(.02)	(.01)
Others	.02**	.04	-.01	-.07***	.00	.05	.01	-.00	-.04***	.02**
	(.01)	(.03)	(.02)	(.01)	(.01)	(.05)	(.01)	(.02)	(.02)	(.01)
R squared	.357	.322	.195	.420	.262	.469	.348	.366	.386	.152
PANEL B. EMPLOYMENT SHARES BY RELIGION (RELATIVE TO ROMAN CATHOLICS)										
Greek Catholics	-.01*	-.06**	-.01	-.01	-.00	.14***	.00	-.03	.01	.01
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
Calvinist	-.01	-.07**	-.01	.05***	.02	.06*	-.01	-.01	.01	-.00
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
Lutherans	-.01	-.04	.02	.02*	.02	.06*	-.02**	.01	-.01	-.01
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
Greek Orthodox	-.01*	-.10***	.04**	-.02**	-.01	.16***	-.01	-.01	-.05***	-.01
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
Unitarians	.00	-.09***	-.03	.02	-.13***	.03	-.02***	.04**	-.01	.02**
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
Jews	-.01*	-.04	.37***	-.02**	.02	-.05	-.04***	.01	-.09***	-.02*
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
Others	-.01	-.04	.07***	-.02	.05**	.07*	-.02***	-.02	-.04**	-.01
	(.00)	(.03)	(.02)	(.01)	(.02)	(.04)	(.01)	(.02)	(.02)	(.01)
R squared	.436	.275	.760	.504	.336	.397	.506	.241	.357	.214

Estimates based on seemingly unrelated regression (SUR) with identical sets of categorical regressors. Standard errors are in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively. Number of observations are 240 and 244 in Panel A and B, respectively. Sector-specific township fixed effects are included.

Table 1.5: Statistical relationship between diversity and industrial sorting by group

to the aggregate patterns displayed in Figure A16 of the Appendix above. Specifically, , while differences are more dispersed in the religious domain.

Moreover, to provide an indirect test of whether similar patterns were to be observed on the whole sample and in relation to industrial employment, I also investigate the relationship between social and economic status using cross-comparisons between townships. Specifically, I consider the index of dissimilarity defined by $\frac{1}{2}\sum_k \left(s_{ik} - s_{jk}\right)^2$ in relation to any township pair (i, j), where where s_{ik} and s_{jk} denote relative population shares associated with a given group k. Dissimilarity thus measures the evenness of group affiliations across townships, ranging from 0 in case of identical profiles to 1 when there is absolutely no overlap between group divisions across pair members. Calculating this index for all township pairs across various dimensions, it becomes possible to regress sectoral and/or industrial dissimilarity on ethnic and/or religious dissimilarity. In case of widespread and substantive identity-based sorting, one would expect to find a positive statistical relationship between economic and social dissimilarity: township pairs that are more similar from an ethnic or religious standpoint should also have more similar sectoral or industry profiles. Table A12 in the Appendix indeed shows that, while sectoral dissimilarity is mainly driven by differences in the overall employment share in non-agriculture across pair members, industrial dissimilarity is significantly higher across eth-

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nically and religiously different places at all levels of industrialization. The estimated dissimilarity advantage of 2-4 percentage points in relation to places with non-overlapping ethnicities and religions may be rather small in economic terms, yet it signals a substantive relationship between cultural background and industrial choice even in light of their moderate association.[49]

Concentration in productive industries

It is possible that the increased economic diversification and occupation sorting observed in diverse townships observed group-specific differences in sector and industry composition were likely driven in part by non-economic considerations such as identity maintenance (Kuznets, 1960) or social marginalization (Fevre, 1992). To fully validate the theoretical model and its predictions, one would also need to show that the above mentioned phenomena corresponded with increased employment concentration in high-productivity sectors and industries. Given that no detailed information is available on townships' output, wages or taxes by industry, a straightforward empirical test of this is not at hand. It is nevertheless possible to consider the ordinal ranking of industries based on some external criteria that have traditionally been associated with productivity and for which data is available. I examine two such approaches here. The first concerns using aggregate employment growth by industry, which is generally considered a good indicator of technological and productivity growth (Davis et al., 1997; Nordhaus, 2005). The underlying assumption here is that productivity rankings of industries are stable across townships and that employment growth between 1900 and 1910 in an industry is positively related to productivity.[50] The second approach is based on the innovation content of each industry, which has been found to be a strong driver of productivity growth (Crepon et al., 1998; Doraszelski and Jaumandreu, 2013). Specifically, I rely on the contributions by Nuvolari and Tartari (2011) who, by focusing on patent quality, calculated the average innovation content by industry for England during the Industrial Revolution (1702-1841). While the timing and nature of the industrial boom in Britain and continental Europe (or Hungary in particular) were very different, several economic historians have stressed their identical "epistemic bases" (Mokyr, 2002), the conscious imitation and emulation of British achievements by rest of Europe (Tilly, 2010), and the same structural transformations local innovations initiated in their course (Berend and Ranki, 1980).

After mapping the industrial classes used in Nuvolari and Tartari (2011) to the 29 industries contained in the Hungarian statistics, one may directly compare each industry's position across

[49]These results are robust to alternative specifications with different spatial controls and clustered errors.

[50]Note that this may not be true in general: if output shares across different sectors of the economy remain fairly constant, resources and expenditure can increasingly concentrate in low-productivity sectors over time (Baumol, 1967; Baumol et al., 1985). However, if productivity growth of a sector is endogenously determined as a result of technological innovations (Grossman and Helpman, 1991; Eaton and Kortum, 2002) or knowledge spillovers (Glaeser et al., 1992), sectoral employment tends to co-move closely with productivity.

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	Ethnic dimension			Religious dimension		
	(1)	(2)	(3)	(4)	(5)	(6)
PANEL A. PRODUCTIVITY RANK BASED ON EMPLOYMENT GROWTH						
Diversity	**.063*** **	**.035*** **	**.022** **	**.038*** **	**.026** **	**.013**
	(.012)	**(.011)**	**(.011)**	**(.012)**	**(.011)**	**(.011)**
Employment share in industry		.233***	.202***		.247***	.210***
		(.033)	(.036)		(.033)	(.036)
Number of active industries			.044***			.045***
			(.010)			(.010)
County dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1007	1007	1007	1007	1007	1007
R squared	.322	.378	.396	.310	.376	.394
PANEL B. PRODUCTIVITY RANK BASED ON INNOVATION						
Diversity	**.044*** **	**.018**	**.024** **	**.010**	**-.002**	**.003**
	(.015)	**(.014)**	**(.014)**	**(.014)**	**(.014)**	**(.014)**
Employment share in industry		.228***	.243***		.238***	.253***
		(.039)	(.040)		(.039)	(.040)
Number of active industries			-.021*			-.018
			(.012)			(.012)
County dummies	Yes	Yes	Yes	Yes	Yes	Yes
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1007	1007	1007	1007	1007	1007
R squared	.216	.256	.259	.208	.255	.257

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively.

Table 1.6: Statistical relationship between diversity and average industrial productivity

the two aforementioned dimensions.[51] The scatterplot in Figure A18 of the Appendix shows only a weak positive correlation ($\rho = .21$) between employment growth and innovation content across industries, even though the key historical engines of growth such as reproduction, chemistry or machinery are correctly identified by both measures. The results from regressing average (normalized) productivity rank of townships' industrial profiles on ethnic and religious diversity are presented in Table 1.6. Panel A shows that ethnically and religiously diverse townships gained a statistically significant average productivity rank advantage of up to 6 percentage points over their (equally industrialized and diversified) homogeneous neighbors using the employment growth-based approach. Productivity rank differences based on the innovation content are still positive but less significant economically and statistically, which may equally signal the limited relevance of patents for innovation (Moser, 2012), the agrarian character of Hungarian industrialization (van Zanden, 1991; Kopsidis, 2009), or simply the mechanical effects of low innovation variability on the inaccuracy of resulting industry rankings. At any rate, even the fact that a larger share of employment was in expanding industries in diverse places

[51] There are 21 different industries considered in Nuvolari and Tartari (2011), which provides a fairly straightforward mapping to the industry structure used in this paper. The correspondence is bijective in most cases, although a couple of English categories are linked to more than one Hungarian industries (e.g. "Pottery, bricks, artificial stone" to "brickmaking", "pottery" and "other woodworks", or "Food and drink" to "bakery", "butchery", "distillery", "other food" as well as "tourism and hospitality"). In a single case, the opposite is done: "Carriages, vehicules, railways" and "Engines" are lumped together under the Hungarian category of "machinery".

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points to productivity gains.

1.7 Conclusions

In this paper, I provided new estimates for the long-term effects of ethnic and religious diversity on economic growth using a large cross-section of hand-collected township-level data from Hungary of the late 19th century. Specifically, I find that ethnically and religiously diverse communities achieved up to 20-60% higher growth in the 1880-1910 period than their homogeneous neighbors. These results are both economically and statistically significant, and are based on three different methodologies. First, OLS regressions take advantage of the peculiar historical landscape characterized by largely random geographical patterns in diversity as a natural experiment. Second, I address potential endogeneity concerns by a novel IV strategy based on townships' previous exposure to warfare, using a self-compiled dataset of more than 2000 documented military events dating back to the 15-17th centuries. Third, in order to understand the mechanism through which diversity translated to economic growth in an industrializing economy, I propose a simple model-based explanation that highlights the potential trade-offs between comparative productivity advantages and reduced knowledge spillovers diverse communities are likely to face. In particular, the model predicts that in case of productivity differences across groups, diversity can push out the technology frontier by allowing each group to self-select into industries best suited to their abilities. Empirical tests are in line with the model's predictions and confirm that diversity leads to more industrialization, more complex local economies segmented along ethnic and religious lines, and subsequently higher employment in more productive industries.

My results contribute to the relevant economic literature in important ways. In particular, they challenge the controversial but dominant view that social diversity is detrimental to economic development due to between-group coordination problems: if social division captured by specific aspects of diversity are economically relevant, then my results show that the positive effects of comparative advantages may outweigh these negative effects by allowing different groups to self-select into activities best suited to their abilities. Also, my paper makes a strong assertion that geographical mobility, the main driver of diversity in today's globalized economy, is not a zero-sum game between "creative" and "uncreative" places, and that diversity gains may materialize even in the absence of labour mobility. For economic historians of the Austro-Hungarian Monarchy, the paperÕs main attraction comes from disputing the widely held view that economic nationalism, rather than diversity, played a leading role in the promotion of industrialization and economic growth.

My paper also contains at least three important policy implications. First, economic benefits to diversity may accrue even in countries characterized by deep-seated divisions or con-

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frontations between its different populations as the Austro-Hungarian Monarchy of the late 19th century attests. Hence, responsible and benevolent policy-makers should be equally mindful of the indirect economic benefits of diversity as they routinely are of the more immediate and more obvious social conflicts it may engender. Second, the relative balance of costs and benefits in fragmented communities may be altered considerably by sensible policy in order to make diversity pay off. As the theoretical model in the paper implies, reducing or eliminating information bottlenecks between groups (e.g. through social integration, effective public education, increased transparency) may have multiplier effects through less economic segmentation which in turn further facilitates knowledge spillovers. Alternatively, making it easier for productivity differences to manifest themselves (e.g. through the reduction of labour market rigidities or increased competition) can have similar effects. Third, identifying the economically relevant aspects of diversity is difficult but crucial for effective policy intervention. Specifically, while ethnic and religious differences were economically relevant in 19th century Hungary, they may be secondary to educational or skill-related differences in many present-day economies.

Finally, an important point concerning social welfare should not go unnoticed: population diversity *per se* may be associated with geographical differences in economic performance only in the presence of real social or economic rigidities. If these were possible to be fully removed (e.g. preferably through societal fraternity and perfect labour mobility, competition and price flexibility), all location-specific and non-aggregate gains from diversity would disappear. As such, localized economic benefits of mixed populations may be a blessing for those directly concerned, but may also indicate the presence of important roadblocks on the way to bring economic cooperation and prosperity for all.

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1.A Appendix: Figures and Tables

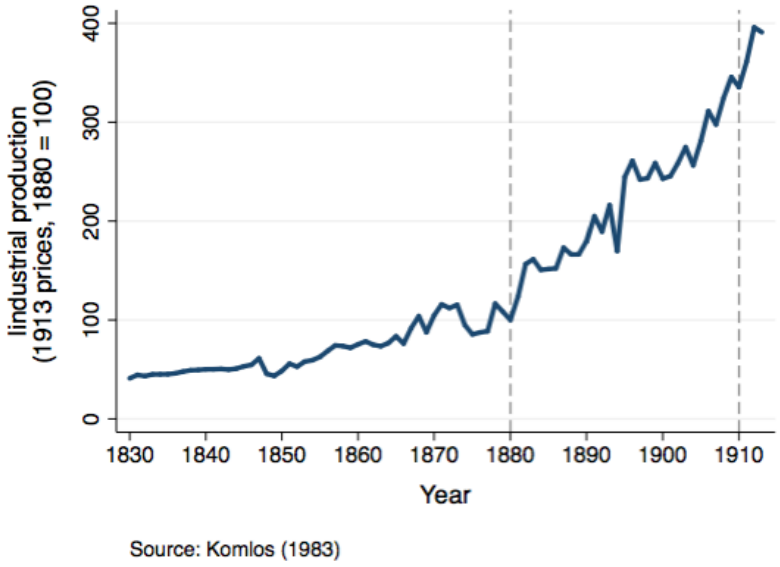

Figure A1: Industrial production in Hungary, 1830-1913

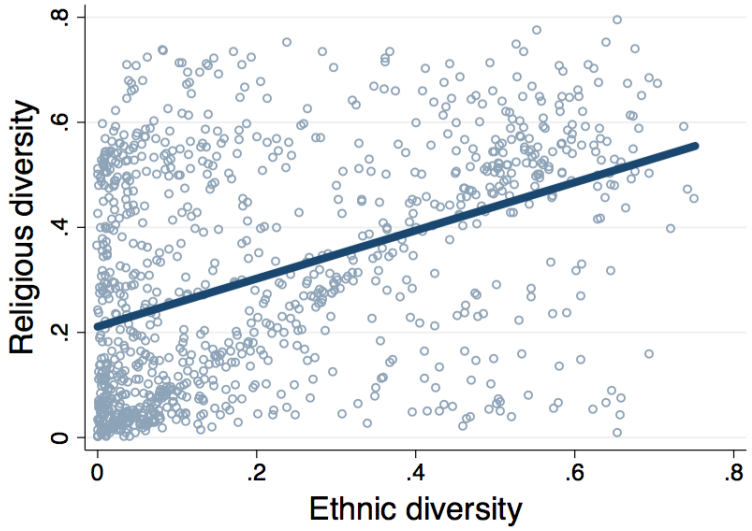

Figure A2: The relationship between the two aspects of diversity across sampled townships in 1880

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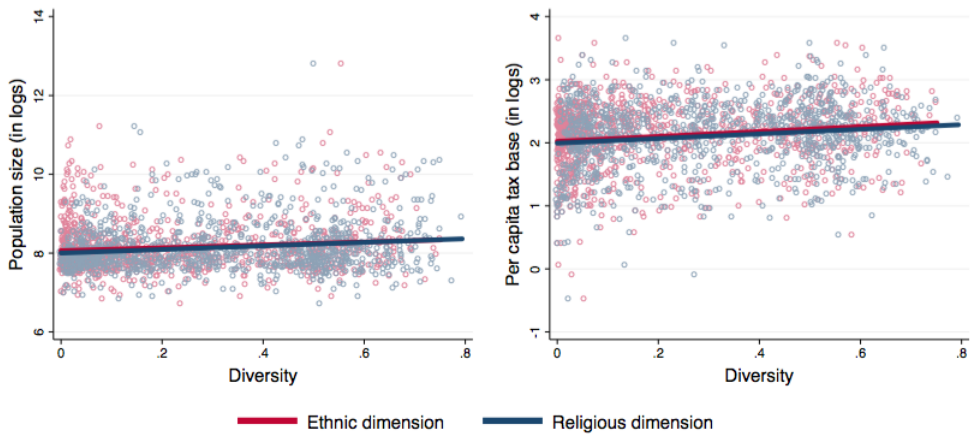

Figure A3: Relationship between diversity and township attributes in 1880

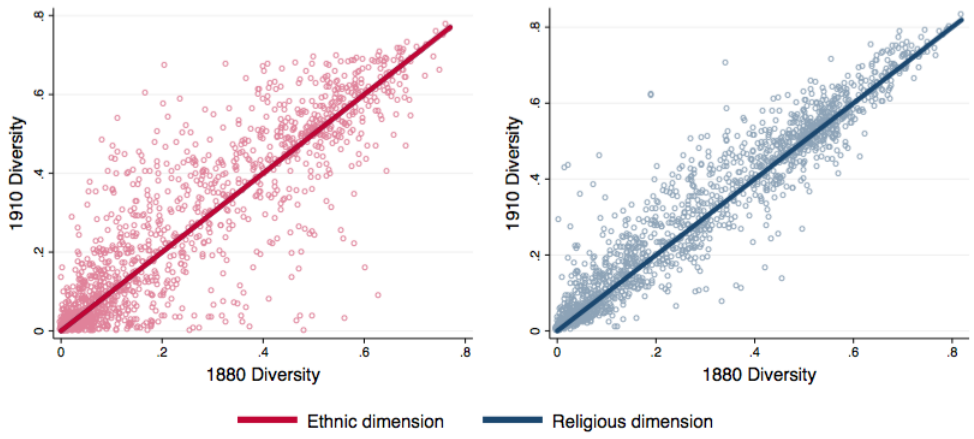

Figure A4: Persistence in diversity across townships between 1880 and 1910

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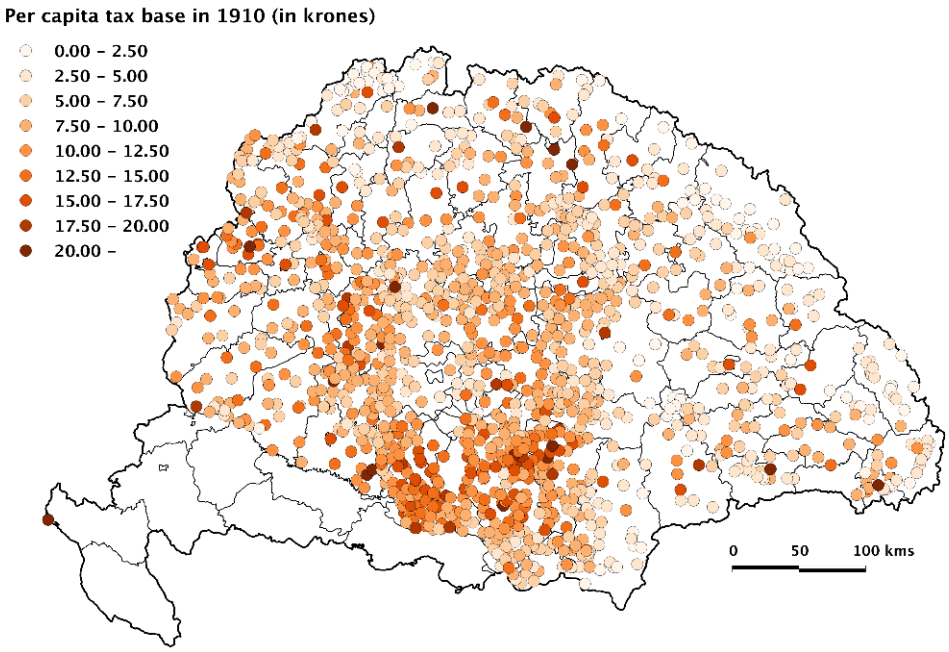

Figure A5a: Per capita tax base of sampled townships in 1910

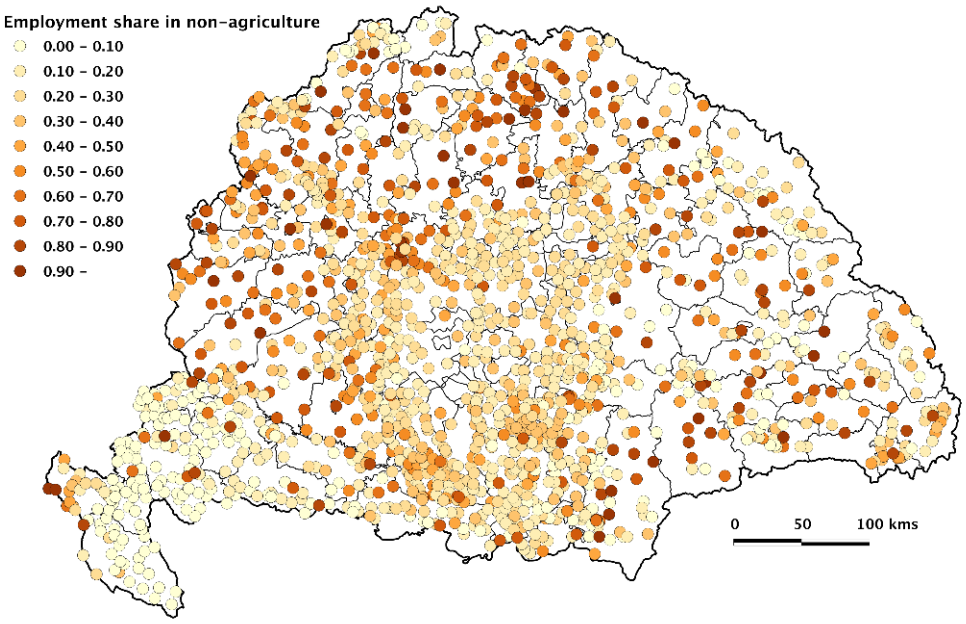

Figure A5b: Non-agricultural share of employment in sampled townships in 1910

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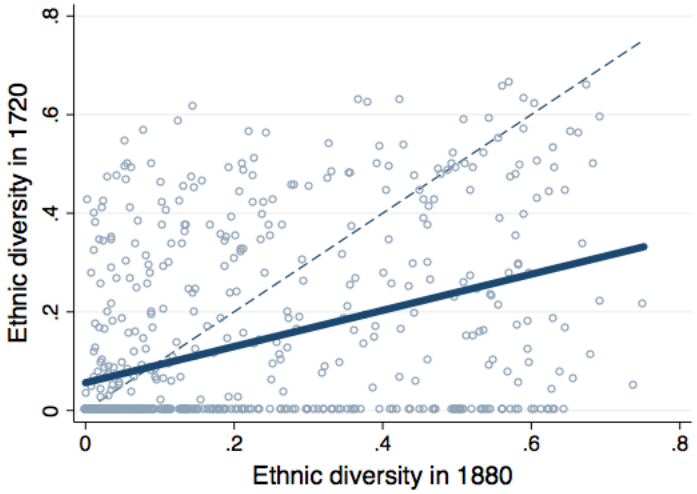
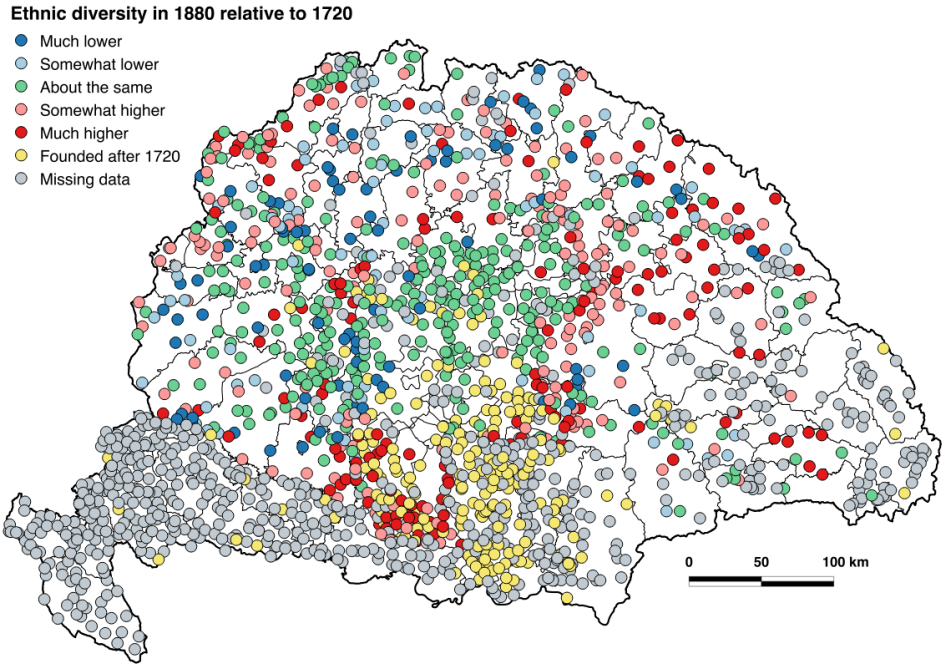


Figure A6: Relationship between township-level diversity in 1720 and 1880



Notes: To make these comparisons, I re-calculated 1880 diversity based on the same classification as was available for 1720. I considered the 1880 and 1720 levels of diversity to be about the same if the difference between them was less than .05, somewhat different if it was between .05 and .20, and much different if it was higher than .20 in absolute terms. Missing data denotes observations where either the 1720 or the 1880 level of diversity was missing, despite the township being in existence on both occasions.

Figure A7: Spatial patterns of changes in ethnic diversity between 1720 and 1880

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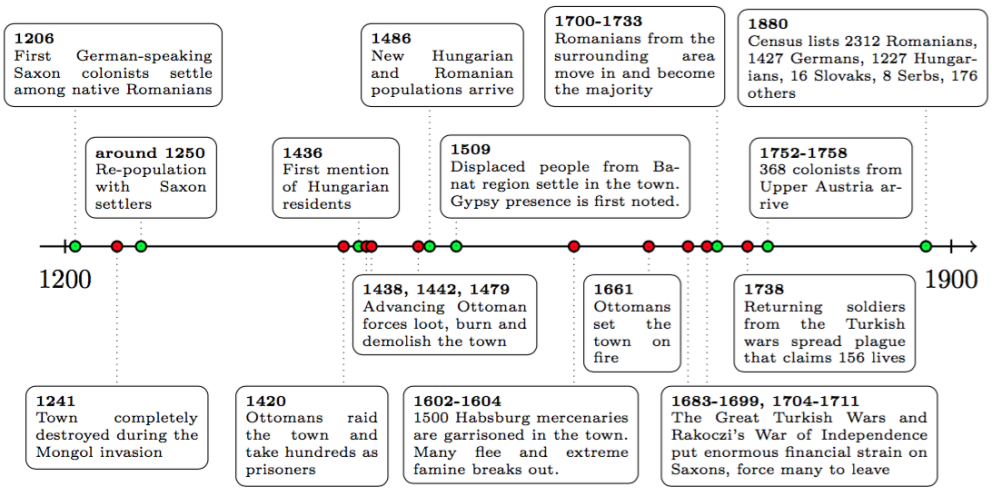

Sources: Own illustration based on historical information presented in the official and non-official municipal websites http://www.orastie.info.ro/index.php?im=21 and http://www.orastieinfo.ro/index.php?mode=istoric, as well as Draskoczy (1999) and Szirtes (2015). The photo depicting Broos in 1912 was downloaded from the web address https://kepeslapok.wordpress.com/2013/04/03/szaszvaros/ on 15/02/2017.

