Lund University
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Fertility, Modernization, Religion and Land Availability in Transylvania, 1900-1910

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Contents

1. Abstract

The period of 1880-1910 was a time of fast modernization and industrialization in Transylvania. Fertility decline only started in the South, while in the North there was a marked fertility increase. This paper attempts to explain these differences, using a cross-sectional analysis of fertility for 4112 Transylvanian settlements. The factors affecting fertility are modeled using the Eastrelin-Crimmins framework. The results show that an explanation placing economic factors (demand and supply) in first place, but accepting the secondary role of innovation factors as barriers to implement fertility regulation, fits the data about Transylvania well. This is in contrast with previous research results, which could not show the effect of some socio-economic variables on fertility, due to the high level of aggregation. They favoured cultural explanations, and shown Hungary as an exception to the rules of demographic transition. In contrast, this paper shows that the classic explanatory factors like infant mortality, migration, literacy, and secularisation do explain fertility differentials in Transylvania at the turn of the 20th century.

Key words: fertility, birth rate, Transylvania, fertility transition, modernisation, demand for children, secularisation, religion

Preface

I am grateful for the help of Elemér Mezei, Levente Pakot and Árpád Varga E., who were so kind to share their ideas and data with me, Sheila Robinson who reviewed an earlier draft, and my excellent teachers at Lund, especially my supervisor, Martin Dribe.

"We may only see that a moment is the last when we look back from the moment that follows it, what is necessarily late."[1]

Péter Esterházy

2. Introduction

2.1. Fertility, modernization, culture

Fertility decline is a dramatic social process, which has affected both our daily lives and the ways in which modern society and economy function. For centuries, population in Europe has been kept in balance at high level of fertility and mortality, the number of children was 6-8 per family, but high infant mortality, famines and epidemics counter-balanced this. Demographic transition can be considered as a revolution that has changed this in an irreversible way. In Western Europe it took place mainly during the 19th century. At first mortality and then fertility declined, and finally population growth slowed down again, and a new balance was achieved later at much lower family size.[2] By now the same process occurred or started all over the world, the majority of the world's population now lives in countries where the average number of children is between 1,3 and 3.

Demographers have been keen to understand this process, especially because the lag between mortality and fertility decline caused an eruption of the world's population.[3] The historic fertility decline of Europe is also well researched, so the reader may ask; why additional research on this area?

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1 The statement refers to the fact that it took the noble Esterházy family some time to realize that the changes are final and they have lost their privileges which they had for centuries. This may be likened to fertility transition, which was also a break with a very long tradition. When infant and child mortality started to decline, it may have taken some time for families to realize that child survival really had changed permanently and only then did they start to adjust fertility behavior. (The translation is by the author. Harmonia Caelestis, pg 368 - "Az utolsó pillanat utolsósága az utolsó utániból látszik, szükségszerűen későn")

2 The „new balance" is a theoretical simplification here, in reality, in many countries fertility continued to decline to bellow-replacement level, and birth rates vary in long swings (Bengtsson 1992).

3 According to Bongaarts and Bulato (2000, pg 2.), the World population increased with 3,5 Billion int he past 50 years, and it is projected to increase with another 3 Billion in the next 50 years. In 1900 the World's population was 1,6 Billion, and by 2050 it is projected to reach 9 Billion. (Bongaarts and Bulato 2000 Pg.18)

The main reason is that the causes of fertility decline are still not entirely understood, and hotly debated in literature. While it is tempting to attribute fertility decline to modernization and industrialization, as traditional demographic transition theory has done, some empirical studies, especially the ones done in the framework of Princeton European Fertility Project (