Figure A8: The historical relationship between warfare and ethnic diversity through the chronicle of the town Broos over the centuries

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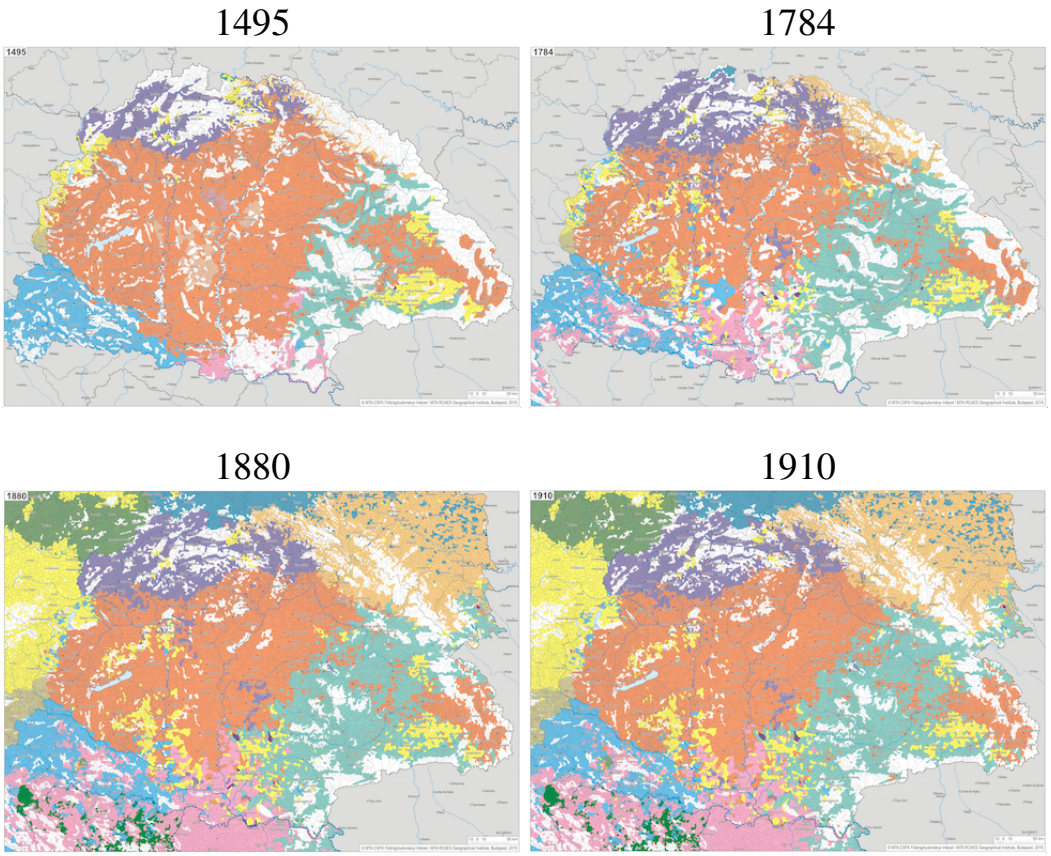

Source: Kocsis and Tatrai (2015)

Figure A9: The changing ethnic landscape of historical Hungary from 1495 to 1910

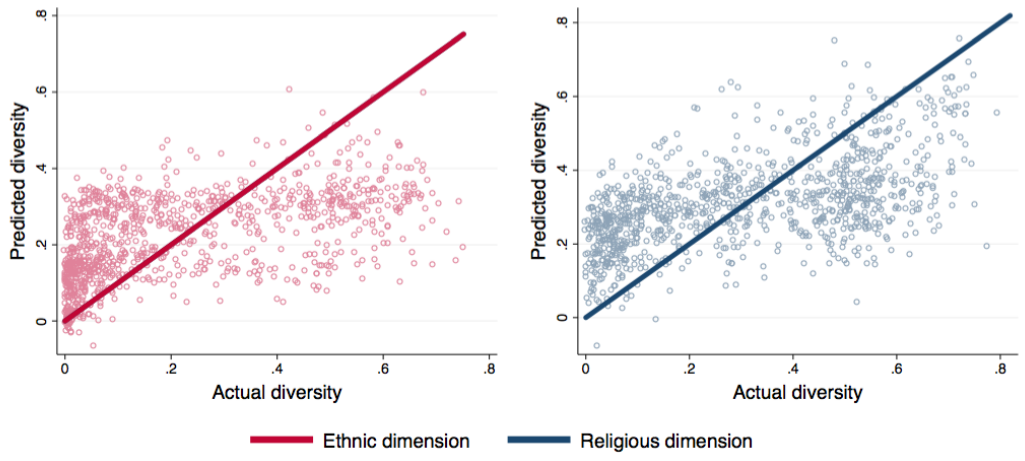

Figure A10: Comparison of predicted vs. observed values of diversity

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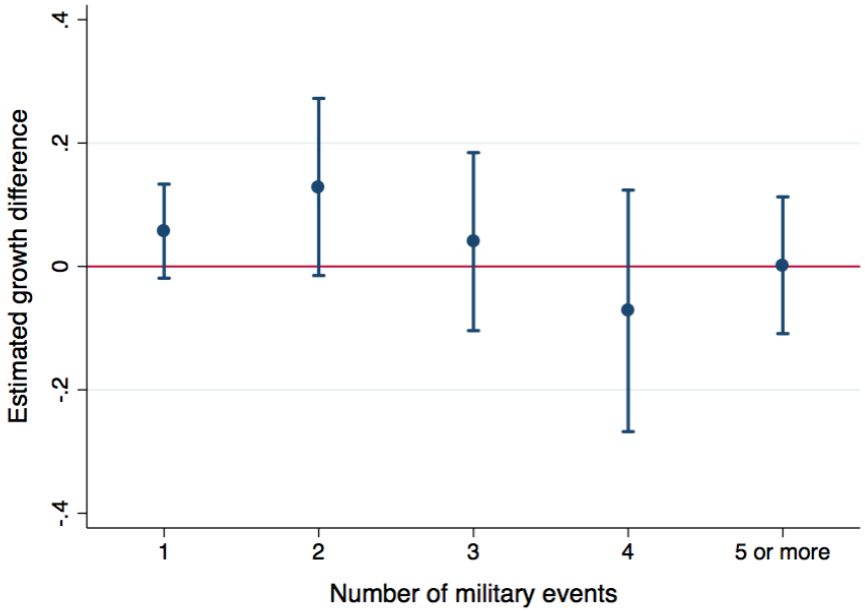

Figure A11: Average growth advantage associated with a given level of past military exposure

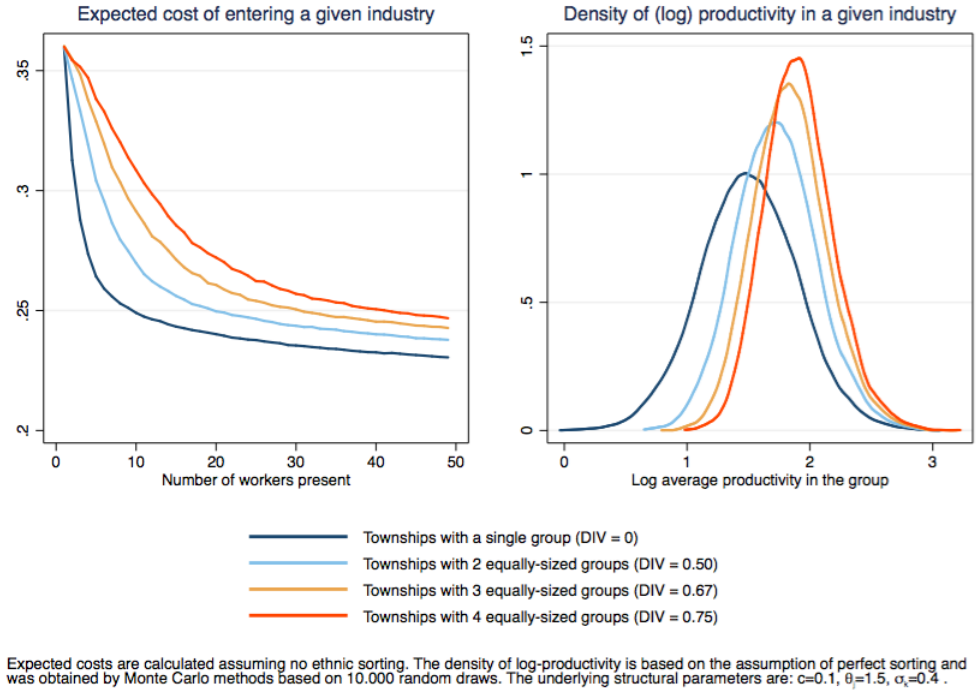

Figure A12: Knowledge spillover and productivity trade-offs associated with diversity

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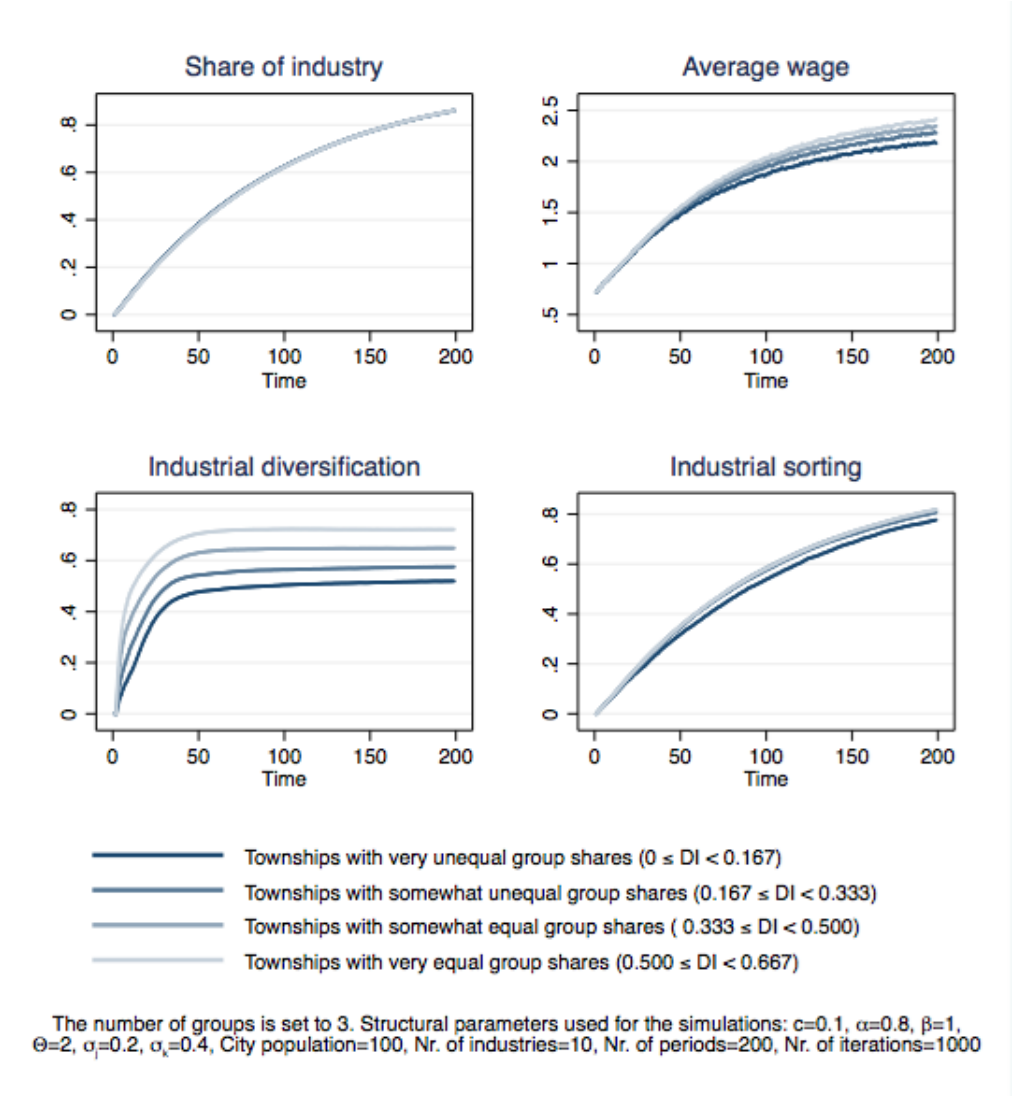

Figure A13: Model dynamics depending on the evenness of group shares in diverse places

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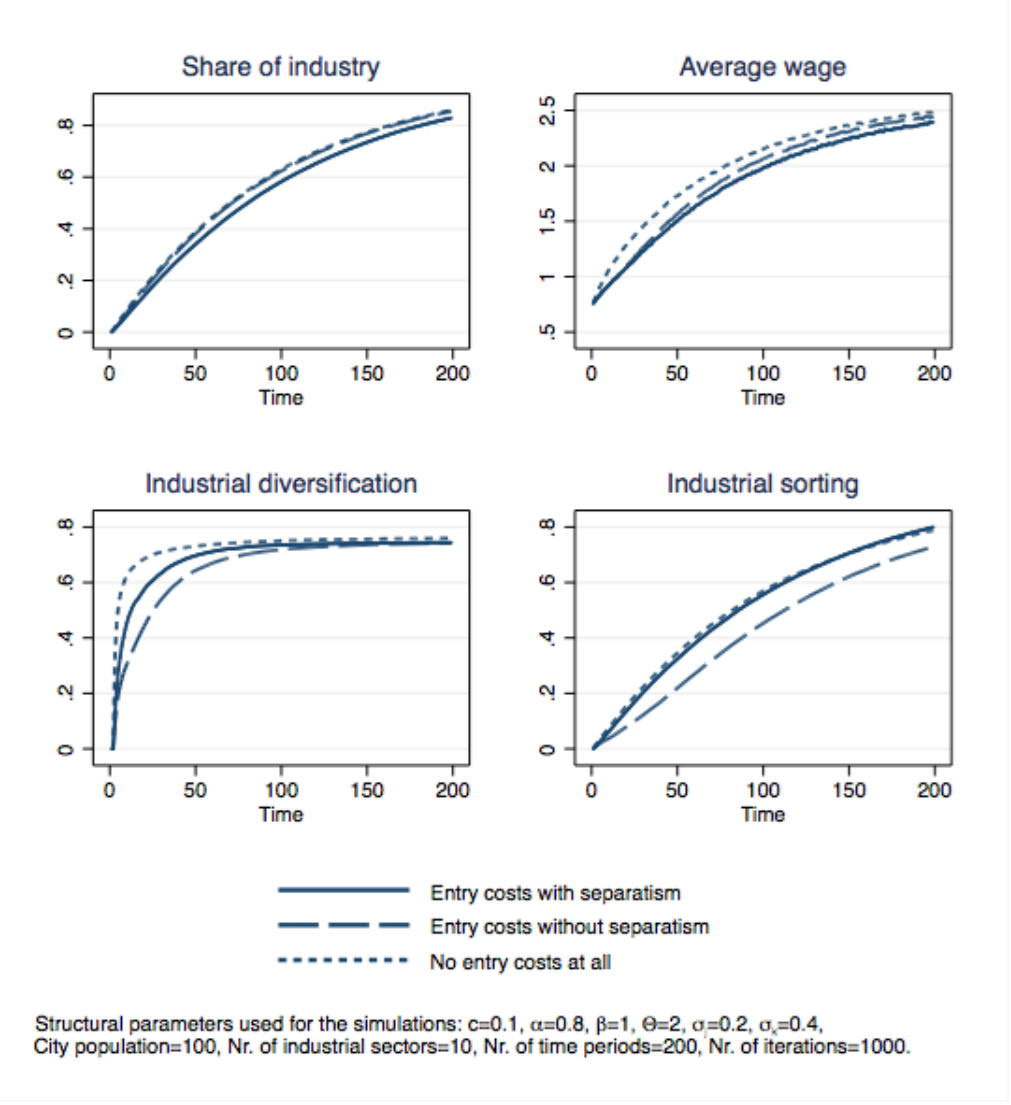

Figure A14: Model dynamics based on alternative assumptions about separatism and entry costs

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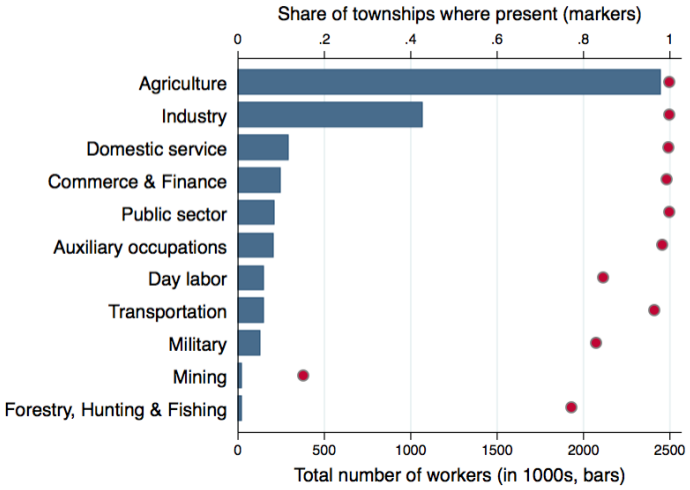

Figure A15a: Aggregate employment patterns by sector in 1910

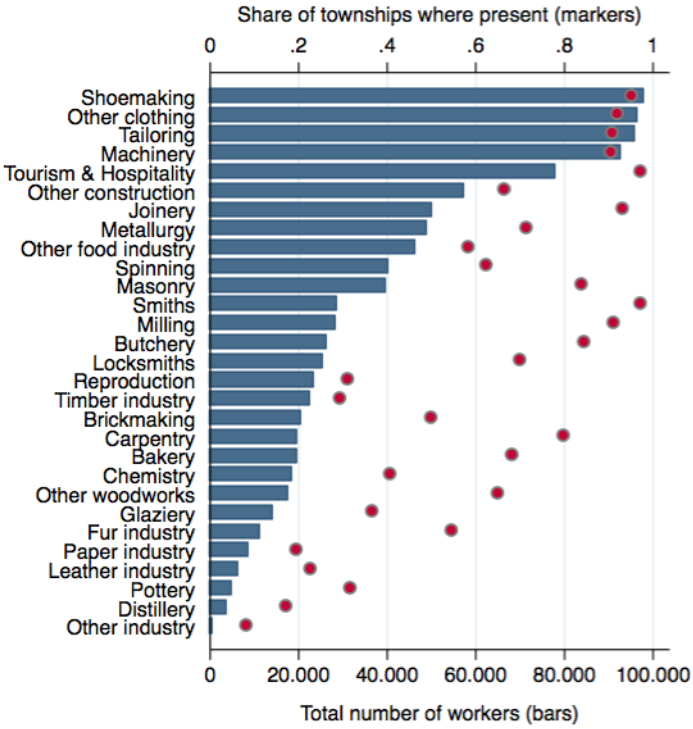

Figure A15b: Aggregate employment patterns by industry in 1910

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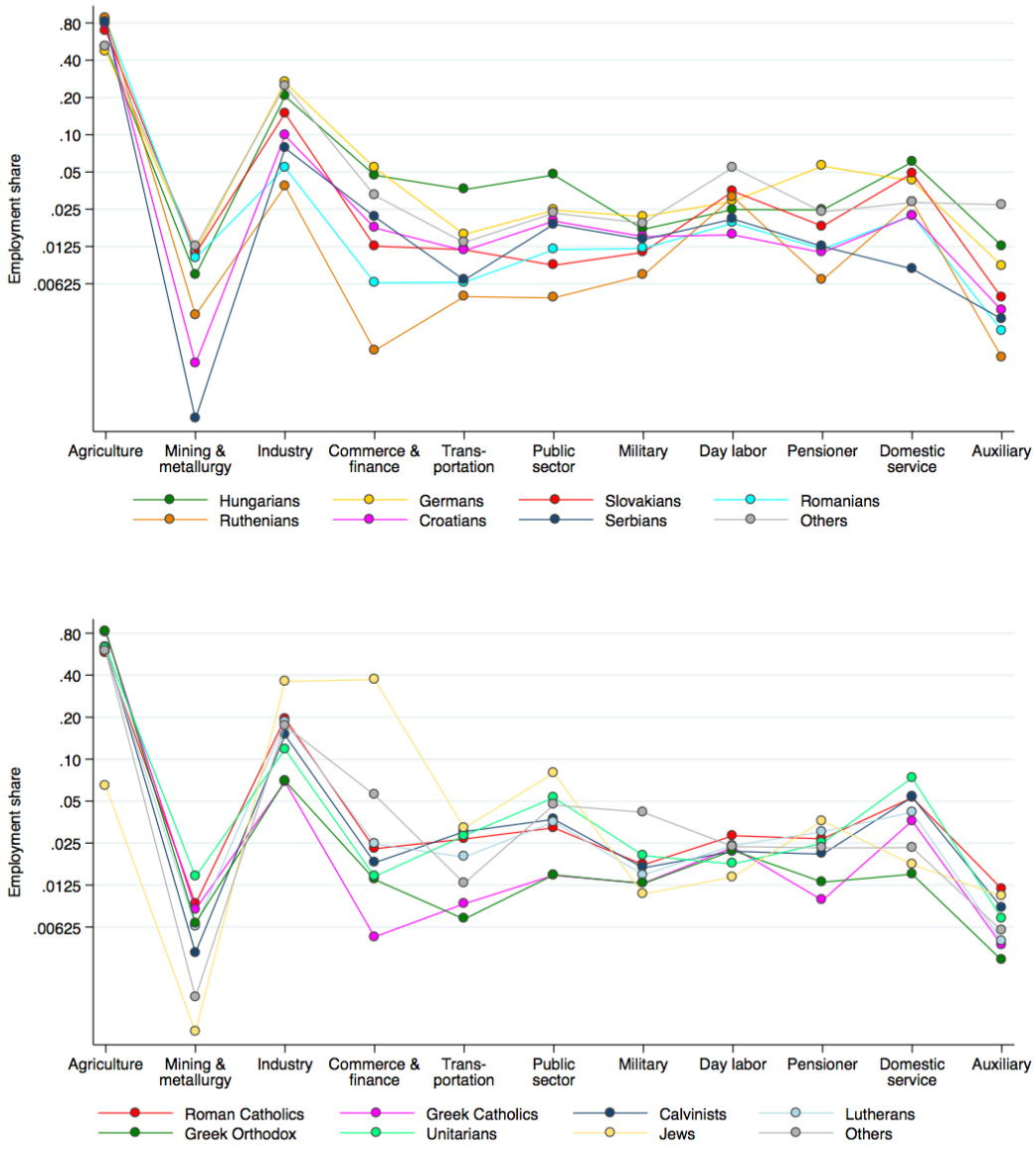

Figure A16: Aggregate employment patterns across sectors by ethnic and religious groups in 1910

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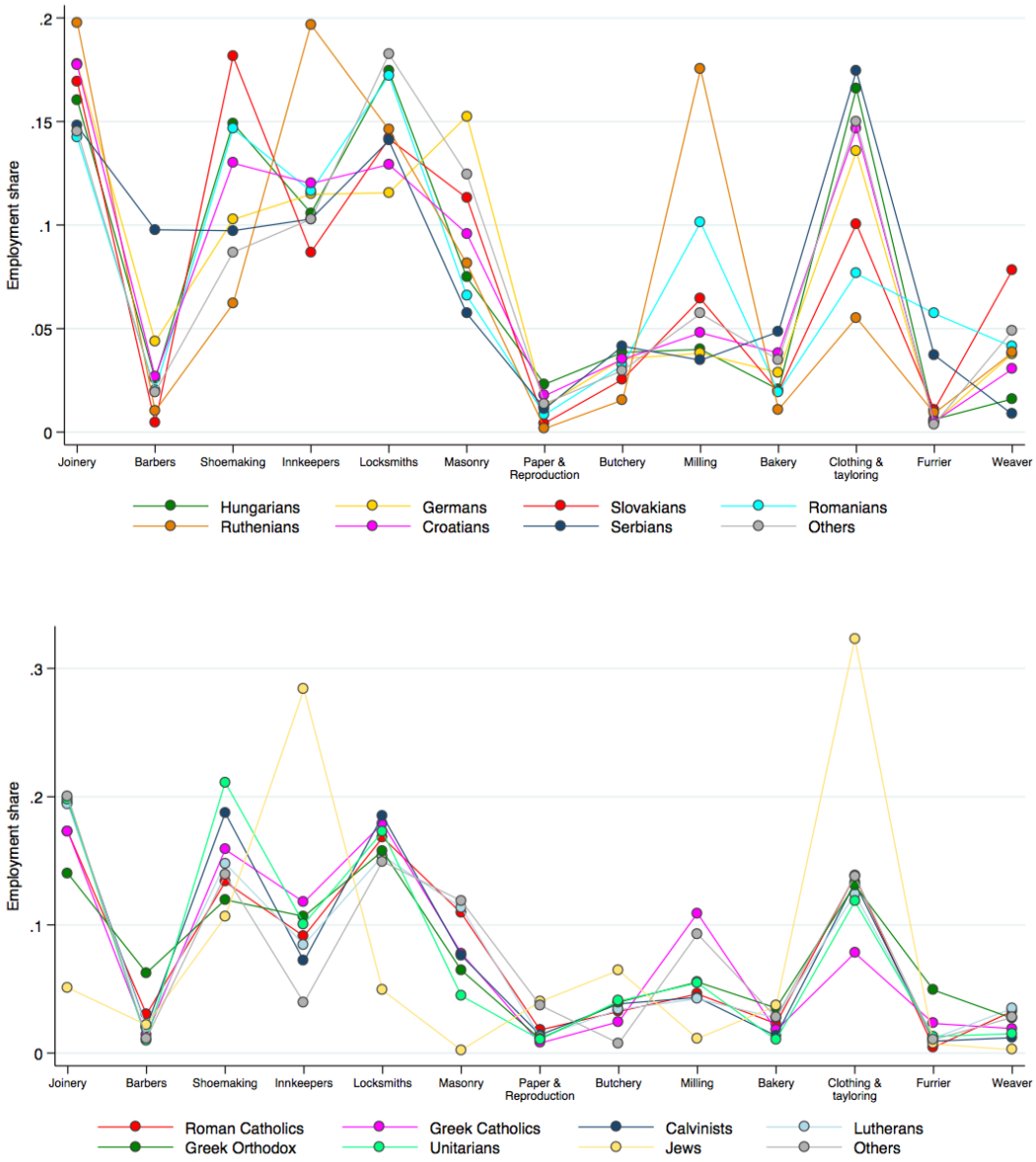

Figure A17: Aggregate employment patterns across industries by ethnic and religious groups in 1910

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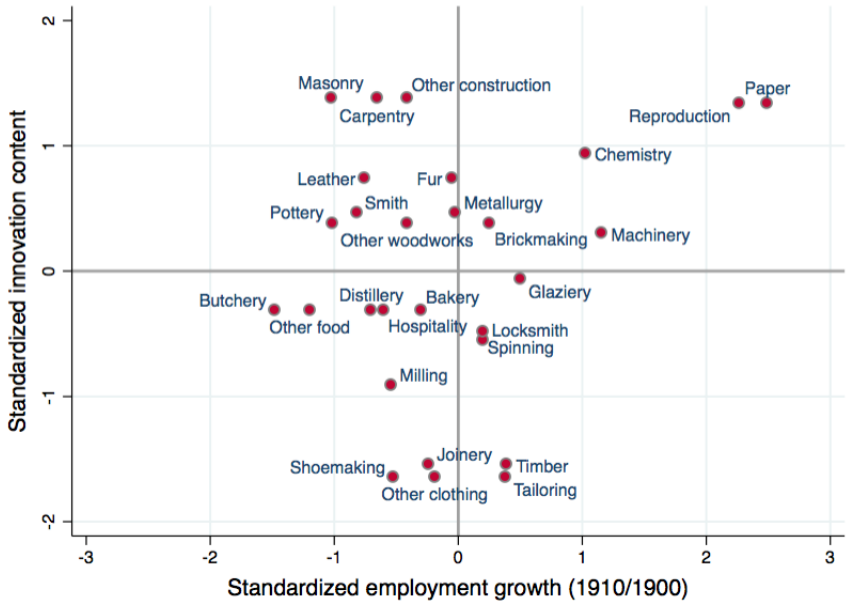

Figure A18: Comparison of productivity rankings of industries in 1910

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	1880		1910	
	Without controls	With controls	Without controls	With controls
PANEL A. ETHNIC DIMENSION				
Diversity	.419*** (.072)	.257*** (.068)	.592*** (.097)	.235*** (.074)
Population size (in logs)		-.009 (.032)		-.045 (.035)
Literacy share		.440*** (.097)		1.427*** (.122)
District seat		.034 (.032)		.208*** (.036)
County seat		.277*** (.061)		.218*** (.077)
Capital city		.949*** (.161)		1.613*** (.194)
City council		.060 (.071)		.324*** (.068)
City legislation		.049 (.089)		.315*** (.115)
Railway		.133*** (.030)		.189*** (.073)
Navigable waterway		-.021 (.035)		.013 (.031)
Mountain		-.220*** (.059)		-.309*** (.072)
Mining		.014 (.056)		.005 (.056)
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008
R squared	.455	.524	.504	.697
PANEL B. RELIGIOUS DIMENSION				
Diversity	.627*** (.066)	.443*** (.067)	.993*** (.077)	.483*** (.060)
Population size (in logs)		-.005 (.031)		-.043 (.033)
Literacy share		.337*** (.096)		1.326*** (.120)
District seat		.013 (.032)		.177*** (.033)
County seat		.269*** (.062)		.206*** (.075)
Capital city		.972*** (.157)		1.533*** (.180)
City council		.036 (.072)		.288 (.064)
City legislation		.016 (.088)		.277 (.108)
Railway		.136*** (.030)		.183*** (.070)
Navigable waterway		-.022 (.034)		.011 (.030)
Mountain		-.202*** (.058)		-.278*** (.072)
Mining		.032 (.055)		.011 (.055)
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008
R squared	.486	.540	.567	.711

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively.

Table A1: OLS regression results for the growth effects of diversity

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	No spatial dummies		County dummies		District dummies	
	Without controls	With controls	Without controls	With controls	Without controls	With controls
A. Ethnic dimension						
Diversity	.255***	.239***	.403***	.204***	.337***	.215**
	(.062)	(.064)	(.072)	(.065)	(.090)	(.083)
			[.145]	[.092]	[.115]	[.102]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of spatial dummies	0	0	59	59	211	211
Nr. of observations	1008	1008	1008	1008	1008	1008
R squared	.552	.692	.673	.761	.830	.869
B. Religious dimension						
Diversity	.367***	.108*	.604***	.310***	.531***	.317***
	(.061)	(.056)	(.066)	(.060)	(.080)	(.069)
			[.120]	[.075]	[.097]	[.079]
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of spatial dummies	0	0	59	59	211	211
Nr. of observations	1008	1008	1008	1008	1008	1008
R squared	.561	.688	.691	.765	.838	.871

Heteroskedasticity-robust standard errors are in parenthesis, while standard errors clustered at the level of regional dummies are in brackets. One and two stars denote significance at 5 and 1% probability levels, respectively. The dependent variable is the 1910 (log) level of per capita tax base across all specifications. Specifications "without controls" feature only the 1880 (log) per capita tax base on the right hand side, along with regional dummies. Specifications "with controls" feature the exact same set of controls as the baseline specification.

Table A2: Robustness results based on alternative spatial controls

	Herfindahl-index based measure		Concentration-ratio based measure		Number of groups	
	Without controls	With controls	Without controls	With controls	Without controls	With controls
A. Ethnic dimension						
Diversity	.403***	.204***	.421***	.214***	.105***	.057***
	(.072)	(.065)	(.085)	(.073)	(.016)	(.014)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008	1008	1008
R squared	.673	.761	.670	.760	.678	.762
B. Religious dimension						
Diversity	.604***	.310***	.586***	.317***	.131***	.071***
	(.065)	(.060)	(.073)	(.069)	(.013)	(.013)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008	1008	1008
R squared	.691	.765	.684	.763	.696	.767

Heteroskedasticity-robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. The "Herfindahl-index" measure corresponds to the baseline measure used throughout the paper. The "Concentration ratio" measure captures the share of township population outside of the biggest ethnic and religious group, respectively. The "Number of groups" measure counts all ethnic and religious groups, respectively, of which the relative share exceeds 1% in the local population The dependent variable is the 1910 (log) level of per capita tax base across all specifications. Specifications "without controls" feature only the 1880 (log) per capita tax base on the right hand side, along with county dummies. Specifications "with controls" feature the exact same set of controls as the baseline specification.

Table A3: Robustness results based on different measures of diversity

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	Per capita tax base	Population size	Employment share in industry	Net share of immigration
A. Ethnic dimension				
Diversity	.204***	.130***	.117***	.012*
	(.065)	(.045)	(.018)	(.007)
Control variables	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008
R squared	.761	.942	.619	.379
B. Religious dimension				
Diversity	.310***	.043	.052***	.010
	(.060)	(.032)	(.014)	(.007)
Control variables	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008
R squared	.765	.941	.597	.381

Heteroskedasticity-robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. In Column 4, the net share of immigration is calculated as the difference between townships' real increase and natural increase between 1900 and 1910, divided by 1910 population. In Column 6, the share of large industrial firms is calculated as the relative share of industrial enterprises in each township (as of 1910) that employed more than 10 workers. All specifications feature county dummies and the standard set of control variables. The 1880 level of per capita tax base is used in all specifications to control for the initial level of economic development, except in Columns 2 and 3 where the respective lagged dependent variable is used.

Table A4: Robustness results based on alternative measures of the dependent variable in 1910

	Below-median population	Below-median income	Below-median diversity	Below-median dissimilarity
A. Ethnic dimension				
Diversity	.092	.338***	1.267**	.411**
	(.127)	(.121)	(.567)	(.206)
Control variables	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	510	503	513	515
R squared	.764	.735	.832	.782
B. Religious dimension				
Diversity	.385***	.474***	.919***	.513***
	(.101)	(.108)	(.240)	(.133)
Control variables	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	510	503	511	505
R squared	.773	.741	.805	.796

Heteroskedasticity-robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. All specifications feature county dummies and the standard set of control variables. Below median diversity and diversity growth in Columns 3 and 4 features different sub-samples depending on the particular (ethnic or religious) dimension considered.

Table A5: Robustness results based on sub-sample analysis

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	HUN	GER	SLO	ROM	RUT	CRO	SRB
Diversity	.275***	.221***	.224***	.204***	.204***	.201***	.188***
	(.069)	(.066)	(.066)	(.065)	(.065)	(.064)	(.068)
Population share	.175***	-.095*	-.178***	-.027	-.260***	.220	.093
of ethnic group	(.049)	(.053)	(.064)	(.063)	(.081)	(.286)	(.081)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008	1008	1008	1008
R squared	.764	.761	.762	.760	.762	.760	760

Heteroskedasticity-robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. The dependent variable is the (log) per capita tax base as of 1910. All specifications feature the 1880 (log) per capita tax base, the standard set of control variables as well as county dummies. Specifications in the respective columns feature the following ethnic groups in order: Hungarians, Germans, Slovakians, Romanians, Ruthenians, Croatians and Serbians.

	RCAT	GCAT	CAL	LUT	ORT	UNI	JEW
Diversity	.364***	.314***	.313***	.343***	.322***	.305***	.234***
	(.064)	(.059)	(.060)	(.060)	(.060)	(.060)	(.062)
Population share	.086**	-.062	-.003	-.168***	-.078	1.436	1.039***
of religious group	(.039)	(.077)	(.058)	(.055)	(.061)	(1.003)	(.253)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	1008	1008	1008	1008	1008	1008	1008
R squared	.766	.765	.764	.766	.765	.765	769

Heteroskedasticity-robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. The dependent variable is the (log) per capita tax base as of 1910. All specifications feature the 1880 (log) per capita tax base, the standard set of control variables as well as county dummies. Specifications in the respective columns feature the following religious groups in order: Roman Catholics, Greek Catholics, Calvinists, Lutherans, Greek Orthodox, Unitarians and Jews.

Table A6a: Robustness results based on extended specification featuring population shares by specific ethnic and religious groups

	All township pairs		Township pairs within 10 kms		Township pairs within 5 kms	
	Without controls	With controls	Without controls	With controls	Without controls	With controls
A. Ethnic dimension						
Diversity	.414***	.208*	.244*	.112	.219	.040
	(.121)	(.107)	(.140)	(.124)	(.195)	(.164)
Nr. of observations	1008	1008	654	654	214	214
R squared	.869	.912	.883	.917	.891	.934
B. Religious dimension						
Diversity	.587***	.262***	.411***	.171	.322	.046
	(.115)	(.096)	(.128)	(.110)	(.242)	(.223)
Nr. of observations	1008	1008	654	654	214	214
R squared	.875	.913	.887	.918	.893	.934

Heteroskedasticity-robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. Controls are the same as in the baseline regression specifications. Distances between townships are calculated by the Haversine formula using geo-coordinates of town centers.

Table A7: Robustness results based on pairwise matching of nearest townships

CEU eTD Collection

	All military events		Major military events only	
	Presence	Intensity	Presence	Intensity
1880 log tax base (per capita)	.129 (.114)	.080 (.104)	.199 (.147)	.188 (.136)
Literacy share	.195 (.335)	.188 (.315)	.643 (.460)	.538 (.441)
Population size (in logs)	.057 (.118)	.139 (.105)	.265* (.132)	.301* (.126)
Population density	.082 (.041)	.069 (.037)	.025 (.040)	.032 (.039)
District seat dummy	.813** (.125)	.772** (.119)	.517** (.158)	.557** (.151)
County seat dummy	.234 (.272)	.260 (.220)	.208 (.280)	.199 (.252)
Capital dummy	3.806** (.905)	10.571** (.854)	4.076** (.931)	9.987** (.887)
City council dummy	.526* (.260)	.634** (.215)	.284 (.264)	.380 (.251)
City legislation dummy	.725 (.425)	.765* (.335)	.540 (.408)	.539 (.364)
Distance to Budapest	.227* (.101)	.176 (.090)	.133 (.123)	.092 (.122)
Distance to Vienna	-.212** (.063)	-.202** (.055)	-.096 (.076)	-.084 (.072)
Railway dummy	.317** (.123)	.320** (.120)	.451** (.171)	.430* (.170)
Navigable waterway dummy	-.097 (.122)	-.061 (.116)	-.000 (.150)	.032 (.145)
Mountain dummy	-.023 (.175)	-.042 (.164)	-.147 (.248)	-.170 (.234)
Mining dummy	.263 (.167)	.307* (.152)	.236 (.204)	.266 (.195)
Nr. of observations	1009	1009	1009	1009
Pseudo R squared	.211	.154	.227	.216

Robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. Probit regressions are run to assess the exogeneity of military presence, measured by a categorical variable that takes the value of 1 if the number of military events is positive, and zero otherwise. Ordered probit regressions are run to assess the exogeneity of military intensity, measured by the total number of military events in each township.

Table A8: Probit estimates for assessing instrument exogeneity based on war exposure

CEU eTD Collection

	Ethnic dimension		Religious dimension	
	Without controls	With controls	Without controls	With controls
PANEL A. SINGLE INSTRUMENT				
Diversity	**2.864*** **	**.194**	**3.345*** **	**.412**
	(.572)	(1.233)	(.784)	(2.626)
First-stage $\hat{\beta}$	.020***	.006	.017***	.003
First-stage R-squared	.293	.335	.307	.365
First-stage partial R-squared	.022	.002	.015	.000
First-stage F-statistic	21.31***	1.42	17.54***	.38
PANEL B. NO COUNTY DUMMIES				
Diversity	**2.250*** **	**.976***	**1.613*** **	**.812***
	(.478)	(.517)	(.257)	(.432)
First-stage R-squared	.052	.132	.078	.147
First-stage partial R-squared	.030	.011	.056	.015
First-stage F-statistic	9.57***	3.16**	23.39***	5.87***
PANEL C. ONLY MAJOR MILITARY EVENTS				
Diversity	**2.384*** **	**.116**	**2.602*** **	**1.188**
	(.507)	(.711)	(.697)	(.779)
First-stage R-squared	.291	.337	.304	.366
First-stage partial R-squared	.019	.004	.012	.003
First-stage F-statistic	12.40***	1.72	4.49***	1.27
PANEL D. DISTANCE BAND AROUND TOWNSHIPS				
Diversity	**2.412*** **	**.618**	**2.402*** **	**.776**
	(.433)	(.456)	(.408)	(.562)
First-stage R-squared	.307	.344	.322	.370
First-stage partial R-squared	.040	.014	.037	.008
First-stage F-statistic	12.99***	4.22***	11.59***	2.69**

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively. Results are based on the 2SLS estimator on a sample of 1008 townships using a cubic polynomial instrument set. Extended specifications use the standard set of control variables. Results in Panel D are based on instruments that also include military events outside of respective townships provided they were located within 5 kms from the geographical center of the given locality.

Table A9: Robustness of IV estimates to alternative specifications

CEU eTD Collection

	Ethnic dimension		Religious dimension	
	(1)	(2)	(3)	(4)
PANEL A. INDUSTRIAL DIVERSIFICATION				
Diversity	**.111*** **	**.080*** **	**.101*** **	**.083*** **
	(.031)	**(.029)**	**(.033)**	**(.031)**
Lagged industrial diversification	.736***	.688***	.733***	.683***
	(.025)	(.030)	(.025)	(.031)
Lagged employment share in industry		.457***		.465***
		(.087)		(.086)
Control variables	No	No	No	No
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	996	977	996	977
R squared	.838	.850	.838	.851
PANEL B. EMPLOYMENT SHARE IN INDUSTRY				
Diversity	**.040** **	**.033*** **	**.022*** **	**.013* **
	(.009)	**(.009)**	**(.008)**	**(.008)**
Lagged employment share in industry	.980***	.948***	.989***	.956***
	(.018)	(.024)	(.019)	(.025)
Lagged industrial diversification		.013***		.014***
		(.004)		(.004)
Control variables	No	No	No	No
County dummies	Yes	Yes	Yes	Yes
Nr. of observations	988	977	988	977
R squared	.897	.897	.895	.896

Robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. Control variables are not included in the regression specification while country dummies are.

Table A10: Industrialization and diversification gains from diversity over time

CEU eTD Collection

CEU eTD Collection

Township name	Population	Employment share by sector											Ethnic association			Religious association		
		AGR	MIN	IND	COM	TRA	PUB	MIL	DAY	PEN	DOM	OTH	χ^2	CV	λ	χ^2	CV	λ
Arad	60969	.06	0	.38	.09	.09	.07	.07	.05	.05	.10	.04	4105***	.14	.00	7010***	.18	.00
Baja	20709	.17	0	.37	.09	.04	.06	.03	.06	.05	.09	.03	2224***	.18	.06	2578***	.20	.03
Budapest	863735	.01	0	.45	.13	.06	.09	.03	.02	.03	.14	.03	25239***	.09	.00	80717***	.15	.00
Debrecen	90153	.23	0	.33	.08	.06	.06	.06	.03	.03	.09	.02	4587***	.13	.01	9600***	.18	.01
Eszek (Osijek)	28505	.07	0	.34	.08	.06	.06	.17	.07	.05	.07	.03	2400***	.14	.02	3014***	.17	.04
Fiume (Rijeka)	48492	.03	0	.32	.13	.13	.08	.05	.05	.04	.07	.02	4776***	.17	.02	7294***	.20	.04
Gyor	42589	.04	0	.45	.09	.05	.07	.08	.03	.04	.11	.03	5385***	.20	.04	3650***	.16	.00
Hodmezovasarhely	62394	.61	0	.17	.04	.01	.03	0	.04	.03	.05	.01	642***	.06	.01	4055***	.14	.02
Kassa (Kosice)	40476	.02	0	.36	.08	.05	.09	.17	.03	.05	.12	.03	2357***	.12	.02	5414***	.19	.04
Kecskemet	67306	.53	0	.19	.05	.02	.04	.04	.03	.03	.06	.01	4223***	.15	.01	3881***	.14	.03
Kolozsvar (Cluj-Napoca)	58481	.07	0	.35	.08	.05	.10	.08	.04	.05	.13	.03	4304***	.14	.00	7109***	.18	.00
Komarom	18863	.05	0	.30	.06	.07	.06	.29	.02	.04	.09	.02	3180***	.20	.17	3065***	.21	.09
Marosvasarhely (Targu Mures)	23728	.07	0	.35	.08	.05	.09	.14	.03	.04	.13	.02	3922***	.21	.08	3280***	.19	.04
Miskolc	49182	.05	0	.38	.10	.09	.07	.10	.04	.05	.11	.02	2296***	.12	.01	6229***	.19	.01
Nagyvarad (Oradea)	61034	.05	0	.36	.11	.06	.09	.10	.05	.04	.11	.03	3619***	.13	.02	8404***	.20	.00
Pancsova (Pancevo)	20201	.21	0	.31	.10	.04	.06	.06	.10	.05	.06	.03	3812***	.25	.06	4723***	.26	.07
Pecs	47844	.07	.05	.37	.07	.05	.08	.08	.04	.07	.09	.03	3093***	.14	.00	4579***	.17	.01
Pozsony (Bratislava)	73459	.03	0	.43	.08	.05	.08	.11	.02	.06	.11	.03	6833***	.15	.00	7627***	.16	.02
Selmecbanya (Banska Stiavnica)	15170	.07	.15	.34	.03	.02	.05	.0	.04	.21	.07	.01	1392***	.20	.01	1757***	.20	.01
Sopron	31597	.14	.04	.27	.07	.05	.09	.14	.02	.06	.10	.03	4983***	.23	.01	5807***	.23	.06
Szabadka (Subotica)	93232	.48	0	.18	.05	.05	.04	.04	.07	.03	.06	.02	6198***	.15	.00	6827***	.16	.04
Szatmarnemeti (Satu Mare)	34151	.16	0	.34	.10	.05	.09	.05	.03	.04	.12	.03	1474***	.12	.02	4315***	.20	.00
Szeged	115306	.34	0	.27	.06	.05	.05	.06	.05	.04	.06	.02	6537***	.13	.04	13377***	.19	.07
Szekesfehervar	34828	.20	0	.31	.07	.06	.06	.11	.02	.05	.09	.02	4569***	.20	.05	4603***	.20	.03
Temesvar (Timisoara)	68471	.04	0	.39	.09	.06	.07	.11	.08	.05	.08	.03	4688***	.13	.00	7204***	.16	.01
Ujvidek (Novi Sad)	33089	.21	0	.33	.11	.04	.06	.03	.07	.04	.08	.03	3765***	.18	.09	4273***	.16	.10
Varasd (Varazdin)	12149	.15	0	.31	.06	.03	.08	.18	.03	.05	.08	.03	1437***	.20	.03	1362***	.18	.04
Versecz (Vrsac)	26941	.40	0	.27	.07	.03	.04	.03	.04	.05	.05	.02	2588***	.17	.03	1849***	.14	.03
Zimony (Zemun)	15835	.14	0	.28	.08	.07	.06	.16	.09	.05	.05	.02	5328***	.31	.17	2559***	.21	.05
Zombor (Sombor)	30039	.38	0	.21	.06	.03	.08	.04	.06	.05	.08	.02	5871***	.25	.14	3843***	.20	.04
Zagrab (Zagreb)	74703	.06	0	.35	.10	.05	.12	.10	.01	.07	.10	.05	5369***	.13	.01	4888***	.13	.02

Robust standard errors in parenthesis. One and two stars denotes significance at 5 and 1% probability levels, respectively. Control variables are not included in the regression specification while country dummies are.

Table A11: Industrialization and diversification gains from diversity over time

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	Ethnic dimension			Religious dimension		
	(1)	(2)	(3)	(4)	(5)	(6)
PANEL A. SECTORS						
Dissimilarity	**-.039*** **	**-.003** **	**-.005*** **	**-.037*** **	**.000**	**-.002***
	(.004)	**(.001)**	**(.001)**	**(.004)**	**(.001)**	**(.001)**
Δ Employment share in non-agriculture		.477***	.473***		.478***	.474***
		(.004)	(.004)		(.004)	(.004)
Δ Number of active sectors			.050***			.049***
			(.004)			(.004)
Two-way county dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	507528	507528	507528	507528	507528	507528
R squared	.117	.853	.854	.115	.853	.854
PANEL B. INDUSTRIES						
Dissimilarity	**.034*** **	**.038*** **	**.034*** **	**.022*** **	**.027*** **	**.023*** **
	(.003)	**(.003)**	**(.003)**	**(.002)**	**(.002)**	**(.002)**
Δ Employment share in industry		.166***	.146***		.166***	.143***
		(.015)	(.019)		(.015)	(.019)
Δ Number of active industries			.029***			.033***
			(.007)			(.007)
Two-way county dummies	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	507528	507528	507528	507528	507528	507528
R squared	.243	.299	.302	.233	.289	.294

Standard errors clustered at the township level in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively.

Table A12: Statistical relationship between diversity and industrial sorting by group

CEU eTD Collection

1.B Appendix: Data sources

Data source	Availability	Variables used	Reference period	Comments
Official Hungarian censuses	https://library.hungaricana.hu/hu/collection/kozponti_statisztikai_hivatal_nepszamlalasi_digitalis_adattar/	Size, ethnicity, religion, literacy of local population; administrative and legal status of townships; sectoral and industrial distribution of workforce	1869, 1881, 1910	
Townships' budget and taxes as of 1881, (Official Statistical Publications, 1893)	Library of the Hungarian Statistical Office	Direct tax base	1881	Semi-autonomous Croatia is excluded
Budget of Hungarian townships in 1908	Library of the Hungarian Statistical Office	Direct tax base	1908	Semi-autonomous Croatia is excluded
Statistical Yearbook of Hungary	http://konyvtar.ksh.hu/index.php?s=kb_statisztika	Access to navigable waterway dummy	1885-1910	
Journal of Mining & Metallurgy	http://bkl.uni-miskolc.hu/	Mine dummy	1880-1910	
Population Dynamic Register of the Hungarian Kingdom, 1901-1910	http://konyvtar.ksh.hu/inc/kb_statisztika/Manda/MSK/MSK_046.pdf	Net immigration rate	1910	
Tominac, J. (1905). Railroads of the Hungarian Kingdom, 1845-1904 [in Hungarian] Rail and Transportation Bulletin	Library of the Hungarian Statistical Office http://adtplus.arcanum.hu/hu/collection/VasutiKozlony/	Access to railroad dummy	1880-1910	
Financial Institutions (Hungarian Statistical Yearbook, Vol. 13, No. 6)	Library of the Hungarian Statistical Office	banks	1883	
Population of Hungary in the age of Pragmatica Sanctio, 1720-1721	http://konyvtar.ksh.hu/inc/kb_statisztika/Manda/MSK2/MSK2_012.pdf	1720 population and ethnic profiles	1720	Semi-autonomous Croatia is excluded
Banlaky, J. (1928): Military history of the Hungarian nation	http://www.mek.oszk.hu/09400/09477/html/index.html	military data	1391-1718	Narrative account of military history
Reference maps from the early 20th century	http://lazarus.elte.hu/hun/maps/1910/vmlista.htm	Mountain dummy	n.a.	A district is mountainous if highest point exceeds 1000-meter altitude.

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Chapter 2

What's Love Got to Do with It? The Modern Family and Its Importance for Protestant Economic History

2.1 Introduction

Several alternative explanations have been offered for the relative economic prosperity of Protestant communities. Max Weber's thesis about the role of Protestant values in the emergence of modern capitalism has, despite its controversies, become one of the best-known and most influential ideas ever advanced in social science.[1] Others such as Becker and Woessmann (2009) attribute the source of Protestant economic prosperity to higher literacy and superior human capital formation originating from Luther's advocacy of universal schooling and self-sufficient study of the Bible. Dittmar and Meisenzahl (2016), on the other hand, emphasize the role of public good provision supported by Reformation laws for German city growth and skill formation.

Not only are these theories framed in the empirical literature as being mutually exclusive, numerous studies outright dispute the existence of specific economic benefits associated with Protestantism. Importantly, Cantoni (2014) analyzes German city growth in the 1300-1900 period and finds absolutely no Protestant effect. Most studies focusing on the US draw the same conclusion: no gaps between Catholics and Protestants are observed in relation to social status, intra- and intergenerational mobility, educational attainment or earnings (Bouma, 1973; Winter, 1974; Tomes, 1984), even though differences in economic and social attitudes may persist

[1] An ocean of work beginning with Sombart (1915) and including Tawney (1926), Robertson (1933) as well as Samuelsson (1961) has contested virtually all aspects of Weber's thesis, from his theological generalizations and historical claims to his idealistic outlook and causal argumentation (see Giddens, 1992, for reference). The "Protestant ethic" nevertheless has remained an article of faith in both social sciences and common knowledge, and continues to inspire new research in a multitude of fields.

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(Lenski, 1963).[2] Cross-country evidence is no less ambiguous: While the institutional development of industrial capitalism shows virtually no correlation with religion in 19th century Europe (Delacroix and Nielsen, 2001), historical GDP estimates based on Maddison (1982, 2006), suggest a positive statistical relationship between Protestantism and economic growth (Glaeser and Glendon, 1998; Becker and Woessmann, 2009).[3]

This paper proposes a new explanation of Protestant economic progressiveness that is broad and generic enough to accommodate many of the aforementioned findings. In particular, by recognizing marriage as the most visible and influential institutional change associated with Reformation, I argue that the main source of Protestant progressiveness lies not with economics but rather with the family. More specifically, I claim that the insistence of early Reformers, Calvin in particular, that spouses had a religious duty to love one another, rationalize domestic life, and educate children for the glory of God was instrumental in the emergence of the child-centered modern family, which in turn initiated the fertility decline and the economic take-off in the 19th century. Importantly, this theory has the added merit of highlighting previously overlooked but economically relevant differences between Protestant denominations, given Luther's and his followers' entertained a less instrumental and more down-to-earth conception of the family than puritan Calvinists.

The empirical analysis in the paper is based on a new hand-collected township-level dataset from historical Hungary, the only European country where a rich blend of Catholic and various Protestant denominations lived in a mixed inter-religious arrangement. By taking advantage of the geographical proximity of townships with different religious backgrounds for identification purposes, OLS regressions reveal that, in 1910, Calvinist townships were 10-20% richer on average than their Catholic or Lutheran neighbors, even after differences in literacy and a wide range of economic factors are accounted for. This divergence instead is attributed to observed differences in marriage patterns, household size and fertility rates. Specifically, Calvinist places were characterized by a higher share of non-single, divorced or widowed individuals in the adult population, smaller households, and lower rates of fertility and natural increase. The magnitude of these differences is huge: statistically, they constitute up to one full standard deviation of the respective variables, while representing several decades of development advantage in the historical sense. Moreover, these differences are also observed in the census of 1784-1787, suggesting that my results are indeed driven by religious and psychological considerations, rather than potentially endogenous early undertaking of the demographic transition in more prosperous places.

[2]It has to be noted that Goldin and Katz (2000) observes higher earnings among Protestants in 1915 Iowa.

[3]Similar conclusions may be drawn from comparing the growth rates of former Spanish and French colonies steeped in the Catholic tradition with those of former British colonies (Grier, 1997).

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To explain how exogenous variation in fertility translates into growth differentials, I develop a simple theoretical model of fertility choice along the lines of the unified growth theory. This model implies that lower preference for children (or higher education costs associated with them) leads to higher steady-state per capita income in economies characterized by a fixed factor of production such as land. Moreover, these predictions of the model carry over to cases when different ownership structures and bequest arrangements are considered. The model's main predictions are tested on data from agrarian Hungary of the late 19th century, which confirms the less fragmented and more efficient use of cropland by Calvinists' relative to other confessional groups.

The remainder of the paper is structured as follows. In Section 2.2, I present new evidence of Protestant economic prosperity based on unique local-level data from the early 20th century Hungary. Section 2.3 proposes a new hypothesis that places marital love and modern family values, rather than economic concepts such as work ethic or human capital formation, at the centerpiece of Protestant economic development, and discusses Luther's and Calvin's views on the matter. Section 2.4 reviews the available empirical evidence in the form of observed differences in marriage patterns, household size and fertility outcomes along sectarian lines, both before and during the period of the demographic transition, and refutes conventional alternatives explanations. Section 2.5 presents a simple model of fertility choice to understand the main mechanism through which exogenous changes in fertility may become economically relevant in an agrarian society characterized by fixed factors of production. Section 2.6 concludes.

2.2 Protestantism and economic success: New evidence from early 1900s Hungary

2.2.1 The Hungarian setting

Similar to 19th-century Prussia, historical Hungary provides a natural setting to study the relationship between Protestantism and economic prosperity. First, the Hungarian society of the pre-WW period was extremely diverse in both ethnic and religious sense (Menyhert, 2016), even at the lowest administrative levels. In contrast to 19th century Prussia where Protestant and Catholic areas were more or less geographically divided, religious diversity in Hungary makes it possible to focus on religious differences within small geographical areas and correctly identify any potential Protestant effect as distinct from other cultural, institutional or geographical factors.

Second, historical Hungary was unique in the sense that both traditional branches of Protes-

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tantism, Lutheranism and Calvinism, were simultaneously present in high numbers. The distinction between these two traditions in the current context is so important that one may question the validity of empirical tests of the Weberian hypothesis, as performed by Becker and Woessmann (2009) or Cantoni (2014), in the overwhelmingly Lutheran German lands.[4] This is because, despite their revolutionary stance against the reigning religious traditions and practices of Catholicism, Luther and his followers remained largely traditionalists as far as the economic consequences of their religious teachings are concerned, and retained Catholics' deep-seated hostility towards entrepreneurship, usury and wealth creation. Calvinists, on the other hand, by making many core Lutheran concepts (such as predestination and the unknowability of God's will) more prominent in their worldview, developed a more secular, opportunistic and pragmatic approach to economic activity (Nelson, 1969).[5] This paper not only provides empirical evidence that economic prosperity differed across the two branches of Protestantism, it also shows that, however important their differences in entrepreneurial spirit may have been, the economic consequences of their differing attitudes to marriage and the family were more salient.

Finally, the depth and richness of available historical data for Hungary at the local level makes sound empirical analysis possible in an age where religiosity was far more prevalent and had a much bigger societal impact.[6] Moreover, the combination of societal stability, institutional persistence and steady economic progress makes identification of causal relationships much easier.

Origins and basic character of Protestantism in Hungary

Before turning to the empirical analysis, I briefly review the historical origin and basic character of Hungarian Protestantism and assess the extent to which the present setting is comparable to that of the German lands. Concerning theological matters and religious beliefs, Protestantism in Hungary was quite similar as in Germany: the personal flavor and interpretation that characterized the teachings of Protestant missionaries and innovators in Hungary at the onset of the Reformation in the 16th century quickly gave way to fairly strict adherence to the doctrinal interpretation of Lutheran and Calvinist positions (Bucsay, 1985). Differences in popular

[4]Germany generally did not accept Calvinism, except in areas of Westphalia and northwestern Rhineland where Calvinist refugees from the Netherlands had settled. Elsewhere, the first prince of the Empire to accept Calvinism was Elector Frederick III of the Palatinate (1559-1576) whose University of Heidelberg became the foremost center of Calvinism. Other locations where Calvinism took root were in Nassau, Bremen and Anhalt. See Holborn (1959) for further discussion.

[5]Importantly, this distinction was acknowledged by Weber himself: while he devotes the bulk of his analysis to the Calvinist conception of Protestantism, he completely ignores Lutheranism when discussing the ascetic movements that promoted the advent of capitalistic enterprise in his understanding.

[6]While irreligion was virtually and officially non-existent in early 20th-century Hungary, the non-reporting of religious affiliation (either through non-response or non-affiliation) reached close to 50% in the 2011 census.

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religiosity may have been more recognizable: Protestant conduct books and personal accounts from 17th-century Hungary signal a more pietistic and contemplative religious character that placed less emphasis on activity and industriousness of the Dutch Calvinists or German Lutherans, and may also point to a lower intensity of religiosity (Molnar, 1994). Even more stark was the contrast in ecclesiastic matters: the Lutheran idea of the "territorial church" that combined religious and political authority, and came to dominate Germany never took hold in Hungary, and the autonomy of Protestant churches with respect to secular rulers subsisted throughout history (Holborn, 1959; Bucsay, 1985).

Even more important is the reversed socio-economic role of Protestantism in 19th-century Hungary: while the majority of the population were Protestants in Germany along with the political and economic elites, the Roman Catholic Church was clearly dominant in all spheres in the Austro-Hungarian alliance. This raises questions not only whether and how minority status may affect social and economic behavior, but also about the political economy of religious choice more generally.[7] In particular, this paper argues that differences in religious affiliation between townships within small geographical units can be considered as the result of a natural experiment based on a set of historical accidents.[8] However, it may also be true that religious choice reflected strategic considerations regarding specific socio-economic outcomes or political attitudes.[9] Assessing the relevance of such endogeneity concerns is particularly hard given the lack of systematic historical evidence on the evolution of religious affiliation at the local level, the complexity and longevity of associated political, religious and military struggles, as well as the large degree of autonomy popular religiosity enjoyed with respect to these latter.[10]

[7]In 1908 Prussia, the 30% Catholic population paid less than a sixth of total income tax paid in 1908 and made up only 25%, 14% and 12% of university students, regional government officials and academic lecturers, respectively (Blackbourn, 1980). In Hungary, Protestants made up around 22% of total population and were represented more or less accordingly in the most important socio-political domains such as legislation or education (Kollega Tarsoly, 2000; Karady, 1997). Their relative disadvantage against Catholics resulted mostly from the non-representation of other religious groups (e.g. Ortodox Christians or Jews) in these spheres, as well as from their less centralized political participation (Ogbu, 1978).

[8]Just as in the German lands, Reformation took Hungary by storm in the 16th century and converted 90% of the population and most nobilities within a few decades. German-speaking areas persisted in the Lutheran faith but the Hungarian ethnic majority quickly switched to the more rudimentary Calvinist persuasion, especially in the Ottoman-occupied central parts of the country. However, as the political disarray of the 16th century gradually subsided and the Habsburg domination over the Hungarian territories strengthened, a vigorous re-Catholization process began that, through both political repression and overt persecution, succeeded in reclaiming the majority of the country by the end of the 17th century. Subsequent Protestant insurrections - advocating religious tolerance mixed political demands for territorial and legal autonomy within the Empire - proved vital in gaining enough time for Protestantism to subsist until the general climate of opinion changed for the better during the 18th century. See Bucsay (1985) for further discussion.

[9]In fact, Molnar (1994) and Brandt (1998) both argue that the socio-economic consequences of Hungarian Protestantism were evident in political modernization and the development of nationalism.

[10]In contrast to the German lands, religious struggles had no clear starting and points and lasted in various forms well until the 18th century. Moreover, the German principle of "*cuius regio, eius religio*", accepted in the 1555 Augsburg Settlement and granting landlords the freedom of determining the religion of their subjects, was only sporadically implemented in Hungary. This was clearly instrumental in preserving Hungarian Protestantism during the vigorous Counter-Reformation of the Catholic Church that fully eliminated it in all other parts of the Habsburg Empire.

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What I will nevertheless be able to show, at every stage of the analysis, is that observed differences in socio-economic outcomes across religions were unlikely to be motivated by economic or class-based sorting.

2.2.2 Main empirical analysis

The empirical study in the paper concerns historical Hungary, a constituent of the Austro-Hungarian Monarchy, at the turn of the 20th century. The main analysis is based on a new comprehensive dataset of Hungarian townships I hand-collected and compiled from official statistical sources of various kinds. Importantly, these concern the population census of 1910 that contains information on size, literacy, marital status, age distribution, ethnic and religious profile as well as labour market characteristics of the population by township. In addition, I also used occasional and periodical thematic publications by the the Hungarian Statistical Office to account for demographic patterns, natural and infrastructural endowments, geographical properties, budgetary situation of townships.[11] Among the roughly 15000 Hungarian townships, I systematically selected all that had a population of at least 2000 at the time of the earliest census in 1869.[12] The resulting sample contains altogether 1689 townships in 517 administrative districts in 72 counties, covering more than half of the country's total population.[13]

With a focus on the single cross-section of 1910, most relevant information comes from the coincident census containing data on religious affiliation as well as standard demographic variables such as population size, gender, ethnicity and literacy. In particular, I classified each township according to the religious affiliation of the absolute majority (50% plus at least one person) of the local populace. Since townships are listed by district and county, it was also possible to classify districts and counties as mixed if at least two townships of different religious background were sampled from them. The descriptive statistics, reported in Table A1, reveal that almost half of all sampled township were Catholic and close to 20% Protestant, the majority of these being Calvinist. These statistics also show that Catholic townships were more populous, enjoyed more administrative advantages and had better infrastructure than either Lutheran and Calvinist places on average. However, as far as human capital endowment is concerned, Protestant townships had the edge: literacy rates among their populace were con-

[11] Variables and corresponding data sources are detailed in the Appendix.

[12] The choice of using the earliest possible information to select a sample of townships for analysis was motivated by the consideration to focus on historically important places rather than contemporaneous population trends in order to mitigate potential endogeneity and sample selection concerns. To ensure even geographical coverage, in the few such cases where no settlement reached the aforementioned population threshold in a given district, I selected the most populated locality regardless of its actual population. In the few cases (less than 1% of the cases) where townships merged or disintegrated between 1869 and 1910, I consistently treat the totality of (once) separate constituents as a single observation.

[13] Among the sampled localities, 301 belong to the semi-autonomous lands of Croatia for which the preferred measure of economic development is not available and which do not feature in the main analysis as a result.

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	Aggregate statistics				Mean values by religion		
	Mean	SD	Min	Max	Catholic	Lutheran	Calvinist
Sample size							
Observations	1328				629	75	168
Economic outcome variable							
Per capita tax base	8.31	4.88	0.73	65.97	9.17	7.52	8.14
Control variables - Main controls							
Literacy rate	.587	.161	.027	.951	.644	.700	.655
Population size	6678	25069	791	863735	8010	5067	6513
Control variables - Administrative status							
District seat	.239	.426	0	1	.254	.147	.214
County seat	.046	.209	0	1	.049	0	.024
City council	.083	.276	0	1	.087	.053	.065
City legislation	.020	.139	0	1	.027	0	.012
Control variables - Infrastructure							
Railway access	.620	.485	0	1	.669	.587	.643
Waterway access	.088	.284	0	1	.115	.080	.077
Mining	.127	.333	0	1	.126	.120	.018

Table A1: Descriptive statistics for the whole sample in 1910

siderably higher and less volatile.

Table A1 also contains descriptive statistics for the main economic outcome variable, which is based on the per capita measure of direct taxes each township owed to the central government. These duties were centrally determined, uniform for all townships and comprised levies on property and housing, personal income, corporate profits as well as capital gains and interest revenues, among others.[14] As such, it provides a very nuanced and accurate indicator of the totality of economic activity at the local level. Table A1 reveals that residents of Catholic townships paid around 10% more in direct taxes on average than the national average, with those from Lutheran and Calvinist townships paying even less.

Similar descriptives statistics are reported for the mixed districts in Table A1 in the Appendix. Of the 400 townships located in such mixed areas, more than 80% are roughly evenly spread between Catholic or Protestant designations, with more identical observable township profiles across denominations. The map illustration in Figure A1 presents the spatial distribution of sampled townships by religious affiliation in 1910. It shows the dominant position of Roman Catholic church, the scattered Lutheran communities and the Calvinist pockets in the

[14]Direct taxes were an importance source of revenue for the Hungarian government's budget, even though their importance decreased considerably over time: their financing share decreased from 35% to around 23% between 1869 and 1910. In the latter year, 25% of all direct tax revenues totalling 1400 million krones came from land tax, 33% from income tax, 14% from housing tax, 18% from corporate tax and 7% from capital gains and interest tax.

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country, but mainly highlights the high degree of religious mixing both within and between townships.

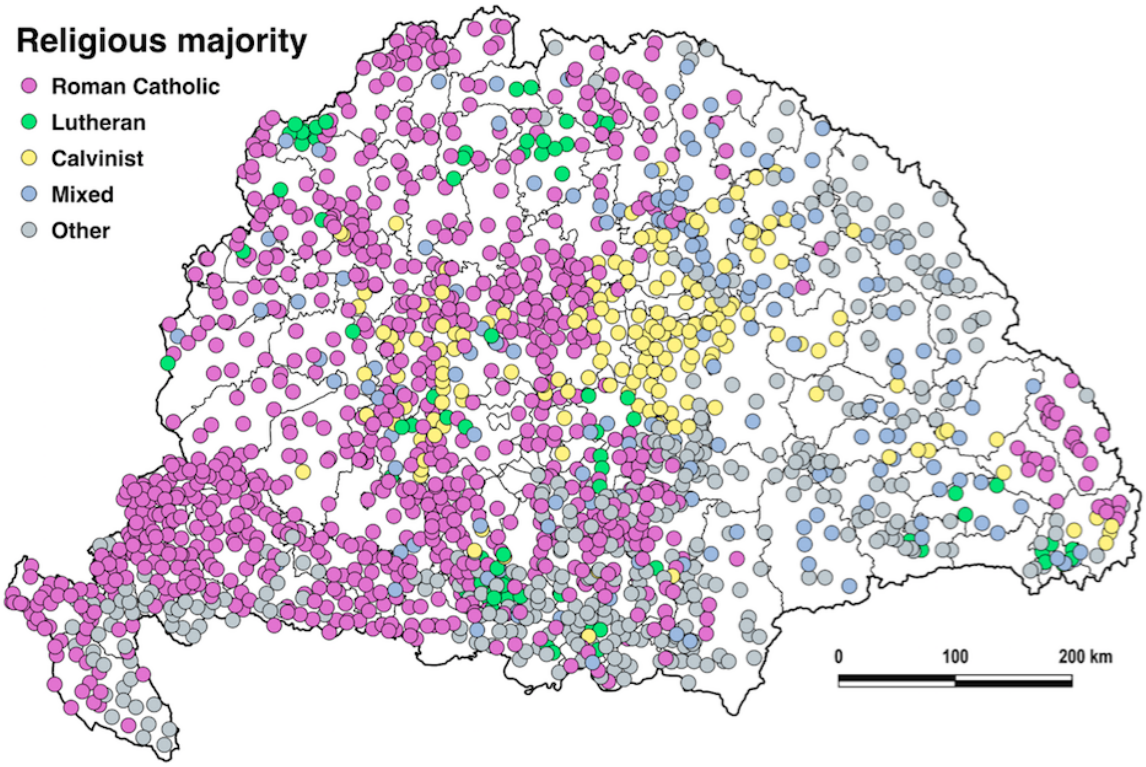

Figure A1: Dominant religious affiliation of sampled Hungarian townships in 1910

Estimation strategy and results

The main empirical strategy consists in estimating the development gap of Protestant townships relative to Catholic in 1910 based on the following baseline specification:

$$y_{id} = \alpha_d + \beta_{LUTHER} D_{id}^{LUTHER} + \beta_{CALVIN} D_{id}^{CALVIN} + X_{id}\delta + \epsilon_{id} \tag{2.1}$$

where the subscript i denotes individual townships in district d, y_{id} represents the measure of per capita economic development, X_{id} is a vector of control variables, α_d is district fixed effect and ϵ_{id} is the idiosyncratic disturbance term. D_{id}^{LUTHER} and D_{id}^{CALVIN} stand for dummy variables that take the value of 1 only if the dominant religious affiliation of a given township is Lutheran or Calvinist, respectively. With this specification, β_{LUTHER} and β_{CALVIN} capture Protestant progressiveness relative to Catholics as the reference group provided that townships dominated by other (non-Protestant and non-Catholic) religions are excluded from the regression sample. The district-level fixed effects α_d are very important in ensuring that the inter-regional differences in economic development are accounted for and only within-district

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	Protestant denominations together		Protestant denominations separately	
	Without controls	With controls	Without controls	With controls
Protestant	**.037**	**-.014**		
	(.039)	**(.045)**		
Lutheran			**-.107***	**-.117***
			(.062)	**(.063)**
Calvinist			**.138*****	**.106****
			(.042)	**(.050)**
Literacy rate		.494		.534
		(.429)		(.434)
Population size (in logs)		-.098*		-.073
		(.053)		(.054)
District seat		.174***		.165***
		(.052)		(0.51)
County seat		.164		.137
		(.329)		(.324)
City council		.382***		.350***
		(.105)		(.106)
City legislation		.350		.338
		(.412)		(.398)
Access to the railway		.017		.006
		(.052)		(.053)
Access to navigable waterway		-.202		-.232
		(.158)		(.149)
Mining activity		-.098		-.111
		(.105)		(.135)
District dummies	Yes	Yes	Yes	Yes
Nr. of observations	327	327	327	327
Nr. of territory dummies	71	71	71	71
R squared	.554	.625	.573	.640

Robust standard errors in parenthesis. One, two and three stars denote significance at 10, 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A2: Protestantism and economic development in 1910

variation are explained by religious differences. Given that β_{LUTHER} and β_{CALVIN} are identified solely from observations in mixed districts, the regression sample is also limited to these areas in order to avoid potentially differentiated covariate structures in non-mixed districts bias the baseline estimates.

Table A2 presents OLS estimates of Equation 2.1 for respective specifications treating Protestant denominations jointly and separately. The first two columns show that as long as Protestant denominational differences are ignored, no systematic differences in economic prosperity are found between Catholic and Protestant places. However, once Lutheran and Calvinist townships are treated as separate, a robust pattern emerges: Lutheran places are estimated to be around 10% than their Catholic neighbors on average, while Calvinist places are found more prosperous by around the same proportion. The estimated 20-25% relative development gap between Lutheran and Calvinist townships is statistically highly significant and persists even if differences in a rich set of observable township characteristics are accounted for.

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These findings are intriguing for at least two reasons. First, they square with the conclusions of Becker and Woessmann (2009) and Cantoni (2014), who find that Protestant places were no more prosperous than Catholic ones in the German lands once differences in literacy are controlled for.[15] Second, the massive performance gap between Protestant denominations has not been pointed out before in the literature. Moreover, given the strong similarities between Lutheran and Calvinist townships regarding most traditional growth drivers (including literacy), it immediately calls for a non-conventional explanation.

Robustness checks

To eliminate the potential bias of the main estimates arising from specific methodological or measurement choices, some robustness checks are warranted. First, I test whether the way townships are classified according to religion influences the results. Table A2 in the Appendix shows how the main estimates change when, instead of the absolute majority concept used in the baseline case, alternative majority rules form the basis for classification. In all these cases, the estimated coefficients for Lutheran and Calvinist townships retain their respective signs and are different in a statistically significant manner. Even more convincingly, the higher majority threshold is used for classification, the larger the wedge between point estimates becomes: in case of religiously more or less homogenous townships, the estimated income gap between Lutheran and Calvinist townships reaches as high as 40%. The same magnitudes are implied when, instead of categorical classification of townships, the share of Lutheran and Calvinist population is used to measure the Protestant effect.

Second, I test whether the qualitative results are affected by alternative fixed effect specifications or focusing exclusively on the sample of Protestant townships. The left panel of Table A3 in the Appendix features results coming from sparser county fixed-effects and no fixed-effects regression specifications (based on an accordingly extended geographical focus), which show that Calvinists were more prosperous than Lutherans in the absolute sense, under all circumstances, their progressiveness only manifests itself in mixed areas despite being poorer than Catholics on average. The right panel of Table A3 provides further evidence that the income gap between Protestant denominations is robust to different controlling structures and does not hinge on the inclusion of Catholic township into the analysis. Calvinists' progressiveness relative to Lutherans is evident in all specifications, even though the small number of mixed districts involving two different Protestant denominations does not really let it show in the baseline case.

The main empirical findings are also robust to considering an alternative dependent variable,

[15]Note, however, that most Protestants in Germany were Lutherans, who actually underperformed Catholics in Hungary. However, in light of the reversed political and economic roles associated with these religions and mentioned earlier, it should not be considered surprising.

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should potential unobserved heterogeneity in tax revenues drive my results. Since immigration generally provides a reliable measure of economic performance at the local level (de Vries, 1984; Bairoch, 1988; Acemoglu et al., 2005), I calculated the net immigration ratio in each township for the 1901-1910 period using the 1910 Population Dynamics Register. On condition that immigration is associated with higher economic prosperity immigration-to-population ratios should provide a reliable measure of economic performance at the local level. While data shows outmigration tendencies (due mainly to urbanization and mass emigration to the US) for all religious backgrounds, Table A4 in the Appendix reveals that net immigration rates in Calvinist townships were consistently higher by around 1 and 5 percentage points than in Catholic and Lutheran places, respectively.

Another potential confounding factor is ethnicity. Given that historical Hungary was equally diverse in ethnolinguistic and religious sense, the potential systemic interplay between these two may be important. Indeed, the contingency table in Table A5a in the Appendix shows that while Catholic and Calvinist townships in the sample are predominantly or almost exclusively Hungarian-speaking, the majority of Lutheran townships are of Slovakian origin. To isolate the potential effect of ethnic affiliation on the results, I also estimated the baseline specification on ethnically homogeneous sub-samples. Table A5b in the Appendix shows that Calvinist places retain their statistically significant economic advantage over their Catholic and Lutheran neighbors even exclusively Hungarian and German speaking environment. Lutheran townships, on the other hand, remain significantly poorer than their Catholic neighbors even in Slovakian-speaking territories.

As a more general exercise, one can in fact show that none of the traditional growth channels explain the economic divergence found across religions. Based on a wide range of statistical sources (see Appendix for detail), I have created a set of indicators that provide a detailed picture of four separate (albeit probably interconnected) areas of economic development: human capital formation, labour market performance, industrialization and financial development. Table A6 in the Appendix explains and reports the mean values for each of these indicators by religion. These suggest that Catholic townships were at a clear advantage relative to Protestant places in virtually all of these dimensions. Yet, Table A7 in the Appendix also shows that including any of these control structures in the regression model does not statistically or qualitatively change the main parameter estimates.

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2.3 Spirit of the modern family

If the relative economic affluence of Calvinist communities is not sufficiently explained by economic factors, where can one hope to find its foundations? A review of the economic literature of religion suggests that the most striking economic effects of religion tend to appear

in relation to certain forms of social behavior (Iannaccone, 1998). In case of the Protestant Reformation, the social change that stands out is marriage. As eminent Harvard scholar Steven Ozment (1980) notes: "No institutional change brought about by the Reformation was more visible, responsive to late medieval pleas for reform, and conducive to new social attitudes than the marriage of Protestant clergy. Nor was there another point in the Protestant program where theology and practice corresponded more successfully."

Along these lines, I propose a new hypothesis that places marital love and family mores, rather than ascetic work ethic or human capital formation, at the centerpiece of Protestant economic progressiveness.[16] Specifically, I argue that the insistence of early Reformers on one's moral obligation to live a married life and the spousal duty to love one another, rationalize the household and educate children for the glory of God was instrumental in the emergence of the child-centered nuclear family, which in turn initiated the demographic transition and temporarily increased per capita income. To better understand the historical context and the Reformed position on these matters, as well as to appreciate the full force of this argument in the face of prevailing economic explanations, a brief introduction about the idealized spirit of the modern family is necessary.

2.3.1 The ideological sources of the modern family: Luther and Calvin

The social world in which Reformation emerged had a decidedly misogynist and anti-marriage character (Ozment, 1983). The medieval doctrine viewed the celibate life as meritorious work for salvation, and identified marriage with indolence and sinful sexual relations.[17] While they were preoccupied mostly with theological and ecclesiastic issues, both Luther and Calvin considered the sphere of marital relationship and family life as fundamental for a Reformed conception of religion and society, and went on advocating important reforms in relation to them.[18]

Luther

As an integral part of his campaign to discredit the Roman Catholic church, Luther vehemently attacked celibacy and anti-marriage sentiments from the outset. His conception of marriage was rooted in his dialectical theory of the "two kingdoms", with the secular one comprising worldly institutions such as the family that God gave to humankind in order to meet their natural needs according to expediency. Luther, in particular, believed that the family was the starting-point of

[16]Interestingly, this hypothesis may well have originated in the mind of Max Weber himself, as his famous "Protestant ethic" thesis admittedly outlined "only one side of the causal chain" (Weber, 1921). For some reason, however, Weber scarcely mentions the emergence of the modern family in this context, despite publishing extensively on family systems in various pre-modern societies (Weber, 1961).

[17]A plethora of proverbs such as "If you find this life going too well, take a wife" or "If you take a wife, you get a devil on your back" collected by Sebastien Franck in the early 16th century and quoted in Ozment (1983) aptly attests to it.

[18]For the review below, I relied mainly on the following sources: Garrett (1998); Troeltsch (1992); Lindberg (2009, 2004); Parsons (2005).

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all social development, and was keen to emancipate it from a maze of canonical restrictions and affirm it as God's good and sensible creation. For him, the family is an expression of the way in which sociological problems arising from the relation between sexes are naturally regulated and solved, with the aim of ordered marital life and procreation, and for the most elementary religious exercise of love between its members.

With this evangelical conception of marriage, Luther turned several corners insofar as its cultural understanding was concerned. First, the penetration of the family with the religious spirit of love made marriage more ethical not only by regulating the relationship between sexes by mutual consideration but also by recognizing the singularity of women.[19] This led Luther to consider marriage as the only institution capable of "affording human being with the strongest and happiest bonds of all earthly ties".[20] Second, sex-life came to be seen as something normal within the limits of a legitimate marriage, and Luther openly promoted marrying early in adulthood to pacify unavoidable and sinful sexual desire. Moreover, marital sex even took on a certain ethical character, as a means to bringing children into the world in the highest of numbers.[21] Third, in line with the social function assigned to the Reformed family, parenting and education gained in importance. Luther was preoccupied with parent-child relations, continually urged parents to protect their offspring, care for their material needs and spiritual well-being, and was among the first to recognize that good parenting requires not only discipline but also adaptation to each child's disposition.[22] Luther nevertheless did not think that children belong completely to the parents, and argued that scholarly education should take place mainly within public schools (Ozment, 1983).

Calvin

Whereas Luther's teachings started a crucial reorientation in cultural patterns towards marriage, Calvin and his faithful provided the emotional foundations for the emergence of the modern nuclear family. The salient theme which differentiated Calvin' s perspective on familial matters relative to Luther was his insistence that marital and familial relations, just as the entire human

[19]Luther could not imagine life without women: ÒThe home, cities, economic life and government would virtually disappear. Men can't do without women. Even if it were possible for men to beget and bear children, they still couldn't do without womenÓ (LW 54: 161).

[20]Luther nevertheless retained many of the typical presuppositions of his peasant, patriarchal background, and took the masculine domination of the family for granted, both in the moral and legal sense. For example, he interpreted the physical superiority of man as a sign of God and expected the patriarchal house-father to represents the law within the household.

[21]As far as the ability to support a family is concerned, Luther emphasized the role of Providence against misgivings about economic difficulties.

[22]In an oft-repeated statement, Luther declared that "there is no power on earth that is nobler or greater than that of parents". Importantly, he repeatedly cautioned against the wide-spread contemporary practice of parents forcing their children into marriages against their will and regarding marriage settlements as essentially economic transactions.

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existence, constituted an occasion for the glorification of God.[23] He maintained that, instead of being places to fulfill one's basic humanity (as Luther suggested), the family should be a "little church of Christ" that strives to bring society into harmony with God's will.

A central character of the godly Calvinist family was order.[24] Instead of appreciating the relative value of marriage in restraining concupiscence, Calvin held that marriage should be strictly regulated by the rational view of its service to the common good.[25] This rationality, however, did not mean that Calvinist marital life was devoid of sentiment or affection: the realization that all individuals are equally reliant on God's grace compelled Calvin to consider marriage as characterized by mutual submission, indebtedness and sacrifice.[26] For true companionship between husband and wife to develop, two other Calvinist notions were equally important. The first of these concerns eschewing the Catholic idea of sacred space and arguing for the omnipresence of God. The home of the Calvinist family should consequently become a "sanctuary" where many pious rites take place that mirror the activities in actual places of worship.[27] The second notion concerns the moral purity of the household, urging the Reformed faithful to stay at home and avoid the spiritual pollution of the outer world as much as possible. This greatly contributed to the emotional nucleation and psychological isolation of the Calvinist family from its social environment.

A further important distinction that follows from Calvin's teleological understanding of marriage concern his ideas about parenting and education. His vision for the home to complement the church in its mission of passing on the faith requires that parents instruct and educate their children themselves. Rather than considering every child as a gift of God as Luther emphasized, Calvin maintains that childbirth is welcome only on condition that parents take responsibility for the child and administer good religious instruction to her. The great importance that Calvin and his followers placed on personal conversion and the perfectibility of the individual encouraged women to have fewer children of "greater spiritual quality" (Goodson,

[23]The relevant ideological sources of Calvinist teachings relative to family life derived from Calvin's ([1559] 1960) Institutes as well as from much of his sermonic literature, Biblical commentaries, and theological essays (see, especially, Calvin 1948; 1954; 1965)

[24]Calvin associated order with the very nature of God, and frequently referenced Paul's admonition to the Corinthians that "all things should be done decently and in order". Stable social life thus begins with ordered Christian homes, organized hierarchically under the near-complete authority of the father.

[25]Natural instincts and sexual pleasures, in this respect, were to be treated like other kinds of pleasures, in subordination to the greater glory of God.

[26]Given this divine character of marriage, it is therefore obvious for Calvin that "whoever considers seriously the design of marriage cannot but love his wife. The co-existence of such views with the primacy of the father in the familial hierarchy have given ground to extremely diverse and opposing scholarly accounts as regards Calvin's position with respect to women, gender equality and the marital relationship. For further discussion, see Potter (1986); Parsons (2005); Plank (2013).

[27]These mostly concerned orchestrated daily routines including domestic prayers, the singing of Psalms, Bible reading as well as thanksgivings and occasional sermons, with the father adopting the pastor's role. Somewhat earlier, Luther also referred to fathers as "bishops" and "priests" and his emphasized the importance of domestic piety. See Lebrun (1993) for further details.

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1997). While the idea of birth control and family planning was equally abhorrent for all early Reformers, the greater devotional and individualistic needs of Calvinist families often resulted in childbirth being delayed or spaced out.[28]

2.3.2 The social practice of Protestant marriage and family

The family ideal of Luther and Calvin was clearly and consciously a very high one, far removed from the actuality of everyday life. It may therefore be expected that their practical societal consequences were as indirect and muted as the materialization of particular theological ideas in general (Goldscheider, 1971; McQuillan, 2004).[29] Yet, there is ample historical evidence suggesting that Protestant communities indeed served as social carriers for introducing and institutionalizing modern patterns of marriage and family life, long before changes in materialistic and technological foundations associated with the industrial revolution took place.

Three different far-reaching societal aspects of the Reformed marriage and family are worth considering. First, by proclaiming marriage a worldly thing, the Protestant Reformation set off a wave of legal changes concerning that the recording and regulation of marriages became a function of the state. Indeed, newly converted Protestant areas of German and Swiss lands dissolved monasteries and nunneries, simplified marriage laws and set up marriage courts as early as the 1520s (Ozment, 1983).[30] Importantly, the increased domestic legislation of the Reformation also made divorce possible for the first time in centuries, and extended the valid grounds for divorce. The practical relevance of this was nevertheless very limited, given the powerful internal constraints as well as external social and economic forces made a full divorce virtually impossible.[31] Even though the divorce rate remained well below 1% until the 20th century in all of Europe, it was considerably higher among Protestants than Catholics in the late 19th century for which official statistics are available (US Bureau of the Census, 1909).[32]

[28]Luther argues that practicing birth control indicts an "unbelief by distrusting God's goodness", while Calvin calls the voluntary refraining from insemination or intercourse a "monstrous thing" (Calvin, 1948). Their varied arguments against birth control included that it wounds the image of God, rejects his blessing, reduces the number of the elect, and compromises one's chance to correct for one's faults (Schnucker, 1975).

[29]For example, Strauss (1978) notes the apparent widespread ignorance of the basic Reformed theses among ordinary Germans even in the 17th century.

[30]Discipline records from French Huguenot Churches from the 16-17th century attest to the consternation some of these reforms caused among the faithful (Plank, 2013).

[31]Beyond the generally accepted grounds of adultery and desertion, the newly instituted Reformed grounds for divorce began to include impotence, incapacitating illness as well as grave incompatibility, among others. However, actual divorce was extremely rare: for example, during the first two years of its existence (1542-1544), the Consistory of Geneva heard only three requests for divorce (all filed by men) and approved of only one of those (Watt, 1993; Kingdon, 1995).

[32]International statistics on marriage and divorce presented by the US Bureau of the Census (1909) show that divorce was much more frequent among Protestants in 1900 Hungary (3.5 times), 1900 Austria (2.25 times), 1880 Poland (2 times). Similar patterns are observed in late 19th-century Germany: the divorce rate was twice as high in Protestant Prussia as in Catholic Bavaria around 1880, while separation by Protestant couples in 1900 Berlin was more than 3 times as common.

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The second practical consequence of the Reformed ideal concerns the shared responsibility and increased intimacy of Protestant marriages. Joint spousal authority in running Protestant households was observed as soon as the early 16th century, while Puritan communities of 17th-century New England attest to wives' increased influence in both familial and political decision-making as well (Ozment, 1983; Ulrich, 1991). Ample historical evidence shows also that the theological ideal of intimacy and intense marital love was effectively realized in many Protestant households (Garrett, 1998; Morgan, 1958).[33] This domestic spiritual intimacy was partly a response to the elimination, by Protestantism, of many social and psychological supports upon which the community and the individual had previously depended for comfort and existential meaning (Demos, 1971; Stone, 1979). Interestingly, eschewing the traditional notion that women were to be under the headship and control of men, the Reformed ideal had equally strong implications as far as widowhood is concerned: instead of rapid re-marriage, Protestant widows (and widowers in lesser numbers) were encouraged to embrace their virility and demonstrate their equality of virtue and character.[34]

The most salient socio-economic consequence of Reformed family arrangements, however, concerns lower fertility. Its ideological motivations are evident in the particular strategies of family limitation observed by Lutheran pietist women in the Midwestern town of St. Charles, Ill. around 1885: relative to liturgical Catholics, they not only gave fewer births but also delayed and spaced them out by several years (Parkerson and Parkerson, 1988).[35] The economic rationality of having fewer children in the household was likely of importance as well: Caldwell (1976), for example, argues that the emotional self-sufficiency of Protestantism allowed the married to renounce their traditional obligations to the extended kin, become economically more independent and channel investments towards their children.[36] Indeed, there is plenty of evidence that the nuclear family has historically been associated with lower fertility than alternative family systems (Lorimer, 1954; Davis and Blake, 1956; Lesthaeghe, 1980; Caldwell,

[33]Puritan leaders' diaries in American colonies are prime examples of this. John Winthrop, for example, repeatedly expressed his intense worry that perhaps he loved his wife too much, and more than God himself. Similar concerns are voiced by Rev. Edward Taylor's letters: "Conjugal love ought to exceed all other (but)...it must be kept within bounds too. For it must be Subordinate to God's Glory" (quoted in Miller and Johnson, 1963).

[34]Two representative and influential works from early modern England are particularly enlightening in this regard. The conduct book for widowed Christian women by Vives (1524) prescribes chastity as the source of virtue and urges them to keep living as if their husbands are not dead. Placing more emphasis on empowerment, the treatise "The Widdowe Indeed" by William Page (c.1620) discourages remarriage not out of loyalty, but to show discipline and achieve self-control amid true desolation towards the universal goals of order and salvation.

[35]According to Parkerson and Parkerson (1988), the increasing share of Protestants in the US population despite their low fertility during the 19th-century also points to its ideational basis. Specifically, it concerns the pragmatic notion of the "arithmetic of conversion", which made many Protestants recognize that denominational growth could be achieved more efficiently through their conversion efforts rather than the more traditional method of having large families.

[36]Caldwell (1976) holds that the economic rationality of high or low fertility depends on the direction and magnitude of intergenerational wealth flows. These went from younger to older generations in all traditional societies, and their reversal could occur only after the family has become nucleated both emotionally and economically. Kagitcibasi (1996) also argues that a decrease in emotional interdependencies was crucial for families to achieve material independence, which reduced children's economic value to the household and led to lower fertility.

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1982; Folbre, 1983; Mason, 2001).[37] While differences in family nucleation between Catholics and Protestants have not been extensively studied, the relatively low birth rate of Protestants has been observed since the 19th century for various historical and geographical settings (Beaujon, 1888; Galloway et al., 1994; Brown and Guinnane, 2002). Importantly, research also shows that Catholic households not only give birth to a higher number of children, but also desire and expect themselves to do so (Knodel, 1974; Bouvier and Rao, 1975; van Poppel and Derosas, 2006).[38]

2.4 The modern family and its demographic consequences in Hungary

In this section, I start with presenting the first systematic evidence of substantial differences in marriage and family patterns and its demographic consequences between confessional groups at the township level in historical Hungary. Later, I show that these differences have an ideational basis and are not explained by differences in material conditions.

2.4.1 Marriage patterns and its demographic consequences

Based on data from the 1910 Hungarian census that reports the age distribution, marital status and household conditions by township, descriptive statistics of marriage and family patterns for mixed-district townships are presented in Table A8 of the Appendix. In particular, Panel A shows that the relative share of married adults (aged 15+) is 1-2 percentage points higher in Protestant townships. These places also had a roughly 10% higher share of widows relative to Catholics, with Calvinist communities displaying a markedly higher divorce rate as well. Differences are even more substantial for average household size as calculated by the number adults per dwelling: the respective figures of 5.42 and 4.88 for Lutherans and Calvinists are 20-30 percent lower than the corresponding value for Catholics. The cross-sectional distribution of these statistics by religion is shown on the scatterplots of Figure A2 in the Appendix, which verify that confessional differences in marriage patterns are indeed driven by differences in central tendency rather than outliers.

[37] Most of the referenced scholars agree that the main reason is the reduced economic and social value of children in nuclear families, relative to extended or lineage-based family arrangements. While some micro-demographic studies in developing countries find no relationship between family type and fertility (Driver, 1963; Burch and Gendell, 1971; Nag, 1975), the ones conducted in contemporary developed societies suggest that kin orientation and the availability of parental help does change fertility preferences and increase the chances of motherhood (Del Boca, 2002; Kuziemko, 2006; Mathews and Sear, 2013).

[38] Philipov and Berghammer (2007), on the other hand, find that it is religiosity and the attendance of religious service in particular, rather than religious denomination, that correlates with higher fertility ideals and expectations.

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	Share of singles	Share of divorced	Share of widowed	Household size
Lutheran	**-.387*** **	**.143**	**.327** **	**-.207**
	(.106)	**(.102)**	**(.147)**	**(.141)**
Calvinist	**-.368*** **	**.895*** **	**.640*** **	**-.528*** **
	(.145)	**(.173)**	**(.118)**	**(.105)**
Control variables	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes
Nr. of observations	326	326	326	326
R squared	.692	.579	.614	.537
Wald-test ($H_0 : \beta_{Luther} = \beta_{Calvin}$)	.02	19.12***	2.96*	3.55*

Robust standard errors in parenthesis. One, two and three stars denote significance at 10, 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran or Calvinist townships located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. All dependent variables are standardized, so parameter estimates represent standard deviations. The adult population considered for calculating marital status shares represent all local residents aged 15 or more.

Table A3: Confessional differences and marriage patterns

Standardizing these township-level observations across the whole sample and regressing them on the baseline right-hand side specification of Equation 2.1 and the contemporaneous level of income yields the estimates presented in Table A3. These confirm statistically highly significant differences in marriage patterns by religion at the local level, even in the presence of township controls. In line with Reformed marital ideal, Protestant communities are found to have a smaller share of singles and higher share of divorced and widowed adult population than among Catholics. For Calvinists, in particular, the estimated within-district differences are no smaller in magnitude than the aggregate degree of divergence shown in Table A8, which suggests that confessional differences were also strong predictors and likely drivers of the vast regional disparities that characterized early 20th-century Hungary in this regard.[39] Moreover, the absolute differences in marriage shares associated with the estimated 0.4-0.9 standard deviation Protestant roughly correspond to those observed in inter-religious German communities of Oppenheim and in Alsace some centuries earlier (Zschunke, 1984; McQuillan, 1999).[40] Importantly, the results in Table A3 not only show confessional differences in marriage behaviour and choices, but also highlight the qualitative differences between Catholic and Protestant marriages themselves. Indeed, to my best knowledge, the significant confessional differences in household size is is the first systematic empirical demonstration of the e observed differences in household size (measured by the number of adults per household) show the substantial advantage Protestant, and in particular Calvinist, communities achieved in terms of the emotional and economic nucleation of the family.

[39]For example, among women aged 15-49, average age at marriage ranged below 20 to above 25, while the share of married varied from below 50% to above 75% across jurisdictions (Harrach, 2012).

[40]Zschunke (1984) finds that the total fertility rate in 18th-century Augsburg was 11 in Catholic families and 9 in Protestant ones. McQuillan (1999) finds that the mean age of Lutherans at first marriage was roughly 2 years lower than that of Catholics in Alsatian villages throughout the 1750-1870 period. On the other hand, Francois (1991) finds no systematic differences in Catholic and Protestant fertility in 17th-century Augsburg, despite an "invisible frontier" separating confessional groups in most socio-economic dimensions.

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	Population dynamics			Population ageing	
	Birth rate	Death rate	Natural increase	Youth share	Elderly share
Lutheran	**-.089**	**-.227**	**.093**	**-.015**	**.173**
	(.124)	**(.160)**	**(.147)**	**(.130)**	**(.132)**
Calvinist	**-.648*** **	**-.285***	**-.617*** **	**-.428*** **	**.794*** **
	(.108)	**(.155)**	**(.124)**	**(.127)**	**(.138)**
Control variables	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes
Nr. of observations	327	327	327	326	326
R squared	.688	.502	.610	.663	.608
Wald-test ($H_0 : \beta_{Luther} = \beta_{Calvin}$)	12.67***	.09	15.97***	6.64**	12.18***

Robust standard errors in parenthesis. One, two and three stars denote significance at 10, 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A4: The association between Protestantism and demographic transition and population aging

As the most immediate and consequence of divergent marriage and family patterns, differences in fertility, population dynamics and ageing are investigated next. Table A8 in the Appendix presents descriptive statistics by religion based on the 1910 Population Dynamics Register that contains township-level information on birth and death rates as well as the rate of natural increase. Aggregate rates of 37 births and 25 deaths per 1000 persons observed in the relevant mixed-district sample are considerably higher than the corresponding figures for Western Europe around the same period.[41] Confessional differences were substantial: the birth rate of 38 in Catholic townships was considerably higher than the rates of 34 and 36 in Calvinist and Lutheran places, with similar albeit less pronounced divergence characterizing mortality (a Protestant rate of 24.6 relative to the Catholic rate of 26). What is truly remarkable is the combined effect of these on population dynamics: with the relative differences in birth and death rates largely offset between Lutherans and Catholics, Calvinist townships experienced a 30% lower rate of natural population increase. Moreover, as a direct consequence of lower fertility and mortality, the age profile of Calvinist communities were also distorted: the relative share of adults (aged 15+) was 2 percentage points higher than elsewhere, with around half of this difference concentrated among the elderly (aged 60+). In Figure A3 in the Appendix, the relevant cross-sectional distributions by religion reveal that these differences are indeed symptomatic.

Descriptive evidence is corroborated at the local level by regression analysis involving the standardized values of demographic indicators as the dependent variable. Using the standard

[41] Around 1900, crude birth rates per 1000 persons were roughly 30 in Germany, Italy and the United States, around 25 in England, and as low as 20 in France. As far as mortality is concerned, the respective rate was 14 in England, 16 in Germany, 18 in France and 20 in Italy. See Guinnane (2011) and Mitchell (1980) for further references.

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specification with township and geographical controls, Table A4 shows that fertility in Calvinist places was more than .6 standard deviation lower on average than in similar Catholic or Lutheran communities.[42] The estimated fertility gap in absolute terms (4.3 births less for 1000 persons) is so large that it represents several decades of development advantage when in the historical context of the European demographic transition (Guinnane, 2011). Indeed, the totality of these findings are not inconsistent with the notion of a premature completion of the fertility transition by Calvinists: the limited (albeit statistically insignificant) reduction in mortality and the substantially diminished rate of natural increase observed among Reformed communities are in line with the implications of the established formal theory (Notenstein, 1945). As a direct result of these tendencies, Calvinist townships were experiencing considerable population ageing, evidenced by a .4 standard deviation lower youth (15-) share and a .8 standard deviation higher elderly (60+) share.

2.4.2 Ideological vs. materialistic causes of the modern family

To identify theological ideals as the main driver of observed differences in family patterns and fertility choices across religions in early 20th-century Hungary, one needs to understand better their historical origin and persistence. In particular, this requires challenging the conventional wisdom and showing that the advances Calvinists made in modernizing their families and childbearing were not produced by changes in materialistic foundations. I employ three different strategies for this purpose.

First, I take issue with social historians' claim that mass urbanization in the wake of the Industrial Revolution was the principal factor in uprooting deep-seated traditional family mores (Aries, 1962; Shorter, 1977; Goody, 1983). To test the validity of this hypothesis for historical Hungary, I re-estimated the main demography regressions on the sub-sample of townships with below-median population size, population growth and level of industrialization. The resulting estimates are presented in Table A9 of the Appendix and show, with somewhat less statistical precision, the qualitative similarity of marriage and fertility patterns in all types of townships. While confessional differences in marital shares and household size are more apparent in larger and more developed places, the fertility advantage of Calvinists seems to be largest among the least industrialized townships. This is consistent with the findings by Demeny (1968) who argued that fertility decline in Hungary originated among the peasantry, in the absence of fundamental changes to the underlying socio-economic structure.[43] This points to the extensive

[42] This is consistent with the negative raw correlation between fertility and Protestant population share observed at the regional level for selected Hungarian territories in 1910 using the same statistical source (Pezenhoffer, 1922; Harrach, 2013).

[43] Demeny (1968) notes that fertility around 1880 in regional towns like Pecs or Temesvar was lower than in Budapest, and that the backward province of Krasso-Szoreny completed the fertility transition 20 years earlier than Vienna. In this work, three groups are identified as the leading propellers of fertility decline: Protestant

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and differential use of voluntary birth control by religious groups, and is consistent with the observed use of contraceptive methods as early as the 18th century (Andorka, 1969, 1989).

Second, I show that standard economic explanations for the fertility transition based on improving mortality and changing marginal value of children to the household are equally misplaced in the current context. Since differences in per capita income across townships are accounted for in the main demographic regressions, estimates presented in Table A3 and A4 already pose a serious challenge to the idea that Calvinists' modern family patterns were driven mainly by their economic prosperity. It is nevertheless useful to go further and investigate the most powerful economic arguments in somewhat more detail. Following Guinnane (2011), I first consider the potential role of decreasing mortality as a result of better nutrition, increased public health and superior medication (Notenstein, 1945). Using data on mortality rates at birth, among infants and children from the 1910 Population Dynamic Register shows that improvements in mortality are an unlikely cause of religious differences in fertility. As Columns 1-3 of Table A10 in the Appendix reveal that Calvinists actually had a considerably higher mortality rate at birth than elsewhere, without significant advantages in infant or child mortality, either. Moreover, Columns 4-6 also show that Protestants actually had a lower share of medically treated cases and, if anything, worse access to doctors and pharmacies than Catholics, which suggests that improvements in medicine or sanitation were unlikely drivers of the fertility gap.[44] The second strand of literature emphasizes the changing demand for children, based on the standard substitution effect related to child-bearing and child-rearing costs, as well as a possible trade-off between the quantity and quality of children (**?**). The direct and indirect costs of children are hard to measure, but the labour market participation of household members is generally considered an important determinant of those. However, the equally low participation rate of both Calvinist children and wives in agriculture (Columns 7-8) suggest that the overall cost-benefit balance may not have been very different across denominations.[45]

The ideational basis of Protestant marriage and fertility patterns were most evident if these could be shown to have existed even before the industrial revolution and the demographic transition. For this reason, I collected data on townships' population size, households, marital status and age profile from the first official Hungarian census of 1784-1787. Given the absence of information on the religious affiliation of townships in this work, I relied on historical evidence

Hungarians in western Transdanubia, Catholic Germans in southern Banat, and Greek Orthodox Rumanians in Transylvania.

[44]These results also go against economic theories of fertility that place innovations in and access to contraceptive methods at the root of the fertility decline. See, for example, Michael and Willis (1976) and Bailey (2010).

[45]Alternative explanations based on increased returns to child quality or the emergence of social insurance seem equally inadequate. With less than 10 percent of adults having completed primary school and around 2% of teenagers attending secondary school in 1910 Hungary, child quality considerations likely had very limited aggregate impact (Kollega Tarsoly, 2000). As far as compulsory social insurance is concerned, agricultural workers that made up the bulk of the country's workforce had no access to any kind of government-sponsored mandatory scheme until 1919 (Igazne, 2006).

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	Share of married	Household size	Share of youth	Population increase (1785-1869)
Lutheran	**.439*** **	**-.204**	**-.042**	**-.132**
	(.174)	**(.200)**	**(.204)**	**(.144)**
Calvinist	**-.462*** **	**-.292*** **	**-.489*** **	**-.371*** **
	(.149)	**(.110)**	**(.154)**	**(.102)**
Control variables	Partial	Partial	Partial	Partial
District dummies	Yes	Yes	Yes	Yes
Nr. of observations	286	329	329	329
R squared	.475	.539	.401	.707
$H_0 : \beta_{Luther} = \beta_{Calvin}$	14.96***	.16	3.29*	2.11

Robust standard errors in parenthesis. One, two and three stars denote significance at 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran or Calvinist townships located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. All dependent variables are standardized, so parameter estimates represent standard deviations. The adult population considered for calculating marital status shares represent all local residents aged 15 or more.

Table A5: Demographic patterns by religion around 1785

of highly persistent ethnic and religious composition in a township to assume that the dominant religion was the same as in 1910 (Menyhert, 2016). The resulting estimates are presented in Table A5 and show that, already in the late 18th century, Calvinist families were systematically smaller and less fertile than either Catholic or Lutheran ones. The statistical significance and economic magnitude of these differences are as large as in the 1910 cross-section, and are further accentuated by the observed divergence in population trends across denominations in the post-1785 period.[46] More interesting are the patterns in relation to the marriage rate: in stark contrast to their wedding preferences in the early 1900s, the relative share of married adults in Calvinist communities is found to be much lower than among other religious groups around 1785. Paradoxically, this may equally point to the relative modernity of Calvinist households: as Hajnal (1965) argues in his classic work on European marriage patterns, the relatively late age at marriage and high rate of permanent celibacy characterizing Western European societies reflected the difficulty young people faced in acquiring the means to establish an independent household, a prerequisite for marriage. In particular, to the extent that Calvinist marriage was predicated upon a stronger sense of physical and emotional separation, their lower marriage rate may well reflect the economic hardships of late 18th-century Hungary. This may equally prompted Calvinists to have fewer children as well, while not affecting Catholic and Lutheran households with more lax views and less taxing demands on orderliness.

Taken together, these results support the view that the fertility transition of Calvinists in historical Hungary was influenced primarily by cultural factors rather than economic considerations. As suggested by Cleland and Wilson (1987), the distinction between groups with

[46]Table A5 contains estimates concerning population growth between 1785 and 1869, in an attempt to limit the influence of early 20th-century fertility differences on the parameter estimates as much as possible. However, qualitatively similar results are obtained even if 1880 or 1910 are chosen as the reference point.

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unchanging fertility and those experiencing transition seems not to lie in the changing economic value of children, but in the propensity to translate fertility preferences into appropriate behavior. My findings suggest that Calvinists, with their pre-occupation with ordered households, were more willing and successful at adapting their fecundity to the economic conditions surrounding them.

2.5 Economic implications of the modern family

Are modern family arrangements and lower fertility among Calvinists related to their economic prosperity? If so, through what channels? This section first presents evidence that, in contrast to a series of factors considered in Section 2.2, the birth rate does explain much of the confessional differences in per capita income. It then explores through a stylized model how lower fertility preferences, while potentially endogenous, can have economic consequences in an agrarian society.

2.5.1 Lower fertility as a cause of economic prosperity

I first test whether fertility is statistically related to townships' economic performance and how accounting for the birth rate changes the main parameter estimates. The first two columns of Table A6 show that extending the baseline regression specification to include the birth rate among the regressors qualitatively changes the original OLS estimates presented in Table A2 in Section 2.2. The fertility rate is estimated to be strongly and negatively correlated with the log of per capita income, with each percentage point increase being associated with 6-15 percent decrease depending on the control structure. While this effect is not significantly different from zero once controls are introduced, it is enough to reduce the original estimated income gap for Calvinist places and eliminate its statistical significance. As far as the income position of Lutheran townships relative to Catholic ones are concerned, they are not qualitatively affected.

To account for the potential endogeneity of fertility to economic development, I also explore the strategy of instrumenting fertility with mortality Acemoglu and Johnson (2007). The basic idea behind this approach is that mortality, unlike fertility, cannot be adjusted to prevailing economic conditions. Given that mortality and fertility are positively related across both townships and denominations, this approach certainly has its limitations in the current context. To ensure that these assumptions are compromised as little as possible, I explore using both total mortality and child mortality as instruments. The resulting 2SLS estimates, presented in columns 3-6 of Table A6, are very similar to the corresponding OLS ones in qualitative terms: each percentage point of fertility decline is associated with a (borderline significant) income gain of 14-17 percent, with no statistically significant economic advantages in Calvinist places

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	OLS ESTIMATES		2SLS ESTIMATES			
			Total mortality as IV		Child mortality as IV	
	No controls	With controls	No controls	With controls	No controls	With controls
Lutheran	**-.135****	**-.121***	**-.133****	**-.125****	**-.138****	**-.124****
	(.062)	**(.063)**	**(.054)**	**(.054)**	**(.057)**	**(.055)**
Calvinist	**045**	**.070**	**.052**	**.027**	**.033**	**.037**
	(.053)	**(.051)**	**(.071)**	**(.057)**	**(.057)**	**(.065)**
Birth rate	**-.150****	**-.064**	**-.140**	**-.162***	**-.170**	**-.140**
	(.058)	**(.047)**	**(.099)**	**(.093)**	**(.122)**	**(.118)**
Control variables	No	Yes	No	Yes	No	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes
First stage F statistic			39.13	68.44	29.19	17.93
First stage R squared			.662	.757	.616	.713
First stage partial R squared			.227	.229	.122	.089
Nr. of observations	327	327	327	327	327	327
R squared	.596	.643	.596	.636	.596	.639

Robust standard errors in parenthesis. One and two stars denote significance at 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A6: The reduced-form statistical association between fertility and economic performance

relative to Catholic ones.

These results do not unequivocally identify fertility as the only or even the main source of economic disparity between religions. In particular, the economic backwardness of Lutheran townships is not explained by differences in birth rates. However, understanding the direct economic implications of fertility in an agrarian economy with fixed amount of land can help us pinpoint the actual drivers of religious differences in development.

2.5.2 Outline of a simple model of fertility and economic growth

To better understand the potential mechanism through which lower fertility may lead to higher economic development in an endogenous manner, I present the outlines of a simple model of fertility choice in the spirit of the unified growth theory. This latter describes the endogenous transition of the economy from a Malthusian regime characterized by high fertility, subsistence income and stable production technology to a post-Malthusian, and eventually modern, regime where technological growth and low fertility leads to substantial growth in per capita income (Galor and Weil, 2000; Galor and Moav, 2002). Given the empirical focus of the paper on agricultural Hungary, the canonical model's preoccupation with education and human capital production may be dropped, while retaining other central ideas such as endogenous fertility, population-dependent technological growth and fixed production factor are retained. This is the approach followed by Guttman and Tillman (2015), who manage to explain observed fertil-

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ity patterns in 19th-century France without introducing a quality-quantity trade-off, mortality changes or urbanization. However, while their model highlights the role of land ownership as a source of non-wage income in driving population growth and income trajectories, my main preoccupation will be to interpret their simultaneous development through the prism of different fertility preferences.

Fertility choice

The model consists of overlapping generations that live for two periods. In the first period, everyone is a child and only consumes. In the second period, agents also work and raise a family. Their preferences in this period, as in the standard framework deriving from (Becker, 1960), are over generic consumption c and the number of children n.

For simplicity, assume a Cobb-Douglas utility function of the following form

$$U = \ln [c - c_{min}] + \beta \ln n \tag{2.2}$$

where $\beta > 0$ measures the agent's preference for children relative to own consumption. The level of consumption the matters for utility is net of minimum subsistence level c_{min}, the effect of which is to gradually reduce the preference for children as actual consumption approaches the subsistence level. Utility is maximized subject to two constraints. First, the budget constraint

$$wl + v = c \tag{2.3}$$

implies that agents' consumption equals their wage and non-wage income wl and v where w is the wage rate and l the time allocated to working. The second constraint concerns the use of the (normalized) time endowment:

$$l + \delta n = 1 \tag{2.4}$$

while δ represents the time cost of raising a child.

Maximizing constrained utility with respect to n and solving the resulting first-order condition yields the following expression for the optimal optimal number of children:

$$n^* = \frac{\beta}{(\beta + 1)\delta} \left[1 + \left(\frac{v - c_{min}}{w} \right) \right] \tag{2.5}$$

Comparative statics imply that the number of desired children increases, *ceteris paribus*, as long as 1) the preference for children β increases or the time cost of childbearing δ decreases, 2) the non-wage income relative to the wage rate (v/w) increases, or (3) the wage rate relative to subsistence consumption (w/c_{min}) increases.

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Agricultural production

Agricultural production takes place using land and agents' own labour as inputs to a CES production function that generates constant returns to scale. In line with both theoretical considerations and empirical evidence, technology A is labour-augmenting and land-saving with inelastic substitution between inputs.[47] Formally,

$$y_t = [l_t^\rho + (A_t q_t)^\rho]^{1/\rho} \tag{2.6}$$

where l_t is the supply of labour and q_t is the quantity of land in use. The parameter ρ is negative to ensure that the elasticity of substitution, $1/(1-\rho)$ is less than unity. Technological progress therefore increases the marginal productivity of labour relative to that of land.

Under perfectly competitive factor markets and profit maximization, wages are paid at the marginal revenue product of labor

$$w_t = \frac{\partial y_t}{\partial l_t} = [l_t^\rho + (A_t q_t)^\rho]^{(1/\rho)-1} \, l_t^{\rho-1} \tag{2.7}$$

while the rental price of a piece of land is given by

$$r_t = \frac{\partial y_t}{\partial q_t} = [l_t^\rho + (A_t q_t)^\rho]^{(1/\rho)-1} \, A_t^\rho \, q_t^{\rho-1} \tag{2.8}$$

Endogenous technological growth

As in standard models of the unified growth theory, the technological process is assumed to be driven by new ideas that occur randomly to each individual. In particular, the rate of technological change is assumed to be an increasing, concave function of population size, but also depends on the current level of technology A with decreasing returns. Following (Jones, 2001), the process is formally characterized by

$$a_{t+1} = \frac{A_{t+1} - A_t}{A_T} = \alpha A_t^\theta N_t^\phi \tag{2.9}$$

where $\alpha > 0\,, \theta \in [0,1]$ and $\phi \in [0,1]$.

Theoretical implications

With these ingredients, it is possible to simulate the model economy and see how alternative assumptions about land ownership may induce different evolutionary patterns of fertility, technology and per capita income in places with higher or lower preference for child-bearing

[47] See Acemoglu (2009) for micro-foundations supporting the proposition that technological change will be labour augmenting in the long-run. See also O'Rourke and Williamson (2005) for evidence that this was the case in 19th-century Europe.

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and child-rearing. Two important margins are evident. The first concerns land ownership: if farmers do not own their lands, their only source of income is wage, which make low-fertility groups better off relative to high-fertility ones regardless of the (potentially endogenous) level or rate of technological progress. This is because in such Malthusian setting, all productivity or technology innovations are immediately offset by concomitant changes in fertility. On the other hand, if farmers own the plots they use, their non-wage income increases in response to technological progress: as a result, the substitution will eventually dominate the income effect and decrease their demand for children. The timing of this transition will crucially depend on the efficiency of agricultural production, which is closely related to the distribution of agricultural land across the local populace. In particular, if many farmers are compelled to produce on small, highly parcelled estates due to previous overpopulation or inequality, the Malthusian advantage of low-fertility groups may be sustained for a long period of time.

Empirical test of the model

The main implications of this model for the relationship between fertility and economic development are in line with Calvinists' observed progressiveness in these areas in early 20th-century Hungary. The validity of the proposed framework therefore depends mainly on whether its suggestions for the differential rate of technological progress and the use of agricultural land are consistent with the historical reality. These can be tested using township-level information on land-ownership, production technology and farm size from the 1910 census and the 1895 agricultural statistics. Preliminary analysis of these sources suggest that, in line with the model's implications for a given ownership structure, high-fertility Catholic townships were more technologically advanced, while farmers in low-fertility Calvinist places had larger individual plot sizes and made more efficient use of their land endowment as a community.

2.6 Concluding remarks

In this paper, I carry out an empirical investigation of Protestant economic progressiveness in the historical context. In particular, I take advantage of the unique social landscape of early 20th century Hungary that was characterized by varied Protestant and Catholic populations living in multi- and inter-religious arrangements. Surprisingly, I find that while Lutheran communities are systematically poorer than townships dominated by majoritarian Catholics, Calvinist places are significantly richer than them, even after a large set of township characteristics, including literacy, are accounted for. Given the similarities in economic fundamentals, I turn to differences in the Lutheran and Calvinist conception of marriage and family to explain this divergence. In particular, I argue that Calvin's insistence on spousal duty to love one another, rationalize the household, and educate children for the glory of God was instrumental in the emergence of the child-centered nuclear family and subsequent economic growth.

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This hypothesis is corroborated by extensive empirical evidence that shows Calvinist places to be characterized by more liberal marriage patterns, smaller households and fewer children. Calvinists' lower fertility, in particular, is shown to have been present long before the start of the demographic transition, and can consequently be regarded as the causal factor driving income differences. In the final part of the paper, I develop a small theoretical model that can show how lower exogenous fertility preference can translate into higher per capita income in an agrarian economy constrained by a fixed factor of production. The implications of the model are to be tested against the data, which suggests a more efficient and less crowded use of agricultural land in Calvinist areas.

A few points of interest are worth discussing. First, my findings do by no means suggest that modern family arrangements and its demographic consequences were a main (or even important) driver of economic development in industrializing Hungary around the turn of the 20th century. As evidenced by Figure A1 in the Appendix, Hungarian townships of all religions displayed great cross-sectional variation in economic development, very little of which is explained by religious affiliation. Moreover, the spread of industrialization likely only reduced the economic premium enjoyed by places with lower population size and fertility due to the largely fixed quantity of agricultural land available.

Second, my hypothesis and findings are not inconsistent with the conclusions of similar historical studies focusing on the German lands, such as Becker and Woessmann (2009), Cantoni (2014) or even Weber himself. An important part of the reason being that the Reformation, as a great multi-faceted movement it was, exerted a profound influence on many different aspect of domestic, social and economic life. It is quite plausible, for example, that the individualistic spirit and less hierarchical character of Protestantism were itself responsible for many of the changes that took place in the context of the family. Similarly, the heightened asceticism and rational conduct Weber discusses in the Protestant ethic may have been crucial for managing households and adapting them to the socio-economic realities. Alternatively, higher literacy among Protestants may have been central to the popular appreciation of the subtle theological implications of the Reformers' theses, or even emotionally detaching the family from its social environment, not to mention their direct effect on fertility decisions through increased professionalization (Golde, 1975) or increased returns to child quality (Becker et al., 2010). What nevertheless seems common in these studies as well as mine, is that the economic effects of Protestantism were stronger and more visible in rural areas and among relatively small agrarian communities.

However, my paper do differ from these studies in some important ways. First, it emphasizes the potential importance, or even primacy of specific social behavior, as opposed to economic factors, in shaping Protesant economic outcomes in the historical context. Specif-

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ically, it is the first study to my knowledge that provides empirical evidence concerning the ideational or non-material basis of Protestants' lower fertility. Moreover, it is also the first attempt at identifying lower fertility as not just a by-product but the actual cause of Protestant economic progressiveness.

Finally, my paper highlights several potential areas for further research. One of these is historical by nature and concern our understanding of great transformative events in modern history such as the industrial revolution, the evolution of the nuclear family, the demographic transition as well as the relationship between demographics and economic performance more generally. The other concerns the understanding of the role of the family in. The way Luther studied the Bible provides useful guidance as to how one should proceed: "First, I shake the whole apple tree that the ripest might fall. Then I shake each limb, and when I have shaken each limb, I shake each branch and every twig. Then I look under every leaf."

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2.A Appendix: Figures and Tables

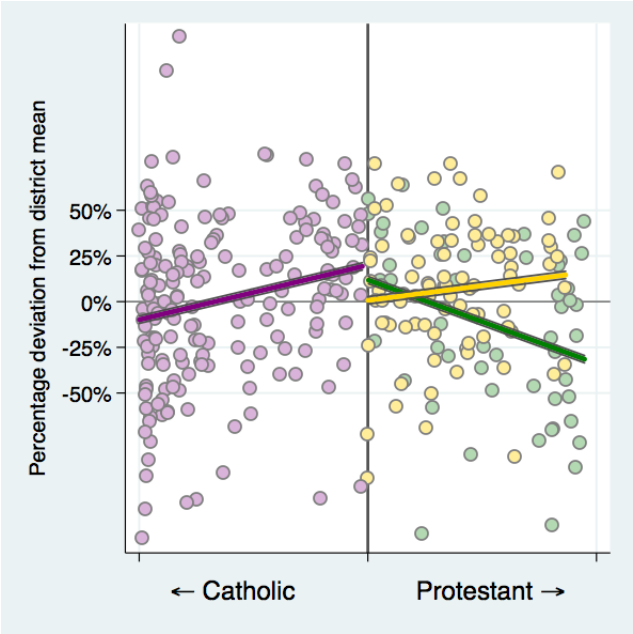

Figure A1: Dispersion of per capita income around the district mean by religious share

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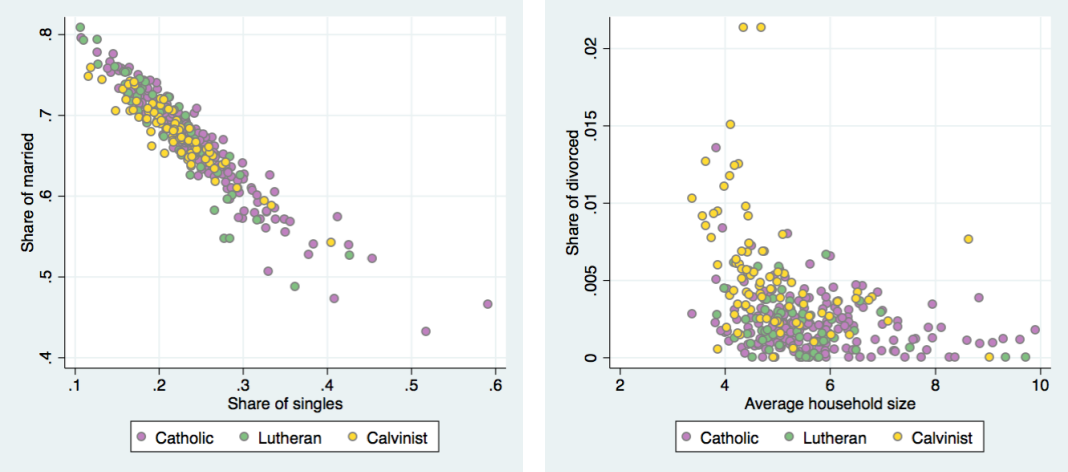

Figure A2: Marriage patterns by religion

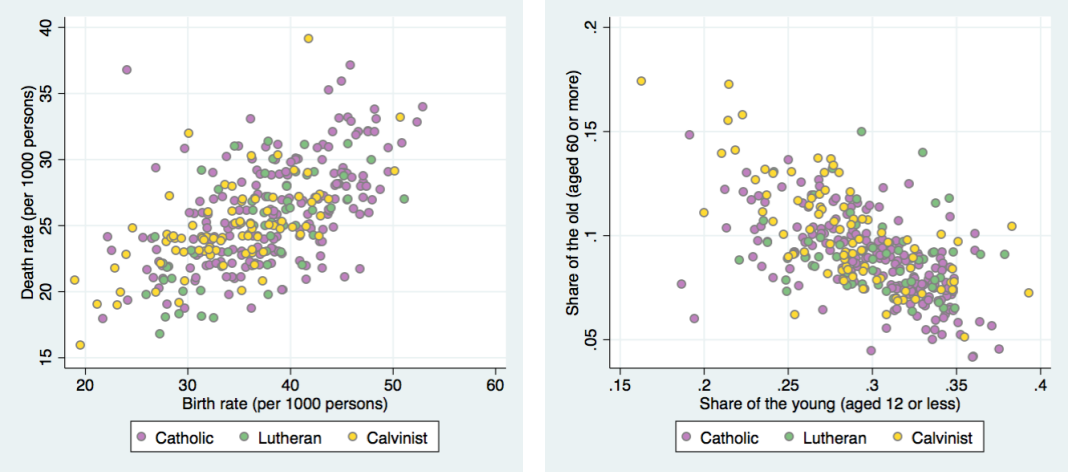

Figure A3: Demographic patterns by religion

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	Aggregate statistics				Mean values by religion		
	Mean	SD	Min	Max	Catholic	Lutheran	Calvinist
Sample size							
Observations	400				189	57	84
Economic outcome variable							
Per capita tax base	9.13	3.83	2.23	34.79	9.09	7.95	9.30
Control variables - Main controls							
Literacy rate	.647	.100	.224	.922	.650	.697	.683
Population size	5844	6972	1115	90153	5682	5795	6776
Control variables - Administrative status							
District seat	.163	.369	0	1	.185	.158	.131
County seat	.023	.148	0	1	.026	0	.024
City council	.055	.228	0	1	.063	.053	.060
City legislation	.013	.111	0	1	.011	0	.012
Control variables - Infrastructure							
Railway access	.633	.483	0	1	.635	.614	.667
Waterway access	.153	.360	0	1	.143	.105	.143
Mining	.060	.238	0	1	.069	.088	.024

Table A1: Descriptive statistics in mixed districts in 1910

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	Through population shares	Through categorical variables			
		Relative majority	Absolute majority	66% super-majority	75% super-majority
Lutheran	**-.171**	**-.140***	**-.117**	**-.145**	**-.278****
	(.096)	**(.059)**	**(.063)**	**(.074)**	**(.091)**
Calvinist	**.282****	**.031**	**.106***	**.259****	**.168**
	(.083)	**(.045)**	**(.050)**	**(.074)**	**(.127)**
Literacy rate	.567	.718	.534	.192	.923
	(.356)	(.398)	(.435)	(.473)	(.796)
Population size (in logs)	-.053	-.073	-.004	.143	
	(.043)	(.048)	(.054)	(.064)	(.132)
District seat	.125*	.143**	.165**	.081	.023
	(.051)	(0.45)	(.051)	(.077)	(.121)
County seat	-.163	.100	.137	.560	
	(.137)	(.190)	(.325)	(.375)	
City council	.323**	.461**	.350**	.349*	-.315
	(.076)	(.101)	(.106)	(.157)	(.401)
City legislation	.864**	.663**	.338		
	(.326)	(.247)	(.398)		
Access to the railway	.049	.047	.006	.073	.059
	(.047)	(.050)	(.053)	(.067)	(.095)
Access to navigable waterway	-.435	-.079	-.232	-.210	-.369
	(.247)	(.134)	(.149)	(.215)	(.277)
Mining activity	-.118	-.092	-.111	.160	.165
	(.111)	(.121)	(.135)	(.187)	(.222)
District dummies	Yes	Yes	Yes	Yes	Yes
Nr. of observations	659	382	327	163	95
R squared	.800	.631	.640	.703	.722

Robust standard errors in parenthesis. One and two stars denote significance at 5 and 1% probability levels, respectively. When religious denominations are captured by their respective population shares, the regression sample is limited to those townships with a joint share of Catholic, Lutheran and Calvinist population exceeds 90% of the local populace. For all other specifications, religious classification is based on the religious affiliation of the specific majority of each township's population that is considered. In these cases, the regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A2: Robustness of results to different criteria for religious classification

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	Catholic & Protestant townships			Only Protestants townships		
	No FEs - entire country	County FEs - mixed counties	District FEs - mixed districts	No FEs - entire country	County FEs - mixed counties	District FEs - mixed districts
Lutheran	**-.246****	**-.215****	**-.117**			
	(.054)	**(.055)**	**(.063)**			
Calvinist	**-.075***	**.022**	**.106***	**.180****	**.190***	**.077**
	(.031)	**(.039)**	**(.050)**	**(.062)**	**(.072)**	**(.094)**
Literacy rate	2.932**	1.811**	.534	2.493**	.163	-2.687
	(.186)	(.235)	(.435)	(.295)	(.543)	(1.377)
Population size (in logs)	.066*	.006	-.073	.087*	.111	.295
	(.027)	(.049)	(.054)	(.036)	(.088)	(.226)
District seat	.077**	.168**	.165**	-.003	-.017	-.139
	(.030)	(.042)	(.051)	(.048)	(.109)	(.158)
County seat	.080	.232*	.137	.067		
	(.065)	(.105)	(.325)	(.109)		
City council	-.030	.146	.350**	.107	-.012	
	(.044)	(.082)	(.106)	(.077)	(.162)	
City legislation	.044	.122	.338	.144		
	(.106)	(.169)	(.398)	(.146)		
Access to the railway	.145**	.083*	.006	.069	-.087	-.364
	(.036)	(.038)	(.053)	(.056)	(.086)	(.255)
Access to navigable waterway	.468**	.074	-.232	.146	.069	-1.162
	(.103)	(.085)	(.149)	(.125)	(.231)	(1.127)
Mining activity	-.189**	-.107	-.111	.043	-.434	
	(.051)	(.061)	(.135)	(.090)	(.152)	
Nr. of observations	861	705	327	240	86	27
R squared	.404	.588	.640	.339	.629	.790

Robust standard errors in parenthesis. One and two stars denote significance at 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative units of the specific hierarchical level (country, county, district) that is considered. All specifications include fixed-effects corresponding to the specific hierarchical level considered and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A3: Robustness of results to alternative model and sample specifications

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	Catholic & Protestant townships			Only Protestants townships		
	No FEs - entire country	County FEs - mixed counties	District FEs - mixed districts	No FEs - entire country	County FEs - mixed counties	District FEs - mixed districts
Lutheran	**-.032****	**-.038****	**-.025**			
	(.008)	**(.010)**	**(.013)**			
Calvinist	**.014***	**.005**	**.018**	**.052****	**.058****	**.058**
	(.006)	**(.009)**	**(.011)**	**(.009)**	**(.017)**	**(.030)**
Literacy rate	.079**	.167**	.127	.080	-.027	.474
	(.031)	(.047)	(.074)	(.054)	(.133)	(.325)
Population size (in logs)	.043**	.044**	.027*	.010	.034	.037
	(.007)	(.011)	(.011)	(.007)	(.017)	(.046)
District seat	.033**	.027**	.018	.028**	.019	.020
	(.008)	(.010)	(.011)	(.010)	(.025)	(.039)
County seat	.062**	.041	.102*	.092*		
	(.021)	(.022)	(.044)	(.039)		
City council	.014	.003	.006	-.010	-.079*	
	(.015)	(.018)	(.024)	(.019)	(.033)	
City legislation	-.049	-.016	-.064	-.008		
	(.026)	(.032)	(.050)	(.031)		
Access to the railway	-.004	.003	.008	.008	.006	.027
	(.006)	(.007)	(.011)	(.009)	(.019)	(.057)
Access to navigable waterway	-.011	-.007	.002	-.007	-.003	.013
	(.010)	(.010)	(.015)	(.013)	(.021)	(.051)
Mining activity	-.001	.002	-.039	.002	-.075	
	(.010)	(.012)	(.033)	(.020)	(.067)	
Nr. of observations	872	715	330	243	86	27
R squared	.253	.400	.534	.275	.398	.487

Robust standard errors in parenthesis. One and two stars denote significance at 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the ratio of net immigration to population size of each township, where net immigration is calculated as the difference between the actual population growth in each township between 1900 and 1910 and the natural increase of the population over the same period.

Table A4: Robustness of results to using the immigration ratio as the dependent variable

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		RELIGIOUS MAJORITY			
		Catholic	Lutheran	Calvinist	Other
ETHNIC MAJORITY	Hungarian	119 (362)	8 (12)	81 (165)	19 (103)
	German	43 (128)	15 (25)	2 (2)	2 (8)
	Slovakian	14 (87)	32 (35)		2 (7)
	Romanian				18 (204)
	Ruthenian				2 (25)
	Croatian	1 (7)			
	Serbian				23 (58)
	Other	1 (10)			

Table A5a: Contingency table of townships' ethnic and religious background

	All nationalities		Only Hungarian		Only German		Only Slovakian	
	Without controls	With controls	Without controls	With controls	Without controls	With controls	Without controls	With controls
Lutheran	-.107	-.118	.144	.141	.018	.084	-.261	-.373*
	(.062)	(.063)	(.149)	(.151)	(.101)	(.121)	(.237)	(.177)
Calvinist	.138**	.099*	.144**	.125*	.367**	.461**		
	(.042)	(.049)	(.048)	(.063)	(.040)	(.154)		
Nr. of obs.	327	327	208	208	60	60	46	46
R squared	.573	.640	.545	.610	.777	.828	.808	.927

Robust standard errors in parenthesis. One and two stars denote significance at 5 and 1% probability levels, respectively. Religious and ethnic classifications are, respectively, based on the affiliation of the absolute majority of each township's population in each relevant domain. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A5b: Robustness of results across ethnically homogeneous sub-samples

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	Townships in mixed districts (all districts)		
	Catholic	Lutheran	Calvinist
A. Human capital formation			
Secondary schools	.084 (.239)	.070 (.053)	.119 (.101)
Secondary school enrollment rate	.011 (.017)	.007 (.005)	.006 (.008)
Libraries (as of 1884)	.593 (1.54)	.368 (.360)	.536 (.542)
Theatres	.010 (.044)	.017 (.013)	.024 (.012)
B. Labour market performance			
Participation rate	.746 (.750)	.763 (.774)	.738 (.730)
Share of women among agricultural workers	.171 (.189)	.205 (.228)	.137 (.138)
Share of women among industrial workers	.112 (.122)	.088 (.101)	.103 (.114)
Incidence of child labour in agricultural work	.093 (.090)	.066 (.061)	.090 (.087)
C. Industrialisation			
Share of workforce in industry	.171 (.162)	.152 (.169)	.110 (.117)
Share of industrial workforce in expanding industries	.342 (.333)	.308 (.324)	.288 (.274)
Businesses in industry (per person)	.032 (.034)	.032 (.035)	.026 (.026)
Share of businesses with more than 10 workers	.006 (.009)	.004 (.006)	.003 (.003)
D. Access to finance			
Banks (per 1000 persons, as of 1894)	.068 (.072)	.068 (.055)	.041 (.047)
Savings & loans associations (per 1000 persons, as of 1894)	.099 (.065)	.089 (.119)	.117 (.079)
Financial capitalisation (per person, in 1000 krones, as of 1894)	.041 (.048)	.022 (.026)	.018 (.020)
Savings deposits (per person, in 1000 krones, as of 1894)	.034 (.038)	.018 (.022)	.014 (.015)

Table A6: Descriptive statistics concerning potential growth factors

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	Baseline specification	Extended specifications			
		Human capital formation	Labour market performance	Industri-alization	Access to finance
Lutheran	**-.118**	**-.097**	**-.080**	**-.088**	**-.118**
	(.063)	**(.063)**	**(.063)**	**(.064)**	**(.063)**
Calvinist	**.099***	**.122***	**.105***	**.121***	**.109***
	(.049)	**(.048)**	**(.050)**	**(.051)**	**(.049)**
Secondary schools		-2.296			
		(1.876)			
School enrollment		3.601*			
		(1.631)			
Libraries		.072			
		(.071)			
Theatres		-8.034			
		(12.434)			
Participation rate			-.300		
			(.640)		
Share of women in agriculture			-1.021*		
			(.487)		
Share of women in industry			.275		
			(.399)		
Share of child labour in agriculture			1.240*		
			(.561)		
Worker share in industry				-.352	
				(.518)	
Worker share in expanding industry				-.143	
				(.270)	
Businesses in industry				5.246	
				(3.645)	
Share of big business				6.643*	
				(2.936)	
Banks					.328
					(.249)
Savings & loans associations					.044
					(.126)
Financial capitalisation					3.032
					(4.586)
Savings deposits					-3.618
					(5.202)
Standard controls	Yes	Yes	Yes	Yes	Yes
Nr. of obs.	327	326	325	327	327
R squared	.640	.658	.674	.651	.647

Robust standard errors in parenthesis. One and two stars denote significance at 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran and Calvinist townships that are located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. The dependent variable is the logarithm of per capita direct taxes.

Table A7: Regression results based on extended specifications

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	Aggregate statistics				Mean values by religion		
	Mean	SD	Min	Max	Catholic	Lutheran	Calvinist
A. Marriage							
Share of singles	.237	.068	.107	.695	.247	.219	.224
Share of married	.671	.059	.408	.809	.665	.681	.678
Share of widowed	.095	.018	.048	.179	.091	.099	.099
Share of divorced	.002	.003	0	.021	.002	.002	.005
Household size	5.94	5.05	3.38	90.71	6.57	5.42	4.88
B. Population change							
Birth rate	36.92	6.62	19	53	38.39	36.30	34.05
Death rate	25.46	3.77	16	39	26.05	24.68	24.64
Rate of natural increase	11.02	5.35	-12	25	11.87	11.30	8.93
C. Population ageing							
Share of youth (aged 11 or below)	.297	.039	.165	.391	.302	.300	.285
Share of elderly (aged 60 or above)	.092	.022	.041	.175	.087	.091	.101
Share of adults (aged 15 or above)	.638	.042	.545	.783	.633	.635	.654

Table A8: Descriptive statistics of demographics

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	Share of singles	Share of divorced	Share of widowed	Household size	Birth rate
PANEL A. TOWNSHIPS WITH BELOW-MEDIAN POPULATION SIZE					
Lutheran	**-.285***	**.156**	**.394**	**-.280**	**-.078**
	(.170)	**(.143)**	**(.247)**	**(.194)**	**(.222)**
Calvinist	**-.169**	**.759*****	**.458****	**-.252**	**-.615*****
	(.253)	**(.239)**	**(.216)**	**(.152)**	**(.197)**
Control variables	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes
Nr. of observations	164	164	164	164	164
R squared	.649	.743	.700	.694	.772
Wald-test ($H_0 : \beta_{Luther} = \beta_{Calvin}$)	.22	5.08**	.04	.01	3.82*
PANEL B. TOWNSHIPS WITH BELOW-MEDIAN POPULATION GROWTH (1880-1910)					
Lutheran	**-.238**	**.024**	**.475****	**-.058**	**-.039**
	(.221)	**(.155)**	**(.213)**	**(.259)**	**(.202)**
Calvinist	**-.205**	**.614*****	**.530****	**-.470***	**-.455****
	(.372)	**(.277)**	**(.207)**	**(.260)**	**(.214)**
Control variables	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes
Nr. of observations	162	162	162	162	162
R squared	.681	.635	.740	.573	.684
Wald-test ($H_0 : \beta_{Luther} = \beta_{Calvin}$)	.01	4.56**	.05	1.59	2.73
PANEL C. TOWNSHIPS WITH BELOW-MEDIAN LEVEL OF INDUSTRIALIZATION					
Lutheran	**.044**	**-.062**	**.239**	**.573**	**.291**
	(.191)	**(.231)**	**(.334)**	**(.415)**	**(.316)**
Calvinist	**.145**	**.845*****	**.552*****	**-.192**	**-.825*****
	(.222)	**(.287)**	**(.160)**	**(.174)**	**(.155)**
Control variables	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes
Nr. of observations	164	164	164	164	164
R squared	.580	.640	.697	.561	.802
Wald-test ($H_0 : \beta_{Luther} = \beta_{Calvin}$)	.14	11.70***	.72	3.25*	12.71***

Robust standard errors in parenthesis. One, two and three stars denote significance at 10, 5 and 1% probability levels, respectively. Religious classification is based on the religious affiliation of the absolute majority of each township's population. The regression sample comprises only Catholic, Lutheran or Calvinist townships located in mixed administrative districts. All specifications include district-level fixed-effects and concern a single cross-section from the year 1910. All dependent variables are standardized, so parameter estimates represent standard deviations. The adult population considered for calculating marital status shares represent all local residents aged 15 or more.

Table A9: Confessional differences and marriage patterns

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	Child mortality			Access to medicine			Costs of childbearing	
	Death rate at birth	Death rate among infants	Death rate among children	Share of medically treated	Local doctor	Local pharmacy	Child labour in agriculture	Female participation in agriculture
Lutheran	**.061**	**-.692*****	**-.029**	**-.458*****	**-.168****	**-.164****	**-.016**	**.172**
	(.197)	**(.155)**	**(.160)**	**(.157)**	**(.083)**	**(.080)**	**(.208)**	**(.145)**
Calvinist	**.309****	**-.151**	**-.198**	**-.406*****	**-.066**	**-.104**	**-.387*****	**-.205****
	(.151)	**(.146)**	**(.162)**	**(.126)**	**(.067)**	**(.066)**	**(.143)**	**(.099)**
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nr. of observations	327	327	327	327	327	327	325	325
R squared	.350	.467	.499	.604	.426	.490	.373	.651
Wald-test ($H_0 : \beta_{Luther} = \beta_{Calvin}$)	1.07	5.84**	.36	.09	1.19	.42	2.10	4.78**

Table A10: Empirical association between religion and conventional drivers of the fertility transition

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2.B Appendix: Data sources

Data source	Availability	Variables used	Reference period	Comments
Official Hungarian censuses	https://library.hungaricana.hu/hu/collection/kozponti_statisztikai_hivatal_nepszamlalasi_digitalis_adattar/	Size, ethnicity, religion, literacy, marital status of local population; administrative and legal status of townships; sectoral and industrial distribution of workforce, labour force participation by gender	1784, 1869, 1910	
Budget of Hungarian townships in 1908	Library of the Hungarian Statistical Office	Direct tax base	1908	Semi-autonomous Croatia is excluded
Population Dynamic Register of the Hungarian Kingdom, 1901-1910	http://konyvtar.ksh.hu/inc/kb_statisztika/Manda/MSK/MSK_046.pdf	Birth and death rates, rate of natural increase, net immigration , mortality rates, access to doctor	1910	
Statistical Yearbook of Hungary	http://konyvtar.ksh.hu/index.php?s=kb_statisztika	Access to navigable waterway dummy	1910	
Journal of Mining & Metallurgy	http://bkl.uni-miskolc.hu/	Mine dummy	1910	
Tominac, J. (1905). Railroads of the Hungarian Kingdom, 1845-1904 [in Hungarian] Rail and Transportation Bulletin	Library of the Hungarian Statistical Office http://adtplus.arcanum.hu/hu/collection/VasutiKozlony/	Access to railroad dummy	1910	
Financial Institutions (Hungarian Statistical Yearbook, Vol. 13, No. 6)	Library of the Hungarian Statistical Office	banks	1883	
Reference maps from the early 20th century	http://lazarus.elte.hu/hun/maps/1910/vmlista.htm	Mountain dummy	n.a.	A district is mountainous if highest point exceeds 1000-meter altitude.

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Chapter 3

Ideas off the Rails: Railroads and Institutional Development in the Austro-Hungarian Monarchy

(joint with Miklós Koren)

3.1 Introduction

A large literature in comparative development has emphasized the importance of institutions that create the right incentives for economic growth. Most scholarly attention has been devoted to the role of property rights, legal systems as well as monopolistic and oligarchic markets. Despite the widely recognized importance of innovation and technological change for economic growth, the role of cultural institutions that facilitated the production and exchange of ideas has received considerably less attention.

As far as the historical emergence of modern, idea-based and growth-enhancing institutions are concerned, the central role of European cities is widely recognized. Urban life generated social contacts that fostered the circulation of information and innovation (Bairoch, 1988), making cities the seedbeds of capitalist business practices (Braudel, 1992). Yet, very little is known about the spatial patterns of the emergence and adoption of these institutions. For example, Barbier (2017) notes that the printing press in the late 15th centuries spread in 'concentric circles' around Mainz and that personal ties were important in its diffusion. Similar concentric patterns of geographical diffusion were observed in relation to Protestantism around 16th century Wittenberg (Becker and Woessmann, 2009). Beyond suggesting a limited degree of geographical mobility, these descriptions reveal very little about the potential channels and character of institutional diffusion in space.

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This paper provides some new insights in this regard by studying the role of the railway roll-out in diffusing Western institutions across historical Hungary of the 19th century. Specifically, it attempts to identify and quantify the importance of cultural channels of economic growth associated with one of the most disruptive modern technologies, as distinct from its direct growth effects operating through trade or labour mobility. The paper's main methodological challenges are thus twofold. First, one needs to isolate the one-way effect of railroads on institutional development amid the multi-faceted processes of urban development that likely contributed to the simultaneous development of both railroads and various cultural amenities. For this purpose, we rely on a wide range of different econometric techniques while also developing a simple model of cultural contagion for both theoretical guidance and identification purposes. Second, one needs to single out a few specific institution types that were important for or created by the spread of foreign ideas, as opposed to simply being natural byproducts of urban development. This latter aim is pursued by focusing on modern social institutions such as civic associations, libraries, press outlets and cafés that are considered historically important and not resource intensive. We show that emergence and proliferation of this type of institutions were positively affected by railroad access. Moreover, we also set out to quantify the positive and significant effect of these institutions on economic growth.

Our paper stands at the intersection of three strands of economic literature. The first concerns the study of the economic and political consequences of cultural institutions in the urban areas. For example, Dittmar (2011) finds that European cities where the printing press was established grew 60% faster than otherwise similar cities during the 16th century. In similar vein, Falck et al. (2011) argues that baroque opera houses built in 18th century Germany attracted high-human-capital individuals which induced local knowledge spillovers and shifted a location to a persistently higher growth path, even though brothels and breweries seem to have been equally beneficial in this regard (Bauer et al., 2015). Institutions that enable the easier dissemination and exchange of information have also been found to have political consequences: (Adena et al., 2015) emphasizes the role of mass media in the rise of Nazism, while (Satyanath et al., 2017) documents the importance of civic associations.

The second important strand of literature concerns the geographical diffusion of facts, innovations and institutions. This rather thin literature argues that facts, understood in general as "pieces of reliable knowledge", may travel remarkably well and serve as foundational objects beyond the place and community of their original field of production (Howlett and Morgan, 2011). This particularly applies to useful innovations, in relation to which we find that infrastructural developments may turn perviously resistant homophilous social systems into more adoptive heterophilous ones and thereby speed up the standard diffusion process (Rogers, 2010). As far as specific institutions are concerned, our findings corroborate that spatial and social proximity and contact has a positive effect on their within-country diffusion (Suarez and

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Bromley, 2016).

Third, the paper also contributes to the growing body of work that examines the causal impact of the railroad on historical development (Atack et al., 2010; Banerjee et al., 2012; Berger and Enflo, 2015; Hornung, 2015; Donaldson and Hornbeck, 2016; Donaldson, 2017). Similar to much of this literature, our results suggest that improvements in transport infrastructure can have substantial short- and long term effects on urban development and growth. However, by focusing on institutional development, we emphasize a previously unrecognized channel beyond the direct implications for trade, market access and the re-location of economic activity. In particular, our results suggest that an important part of these effects stem from enabling individuals of different backgrounds to meet and exchange views more frequently and more effectively.

Our paper is also directly relevant for the economic historians of Central Europe and the Austro-Hungarian Monarchy. Through the railway, we namely establish an important channel of inter- and intra-regional development and modernization. Our results also help to understand the apparent disconnect between the researchers' focus on economic consequences of railroads on the one hand, and the contemporaries' preoccupations with the civilizing and primarily cultural character of the railway on the other hand.

The remainder of the paper is structured as follows. Section 3.2 provides a brief historical background to our research question. Section 3.3 introduces the rich set of local-level data we hand-collected and digitized from official statistical sources for the empirical analysis. Section 3.4 presents the main reduced-form results based on a series of different analytical approaches and econometric techniques. Section 3.5 concludes, while also discussing potential avenues for future research. These are aimed at better understanding the role of the railroads for cultural diffusion on the basis of a simple model of spatial contagion, as well as assessing its indirect economic benefits.

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3.2 Historical Background

3.2.1 Culture and institutions in the Austro-Hungarian Monarchy

To historians, the dual state of Austria-Hungary was a late 19th century museum piece: after 1871, it was virtually the only major European state that was not organized on a national basis. Instead, it was a loose confederation of territories varying in size, national composition, culture and economic development. For political and administrative effectiveness, however, there were considerable official and civic attempts to create a unified country with a strong sense

of identity. Given the political clout of the Kaiser and German-speaking Austria, the German ties of the economic, political and military elites, as well as the general prestige of the German language and culture more generally, most of these attempts took place under German cultural hegemony. While creating a political and cultural unity did not succeed (which is widely considered to be the main cause of the Monarchy's demise), cultural integration turned out to be one of the Monarchy's most important cohesive forces.

Despite political and economic differences between its peoples, there was, to a considerable extent, a common dominant culture throughout the Monarchy. For example, most of its citizens tended to have broadly the same philosophical outlook on life: skeptical, almost fatalistic, self-critical, preferring the pragmatic and convenient to the abstract and philosophical. In terms of life style, members of the middle and upper classes ate many of the same dishes, listened to the same music, lives and worked in buildings of similar architectural design, read the same German-language newspapers and periodicals (Pauley, 1972). While most other cultural strands were limited in their effect and restricted to specific regions, the German influence spread largely uncontested on an empire-wide scale (Kann, 1974). Vienna, in particular, was the undisputed cultural capital for the whole Habsburg realm and, during the late 19th century from where ideas in arts, sciences and customs radiated to the rest of the Empire (Schorske, 1972). Its role was particularly relevant for Hungary, where both the political class and the intelligentsia were indoctrinated with German culture, as digested, filtered and customized in the cosmopolitan bourgeoise consciousness of Vienna (Kann, 1974).

In the process of cultural integration, certain liberal institutional practices that enabled the spread and exchange of ideas played a particularly important role. For one, the Viennese coffee house was a "sort of democratic club, open to everyone for the price of a cheap cup of coffee, where every guest can sit for hours with this little offering, to talk, write, play cards, receive post, and above all consume an unlimited number of newspapers and journals" (Hofmann, 1988). Of equal importance, the theatre was "the microcosm that mirrored the macrocosm, where the spectator saw an excellent example of how one ought to dress, how to walk into a room, how to converse, which words one might employ as a man of good taste and which to avoid" (Zweig, 1964). In similar vein, burgeoning civic associations were places for exercising civil duties and instituting democratic control, while journals and libraries were the main transmitters of leading and authoritative views on the social and political environment. Thermal baths, as principal touristic destinations and by providing opportunities for enlightened recreation, contributed most importantly to the physical mixing of peoples with different outlook (Kosa, 1999).

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3.2.2 Railroad development in the Austro-Hungarian Monarchy

Austria-Hungary was a pioneer in railway construction from the outset, opening the first horse-drawn railway service on the continent in 1832 (between Linz and Budweis), operating steam locomotives around Vienna as early as 1837, and constructing the first alpine mountain railroad in the 1850's (between Semmering and Murzzuschlag). By 1913, almost 45 000 kilometers of rail lines were in operation in the Monarchy, with a network density of the Austrian lands and Hungary among the highest in Europe (Berend, 2003).

Railroads were built primarily with the aim of transporting goods and increasing trade. This is evidenced by contemporary government decrees promoting and financially incentivizing railroad construction, but also by the revenue structure of railway companies: in 1880 Hungary, more than 80% of revenues came from freight transportation, and this share remained above 70% throughout the Monarchy (see Figure A1 in the Appendix). Yet, it was obvious to any contemporary observer that the railroads represented something more important and transcendent than simply a vehicle for economic progress. It was generally regarded by social thinkers and people on the streets alike rather as an harbinger of progress, civilization and modernization. For example, The Economist in 1845 wrote that "the railway property is a new feature in England's social economy which has introduced commercial feelings to the firesides of thousands". Henrich Heine, the German poet went even further: "The railroad is a providential event, comparable to the inventions of gunpowder and printing, which swings mankind in a new direction, and change the color and shape of life." Sergei Witte, the long-standing chief of the Russian railways in the late 19th century argued that "a railway is a ferment that causes cultural brewing", as well as the ecstatic reviews upon the opening of the first railway stretch in Hungary in 1846.

3.3 Data

In this paper, we explore the statistical relationship between the roll-out of the railway network and the appearance of idea-based institutions that supposedly fostered the production and exchange of information in 19th century Hungary. The empirical analysis concerns a new dataset of Hungarian townships that we compiled from various official statistical sources from the 1869-1910 period.[1] This contains a large set of local-level information on all townships with a population exceeding 2000 at the time of the earliest census in 1869.[2] The resulting sample

[1]The statistical sources in the paper include decennial censuses, thematic periodical publications as well as occasional statistical reports on various township characteristics. See the Data Appendix for a comprehensive list of data sources used in the paper.

[2]To ensure appropriate geographical coverage, in the few cases where no township reached the aforementioned population threshold in a given district, the most populous township was selected regardless of its size. In the couple of cases where townships merged or disintegrated between 1869 and 1910, we consistently treat the totality

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comprises altogether 1689 townships in 72 counties and 517 administrative districts, and covers more than half of Hungary's total population and around 10% of all townships in the period.

To determine the year in which the railroad arrived in each sampled township, and to use the exact topology and linkages of the railway network to assess the potential channels of cultural transmission, we reproduced the full expansion of the Hungarian railway network from its beginnings in 1846 (the year the very first section between Pest [Budapest] and Vac was opened) until 1910. Our main data source was Tominac (1905) that chronologically lists all the railway segments in operation, along with some basic information concerning their authorization, length, opening data, technical details and building costs. We also made heavy use of the comprehensive list of past and present railway stations in Hungary (available on-line at "www.vasutallomasok.hu" and endorsed by the Hungarian State Railway) that also features featuring their exact location and corresponding railway lines. Some additional abandoned stations and stops were identified based on historical timetables that also helped us determine the stops and stations that were effectively in use in the period.[3] Some auxiliary segments of the network (little more than 1% of the total network as of 1910) were recovered using official historical maps of Hungary from the period in question. The resulting sample thus includes all railway lines crossing at least one township boundary and used for passenger travel, contains 3621 stations on 464 railway lines covering 20438 kms as of 1910. The evolution of the network is shown in Figure A2 in the Appendix.[4]

As far as cultural institutions are concerned, we focus on those that were instrumental in changing the way people access, processed and communicated information. These include civic societies, libraries, press outlets, cafes, theatres and thermal baths. Our main conjecture is that these institutions are not costly to establish, and that their emergence depends primarily on the cultural exposure of the local populace to them. Table **??** in the Appendix shows the pervasiveness and geographical concentration of each institutional type across sampled townships, along with their respective data sources. This suggests that many of these institutions were present in the thousands in historical Hungary, and while their majority was geographically concentrated in the larger sampled townships, a non-negligible share of them emerged in smaller, provincial, non-sampled places. Figure A3 shows the evolution of the institutions in question during the respective observation windows, which indicates that their emergence and proliferation in some

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of the constituents as a single observation.

[3]These timetables are available at `http://ballal.gofree.hu/G/New/index_elemei/Page2034.htm`.

[4]Industrial lines are not considered but small-gauge lines are. The former and latter represented only around 0.25% and 3.5% of the total existing network as of 1910, respectively. As far as railway stations are concerned, we consider all types of stations and halts, except that, in the rare case of several stops in a township, we included only the main one. Moreover, among the intermediate (non-terminus) stops, we only kept those for which either the exact location parameters were known or which belonged to a township featured in our main sample. (This amounted to dropping around 10% of the original sample. For visualization purposes, remaining stations without exact location parameters were assigned the geo-coordinates of the (center of the)township they belonged to.)

cases was much more rapid than economic development would suggest. Another way to show that institutional and economic development are not simply different sides of the same coin is to plot the income and population densities of townships where specific institutions were present: as Figure A4 in the Appendix shows, institutions such as civic associations and libraries were to be found in poorer and smaller localities as well. Moreover, our analysis also shows that cultural institutions of different kinds do not typically appear together in a township. All this stylized evidence seems to suggest that the chosen institutions are not simply cultural amenities that automatically appear at a certain stage of urban and material development.

3.4 The effect of railroad access on institutional development

This section presents our main findings regarding the causal impact of railway access on the emergence of the cultural institutions. The principal methodological challenge consists in isolating and identifying the one-way effect from railroads to idea-based organizations, in a historical situation characterized by a simultaneous infrastructural and multi-faceted institutional development. For this reason, this section employs a wide-range of different inter-related econometric techniques.

The main motivation for considering railroads as central in this process stems from our observation that cultural institutions are much more concentrated in townships with railroad access than standard indicators of local-level development would suggest. In particular, as Figure A1 shows, cultural institutions were considerably more polarized over railroad access at various points in time, than over standard alternative indicators of economic performance such as population size, literacy, or per capita income. For example, libraries and civic associations were, on average, 2-3 times as numerous in places with railway access than without, while disparity in per capita income or population size was only around 20-30% in relative terms.

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3.4.1 Cross-sectional and panel data estimates

To test whether cultural institutions are systematically more concentrated in places with railway access, we start by pooled cross-sectional and panel regression analysis. The baseline model specification we estimate is rather straightforward:

$$y_{i,t} = \alpha_i + \alpha_t + \beta D_{i,t}^{RAILROAD} + \epsilon_{i,t} \tag{3.1}$$

where subscripts i and t stand for township and year, respectively. $D_{i,t}^{RAILROAD}$ is a categorical variable that takes the value of 1 if township i in year t has access to the railway and zero otherwise, while α_i and α_t are independent township and year fixed-effects. The dependent variable $y_{i,t}$ stands for the standardized number of institutions by a given type in a given place

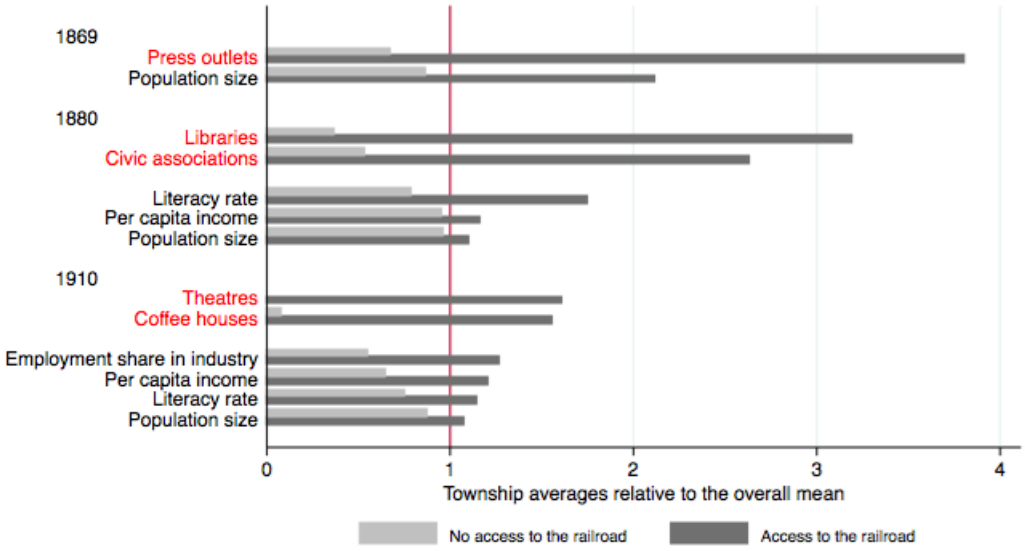

Figure A1: Concentration of cultural institutions in places with access to the railway

and year. As such, β captures the difference in the number of institutions between places at a given point in time (pooled cross-section estimates) and within individual townships (fixed-effects estimates). As a special case, we also estimate a proportional hazard model based on the same right-hand-side specification that focuses on the dynamic change in institutions rather their level:

$$Prob(y_{i,t+1} > X \mid y_{i,t} = X, D_{i,t}^{RAILROAD}) = 1 - \exp(-\lambda_{it})$$
$$\text{where } \lambda_{it} = \alpha_t + \beta D_{i,t}^{RAILROAD} + \epsilon_{i,t} \tag{3.2}$$

where the dependent variable is the probability that the number of institutions in a place increases in the following year.

Table A1 shows the baseline estimates for the presence and emergence of institutions in accordance with railway access. Panel A contains estimates for pooled cross-sectional regressions and shows that townships with railway access had, in any given year and on average, between 0.3 and 1.2 standard deviation higher number of institutions than locations without railway access. These effects are all highly significant both statistically and in economic terms. Panel B shows that the discrepancy in the number of institutions persists even if only within-townships differences are considered: for example, the number of civic associations in a township was a full standard deviation higher during periods of railway access, even after the overall rate of institutional development over time is accounted for. The next two panels contain the estimated proportionate difference in probability associated with railway access that an institution subsequently appears (Panel C) or expands (Panel D) in a given township. In particular, these estimates show that the hazard rate that a specific institution type emerges or multiplies in a township is several times higher if railway access is provided.

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	DEPENDENT VARIABLE			
	Civic associations	Libraries	Theaters	Journals
Panel A. OLS regressions with pooled cross-sections ($\alpha_i = 0$)				
Railroad	1.229***	.812***	.313***	.965***
	(.071)	(.054)	(.011)	(.197)
Nr. of observations	104833	112795	147408	90304
R-squared	.088	.035	.007	.014
Panel B. OLS regressions with township fixed-effects ($\alpha_i \neq 0$)				
Railroad	.996***	.535***	.130***	.590
	(.208)	(.182)	(.034)	(.501)
Nr. of observations	104833	112795	147408	90304
R-squared	.098	.030	.012	.010
Panel C. Cox proportionate hazard ratio estimates for the *emergence* of institutions				
Railroad	1.877***	3.474***	10.786***	6.880***
	(.061)	(.111)	(.721)	(.777)
Nr. of observations	95980	106415	144977	87972
Panel D. Cox proportionate hazard ratio estimates for the *expansion* of institutions				
Railroad	1.820***	2.789***	6.895***	1.936***
	(.060)	(.117)	(1.252)	(.282)
Nr. of observations	10344	13789	1323	666

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively.

Table A1: Railroad access and institutional development - Baseline OLS, FE and hazard estimates

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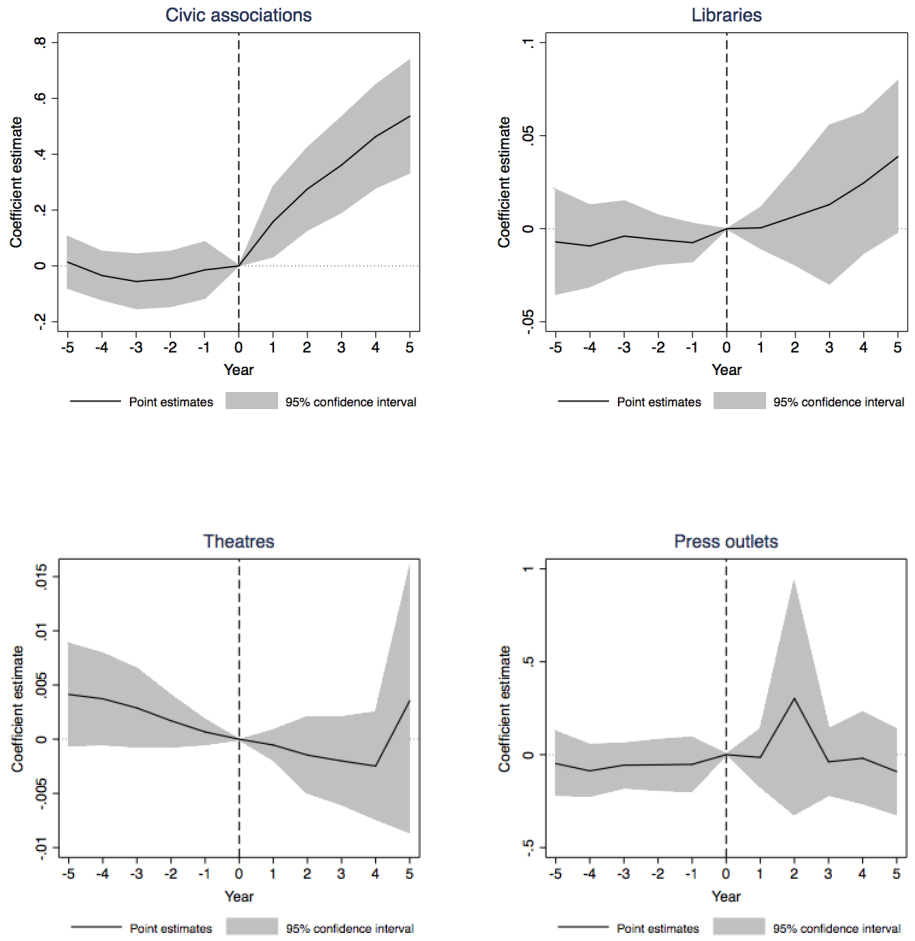

Figure A2: Event study of railroad access and institutional development

3.4.2 Event study analysis

The regression analysis presented previously shows that railway access is statistically strongly associated with higher levels of institutional development. However, these results in themselves do not imply that the railroad was a causal factor in this process any more so than pointing to a joint pattern of urban development where access to railroad constitutes a similar type of institutional progress as opening a library or a theatre. To identify the one-way effect of railways on institutional development, we first look at how the growth rate of institutions changed as a result of gaining access to the railroad. In particular, we want to see that once a township gained access to the railroad, the rate at which its institutions were growing increased. This is best achieved by an event-study analysis that traces out the time trend in institutional endowment for the periods leading up to railroad access, while contrasting it post-treatment outcomes.

To show the potential non-linear dynamic effects from gaining access to the railroad, we code separate dummies for all periods before and after adoption. Each dummy only takes the value of 1 in a single period before or after a township becomes connected to the railroad, and

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is 0 for all other periods. Since gaining access to the railroad varied over time across locations, this approach allows us to pool the statistical information spread across different periods and compare townships at the same stages of railway development. Moreover, featuring township-specific individual time trends allows us to get rid of the potential distorting effect of systemic factors that may differentially influence early and late adopters.

Table A2 in the Appendix shows that gaining access to the railway immediately led to a higher rate of institutional development in certain cases. Statistically significant differences are estimated in relation to civic associations and libraries. For these institution types, pooled cross-sectional estimates show that railroad access increases the rate of institutional development relative to non-treated townships, while fixed-effect estimates show that post-treatment trends are higher than pre-treatment trends for each township individually. For institution types with a relatively short observation window (i.e. journals) or very limited cross-sectional variation (i.e. theatres), these effects are not statistically identified. Figure A2 summarizes this information by plotting the estimated β coefficients for each year, along with the corresponding 95% confidence intervals, during the 5-year period preceding and following railroad access. These show that, in the case of civic associations, the post-treatment trend is clearly and statistically steeper than the one for non-treated places: in contrast to similar pre-treatment development, places with railroad access had on average .6 standard deviation higher number of civic associations than non-treated townships in as little as 5 years time. While this does not unequivocally suggest that railroads were the cause of this development, they indicate that pre-dated the institutionsal boom.

3.4.3 Propensity score matching on pre-railroad development

Even if pre-treatment and post-treatment trends were systematically different, Figure A1 in the Appendix shows treated and non-treated townships were very different from one another. This casts doubts on the validity of our previous approach that used the entire sample of non-treated localities as control group, especially since potentially confounding time-invariant township attributes were not observed on a yearly basis. In contrast to the baseline specifications using the full population of Hungarian townships, this section presents estimates from propensity-score based matching algorithms that attempt to eliminate the aforementioned imbalances.

Specifically, we use propensity score matching to control for pre-railroad development. Our aim is to reduce the selection bias and compare outcomes for townships that are as similar as possible, except for their assignment to the treatment. This reduces the likelihood that post-treatment differences between treated and non-treated places are partly or entirely not due to factors other than railroad access. To obtain highly comparable samples, we match treated and non-treated observations using a set of pre-treatment variables. In particular, we use early cen-

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	CIVIC ASSOCIATIONS (1869-1878)			LIBRARIES (1869-1884)		
	Places with railroad (1)	Places without railroad (2)	Difference in means (3)	Places with railroad (4)	Places without railroad (5)	Difference in means (6)
Panel A. Nearest neighbor matching						
Post-treatment institutions	8.46	3.65	4.81***(1.37)	3.82	.83	2.99***(.73)
Initial institutions	3.14	1.33	1.81***(.61)	2.34	.48	1.86***(.48)
Population size (log)	8.72	8.58	.14 (.11)	8.72	8.46	.26**(.11)
Population change (1850-1869)	.78	.79	-.01 (.05)	.78	.75	.04 (.05)
Distance to Vienna	2.83	2.89	-.06 (.16)	2.83	2.68	.15 (.16)
Distance to Budapest	1.49	1.50	-.01 (.10)	1.49	1.46	.03 (.09)
County seat	.17	.06	.11**(.04)	.17	.04	.14***(.04)
District seat	.37	.37	.00 (.00)	.37	.29	.08 (.06)
Weighted observations	110	110	220	110	110	220
Panel B. Kernel matching						
Post-treatment institutions	4.46	3.66	.80 (.70)	3.38	2.78	.60 (.71)
Initial institutions	1.31	1.36	-.05 (.16)	2.14	1.81	.32 (.32)
Population size (log)	8.49	8.45	.04 (.05)	9.35	8.57	.08 (.06)
Population change (1850-1869)	.75	.74	.01 (.03)	.78	.76	.01 (.03)
Distance to Vienna	2.833	2.93	-.09 (.08)	2.79	2.78	.02 (.09)
Distance to Budapest	1.47	1.54	-.07 (.06)	1.48	1.42	.06 (.06)
County seat	.07	.09	-.02 (.02)	.13	.17	-.04 (.03)
District seat	.33	.32	.01 (.03)	.35	.35	-.01 (.03)
Weighted observations	110	752	852	110	673	783

Table A2: Estimated treatment effects based on propensity score matching

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sus information to generate comparable sets of townships based on initial population size and previous population growth, initial institutional development as well as geographical position and administrative status. Based on the propensity score associated with railroad access, we then estimate the subsequent institutional development gap between treated and non-treated townships, and interpret our findings as the causal effect of railroads.

Table A2 presents the descriptive statistics for both dependent and independent variables by treatment status, as well as the estimated difference between group means, with regard to civic associations and libraries. Importantly, differences in means between the matched samples (Columns 3 and 6), are supposed to be positive for post-treatment institutional development (as of 1878 and 1884, respectively, for civil associations and libraries) but not statistically significant from zero for pre-treatment variables (as of 1869). Table A2 contains the results of two alternative matching algorithms. Panel A shows estimates based on nearest neighbor matching where each railroad-treated township is assigned a comparable non-treated pair without replacement. The main merit of this approach is that it recognizes the high degree of heterogeneity across sampled townships, and is only concerned with finding the best match for each of treated townships. The reported estimates yield large and highly significant treatment effects of 4.81 (2.99) additional civic associations (libraries) over a 10-year (15-year) horizon. However, this approach also results in imperfect matching as treated places are significantly different from non-treated ones in that they had a considerably more institutions at the outset. For this reason, Panel B also shows estimates based on a kernel matching algorithm that uses information from all non-treated townships and assigns a non-zero weight to all of them. The corresponding estimates confirm the improvement in matching, but also result in much smaller treatment effect estimates (.80 and .60, respectively, for civic associations and libraries) that are not statistically significant any more. With the former procedure not fully accounting for observable differences between matched townships, and the latter assigning identical treatment probabilities to all observationally equivalent township, the two approaches may be considered as providing the upper and lower bounds of the true difference associated with railway access.

3.4.4 IV estimations

While we found some evidence of positive treatment effects associated with railroad access in matched samples based on township observables, there may have been unobserved heterogeneity even between treated and non-treated townships that look the same. In particular, places with higher growth potential were more likely to become connected to the railroad network. To address this source of endogeneity, we also attempt to identify exogenous variation in railway treatment based on two different IV strategies.

The first approach exploits the simultaneous development of the electric telegraph, another

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	CIVIC ASSOCIATIONS		LIBRARIES	
	OLS	IV	OLS	IV
Treatment period (in years)	.081***	.585***	.025**	.254***
	(.031)	(.155)	(.010)	(.066)
Township controls	Yes	Yes	Yes	Yes
County dummies	Yes	Yes	Yes	Yes
First-stage β		.405***		.522***
First-stage F-statistic		30.03***		34.30***
R-squared	.694	.481	.594	.246
Number of observations	1008	1008	1008	1008

Table A3: IV estimates based on treatment period length associated with telegraph access

great invention of the 19th century. Its emergence in the 1830s and its rapid geographical diffusion greatly accelerated and facilitated communication over large geographical distances and are widely considered to have had a far-reaching economic and societal impact (Standage, 1998; Steinwender). The Hungarian network started as a state monopoly in 1847 when Vienna was connected first to Pressburg and then subsequently to Budapest. From 1853 onwards, the private use of the telegraph was also allowed, and public telegraph stations and lines started to pervade the whole country: by 1867, the network already consisted of 421 stations and included 8155 kms of telegraph lines, and went on to increase up to 2240 stations and more than 27 000 kms of cables by 1914. For the empirical analysis, we reconstructed the entire evolution of the Hungarian telegraph network from an array of official historical and statistical sources (see Data Appendix for more information).

While most telegraph lines were laid along the railroad, the year they were open to the public shows great variation. Figure A5 in the Appendix shows the low cross-correlation ($\rho = .25$) between the years of telegraph access and railroad access in a township. Our first IV strategy is aimed at exploiting precisely this variation by comparing differences in treatment period length across the two networks. Specifically, our conjecture is that, due to its cost advantage and flexibility over the railroad, access to the telegraph in a township provides a good indication of this latter's future economic potential. Using the treatment period associated with the telegraph as an instrument should therefore provide exogenous variation in the treatment period associated with the railroad that can be used for identifying one-directional causal effect of this latter. For this strategy to be valid, the exclusion restriction of no direct "telegraph effect" on institutional development needs to be satisfied. While this seems objectionable, event study analysis reveals no significant change from pre-treatment trends in the wake of a telegraph access during periods where railway connectedness remained the same (see Figure A6 in the Appendix).

The first set of regressions therefore estimate the difference in institutional development

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across townships at a given point in time, as a function of both the actual and predicted treatment period length associated with the railroad. Focusing, for reasons of efficiency, on the latest available observations for civic associations (1878) and libraries (1884), Table A3 reports the corresponding OLS and 2SLS estimates. The former show that each additional year of treatment corresponds to .08 and .03 more civic associations and libraries, respectively, even if a large set of township characteristics are accounted for based on the 1880 census. 2SLS estimates, on the other, are equally positive and statistically highly significant, albeit their magnitude is substantially biased upward due to the relatively flat predicted treatment profiles used in the second stage.[5]

The second IV strategy is more conventional in that it follows Atack et al. (2010), Banerjee et al. (2012) and Hornung (2015) by assuming that the railway lines were exclusively built to establish a fast connection between important cities, and that intermediary townships along the way mostly gained access by chance. Specifically, our more stringent conjecture is that only townships that are located on a straight line corridor (SLC) between important infrastructural hubs were assigned to adopt railroad technology in a truly random fashion. This implies that intermediary townships outside of the SLC likely gained railroad access due to endogenous reasons, which may bias treatment effect estimates if ignored.

Using GIS techniques, we connected the nodes of the railway network with straight lines. To accommodate exogenous route deviations due to certain geographical features (e.g. rivers, mountains) and increase cross-sectional variation in the data, we also created buffers of different width along these straight lines. All cities within the resulting corridors are then assumed to have connected to the railroad only due to their accidental location between nodes. For all sampled townships, the SLC instrument therefore takes the value of 1 within the corridor and 0 outside of it. Given the gradual expansion of the network, the treatment status of townships were also liable to change in both directions.

Table A4 reports 2SLS estimates using 10 km-wide SLCs as instrument. For a given year, estimated treatment effects associated with railroad access capture the difference in the standardized number of institutions over a 10-years horizon, conditional on townships controls and the initial level of institutional development. Focusing only on those intermediary townships whose SLC status did not change over the observation period, main parameter estimates attribute a modest, positive but non-significant causal effect of railroad access on institutional development. In these specifications, railway access is associated with an institutional advantage of less than .2 standard deviations in either decade of the 1850-1880 period. These findings

[5]First-stage statistics are nevertheless convincing. Each additional year of telegraph treatment is associated with around half a year of additional railroad treatment, with first-stage F-statistics well above the conventional weak instrument threshold value of 10.

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	CIVIC ASSOCIATIONS		LIBRARIES	
	Without controls	With controls	Without controls	With controls
PANEL A. 1850 CROSS-SECTION				
Railway access	.046	.080	.048	.097
	(.087)	(.096)	(.057)	(.068)
First-stage β	.433***	.442***	.436***	.448***
First-stage F-statistic	12.17***	10.45***	12.44***	10.80***
R-squared	.863	.920	.901	.915
Number of observations	1191	549	1191	549
PANEL B. 1860 CROSS-SECTION				
Railway access	.158*	.169	-.033	-.069
	(.096)	(.153)	(.029)	(.039)
First-stage β	.374***	.403***	.372***	.405***
First-stage F-statistic	50.16***	27.47***	49.72***	27.61***
R-squared	.753	.832	.919	.929
Number of observations	1206	564	1206	564
PANEL C. 1870 CROSS-SECTION				
Railway access	.097	.060	.080	.073
	(.154)	(.153)	(.050)	(.051)
First-stage β	.349***	.326***	.347***	.325***
First-stage F-statistic	68.87***	60.36***	65.65***	59.57***
R-squared	.746	.760	.896	.903
Number of observations	1104	1104	1104	1104

Heteroskedasticity-robust standard errors in parenthesis. *, **, *** denote statistical significance at 10, 5 and 1% probability levels, respectively. Results are based on the 10 km wide straight line corridor dummy. Townships that were nodes in the network (or became one over the 10-year observation window) were excluded from the analysis, similar to places of which the SLC status has changed in the same period. Specifications without control variables contain only the initial number of institutions as regressor. Specifications with control variables also include (log) population size, distance to capitals as well as mountain, mine and waterway dummies in addition.

Table A4: IV estimates based on straight line corridors

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are robust to alternative specifications based on different corridor widths and observation windows, and suggest either that either actual railroad layout was highly endogenous or that a more nuanced account of network idiosyncrasies is needed for the assignment of appropriate treatment probabilities in the first-stage of IV estimations.

3.5 Concluding remarks

This paper studies the effects of railway roll-out in historical Hungary on the spread of ideas and institutions during the 19th century. Specifically, we find that cultural commodities such as civil organizations, libraries, press outlets, coffee houses and theaters were highly concentrated in townships that had been connected to the railway network, to a much larger degree than what economic fundamentals would imply. By employing a series of different econometric techniques, we are able to identify railroads as important capillaries and a causal driver of institutional development.

Two avenues for future research seem especially promising. The first of these concern exploiting the spatial characteristics of the railway network that we so far ignored in our analysis. As cultural historiography suggests, there was a clear spatial pattern to the modernization of 19th-century Hungary in that innovations generally spread from the West to the East. Indeed, Figure A7 in the Appendix shows that the center of gravity of both railroads and cultural institutions in Hungary moved east-southest-wards, roughly along the Vienna-Budapest axis and by as many as 100-150 kms. By developing a simple stylized model of spatial contagion, one could test the role of increased mobility of persons in bringing about the institutional benefits associated with the railroad. The empirical tests of such a model would involve peer-effects regression that simultaneously account for both 'as the crow fly' geographical distances and rail distances between locations, while also exploiting the passenger transit data by railroad lines and stations that we have compiled from primary statistical sources.

The second area for future research concern assessing the economic benefits of institutional development. With historical data available for per capita income by township for both 1880 and 1910, one can estimate the growth advantage that townships with access to the railroad enjoyed over their non-connected neighbors. It is also possible to show, by accounting for trade volumes associated with rail transit, that some of these railroad effects its go through the cultural institutions in question. To better understand the role of such institutions for economic growth, one could specifically think about them in the context of innovation-based endogenous growth models.

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3.A Appendix: Figures and Tables

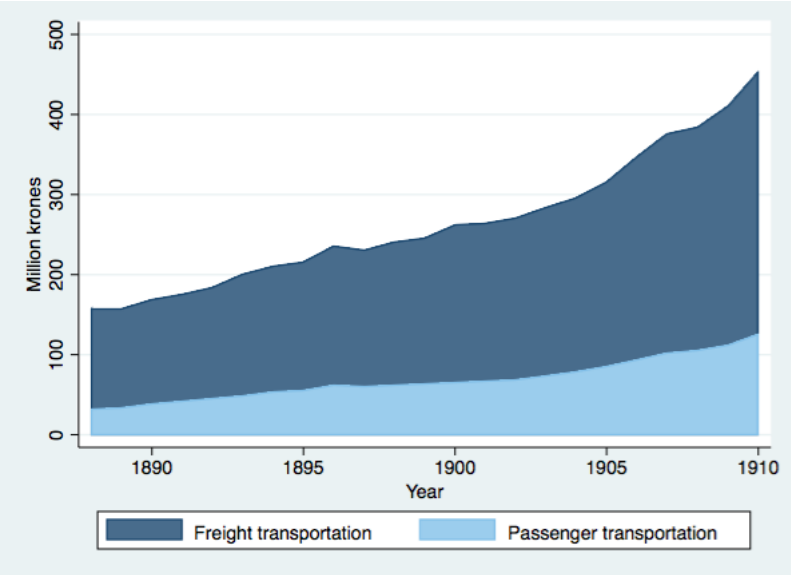

Figure A1: Revenue split of Hungarian rail transportation by year (1885-1910)

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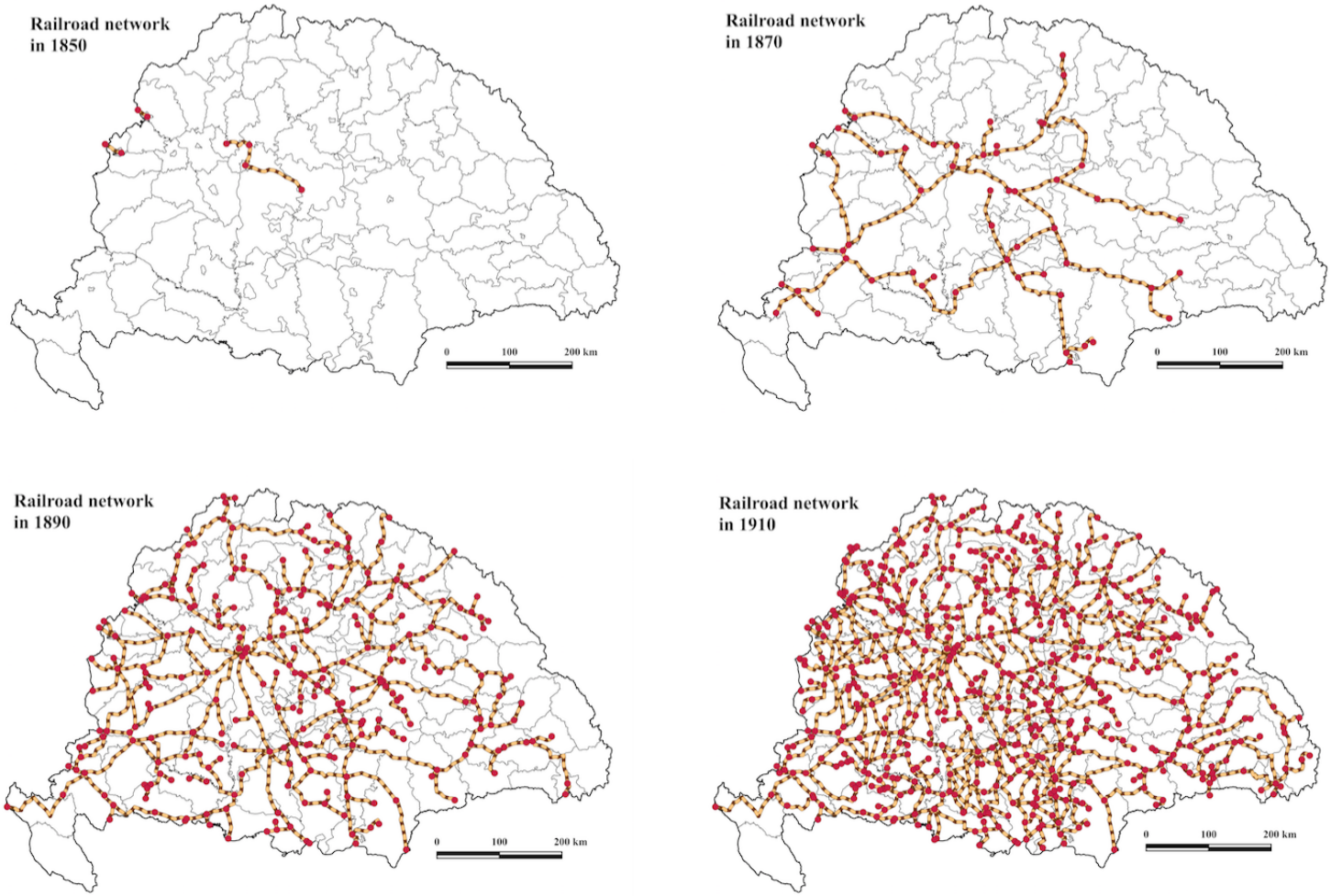

Figure A2: The evolution of the railroad network in historical Hungary (1846-1910)

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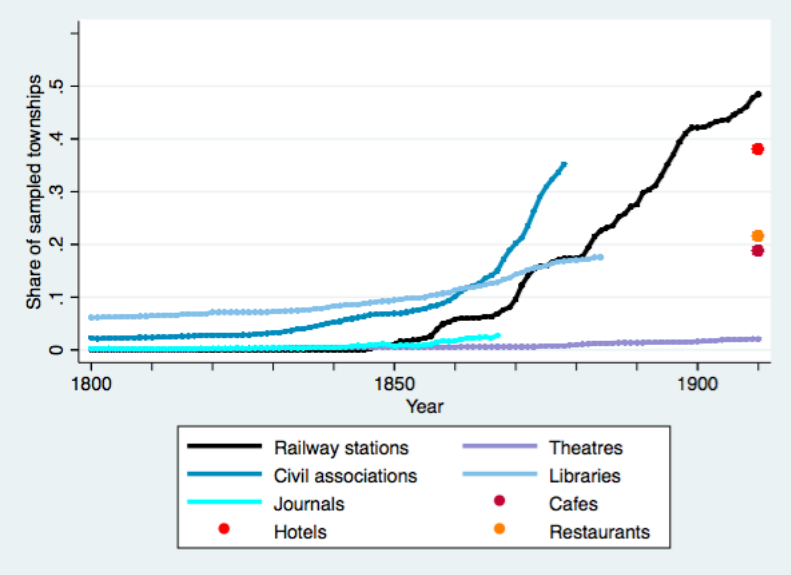

Figure A3: Evolution and availability of main variables of interest over time

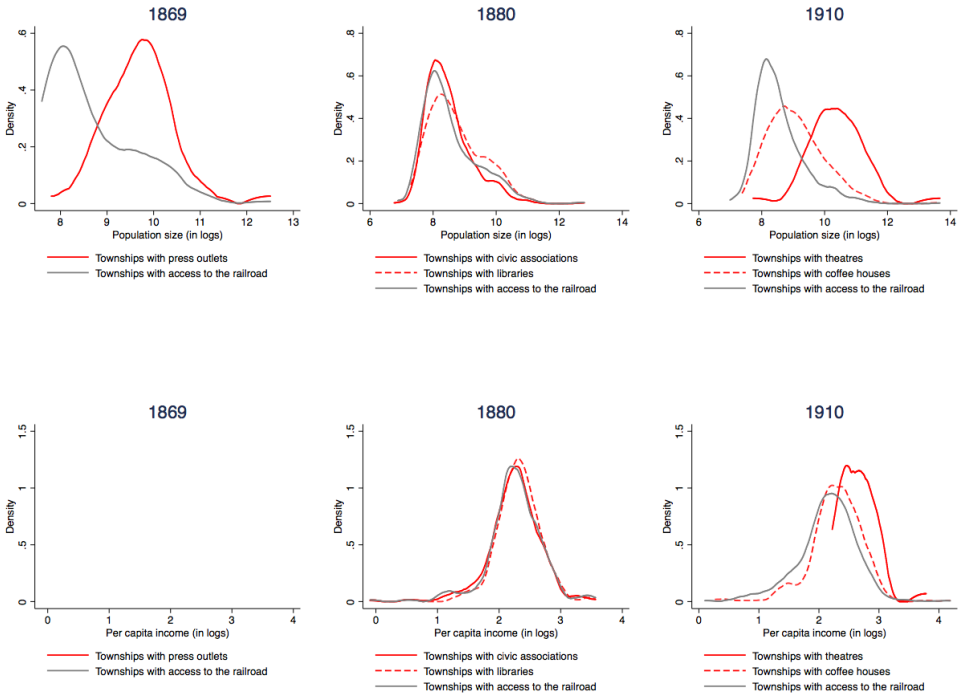

Figure A4: Size and income distribution of treated townships

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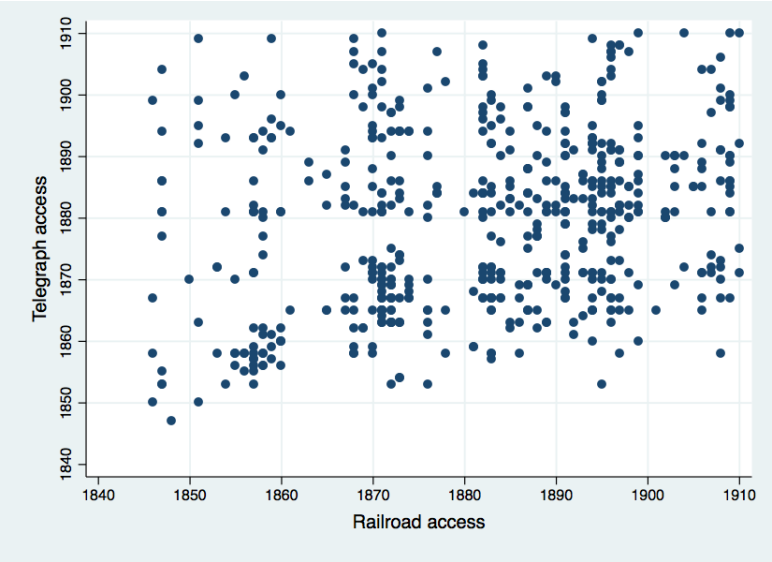

Figure A5: Townships' year of access to the railroad and the telegraph

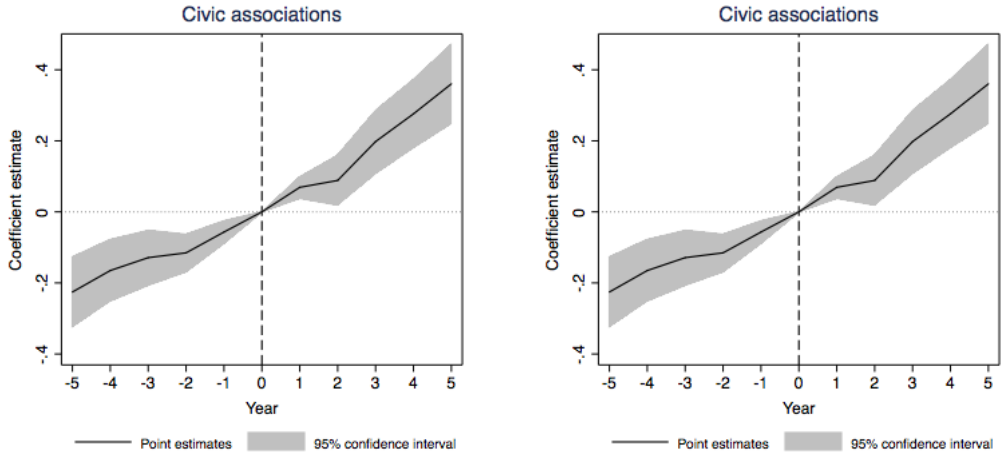

Figure A6: Event study of telegraph access and institutional development

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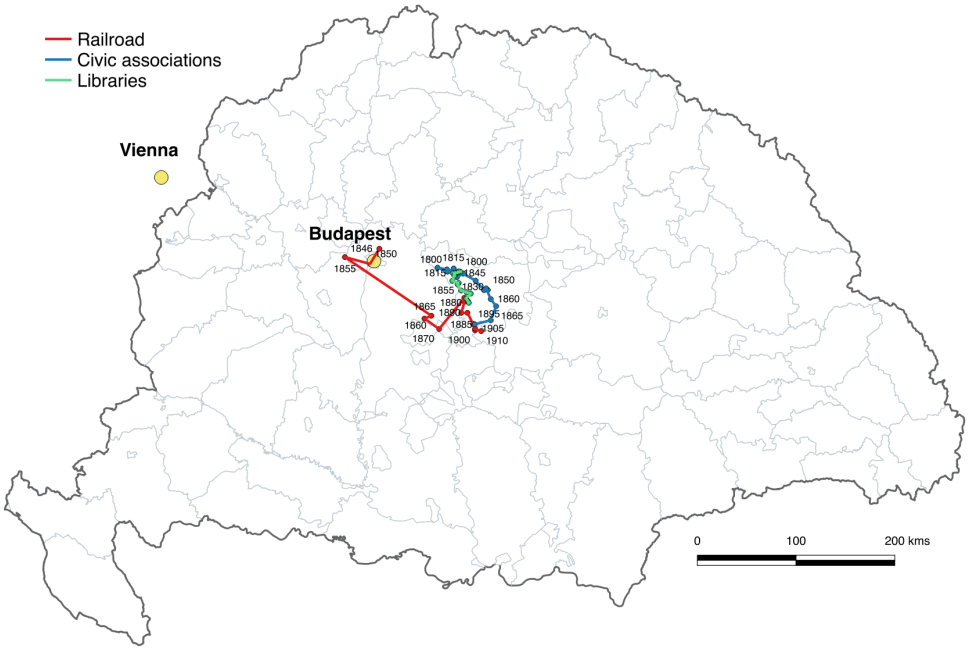

Figure A7: Spatial diffusion of railroads and institutions in 19th-century Hungary

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Table A1: Institutions used in the empirical analysis

Institutions	Data source and availability	Sample period	Total number	Number in sampled townships
Civic associations	Societies and associations of Hungary in 1878 (Official Statistical Publications, 1880) http://konyvtar.ksh.hu/inc/kb_statisztika/Manda/HSK/HSK_1880_2.pdf	1800-1878	3981	3366
Libraries	Public and private libraries of Hungary (Official Statistical Publications, 1886) http://konyvtar.ksh.hu/inc/kb_statisztika/Manda/HSK/HSK_1886.pdf	1800-1884	2346	1991
Theatres	History of Hungarian theatre (Hungarian Theatre Museum and Institute, 2001)	1800-1910	62	62
Journals	Bibliography of the Hungarian Press (1705-1849, 1850-1867, National Szechenyi Library, 1986, 1996)	1800-1867	1100	1092
Cafés	Address book of hotels, restaurants, pubs and cafés in Hungary (eds. Karoly Zsovak, Schmidl Ny., 1911)	1910	1696	1429
Thermal baths	Thermal baths and sources of the Hungarian Kingdom (Hungarian Balneological Society, 1991)	1910	273	148

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	DEPENDENT VARIABLE							
	Civic associations		Libraries		Theatres		Journals	
	Pooled CS	Town FE	Pooled CS	Town FE	Pooled CS	Town FE	Pooled CS	Town FE
5 years before	.013	-.041	-.041	-.007	-.029***	.011***	.041	.083
	(.048)	(.044)	(.038)	(.014)	(.009)	(.003)	(.037)	(.110)
4 years before	-.035	-.084**	-.043	-.009	-.031***	.009***	-.007	.033
	(.045)	(.035)	(.041)	(.011)	(.009)	(.002)	(.031)	(.097)
3 years before	-.056	-.107***	-.037	-.004	-.033***	.007***	-.017	.024
	(.050)	(.030)	(.042)	(.010)	(.009)	(.002)	(.049)	(.076)
2 years before	-.046	-.099***	-.040	-.006	-.035***	.004***	-.048	-.009
	(.050)	(.025)	(.045)	(.007)	(.009)	(.001)	(.061)	(.079)
1 year before	-.015	-.070***	-.042	-.008	-.036***	.002***	-.063	-.025
	(.052)	(.016)	(.046)	(.005)	(.009)	(.001)	(.082)	(.073)
1 year after	.158**	.097***	-.032	.000	-.041***	-.003***	-.079	-.044
	(.064)	(.025)	(.051)	(.001)	(.010)	(.001)	(.111)	(.079)
2 years after	.275***	.211***	-.029	.007	-.042***	-.005***	.228	.262
	(.076)	(.042)	(.057)	(.013)	(.010)	(.002)	(.189)	(.287)
3 years after	.361***	.292***	-.024	.013	-.045***	-.008***	-.132	-.101
	(.087)	(.059)	(.064)	(.022)	(.011)	(.003)	(.137)	(.102)
4 years after	.463***	.391***	-.012	.025	-.048***	-.011***	-.119	-.091
	(.094)	(.069)	(.060)	(.019)	(.011)	(.004)	(.204)	(.157)
5 years after	.536***	.463***	.003	.039*	-.045***	-.009	-.208	-.182
	(.104)	(.082)	(.060)	(.021)	(.012)	(.006)	(.227)	(.173)
Township time trends	Y	Y	Y	Y	Y	Y	Y	Y
Year FEs	Y	Y	Y	Y	Y	Y	Y	Y
Township FEs	N	Y	N	Y	N	Y	N	Y
Observations	104833	104833	112795	112795	147408	147408	90304	90304
R-squared	.683	.597	.822	.769	.909	.717	.807	.650

Table A2: Railroad access and institutional development - Non-linear panel estimates

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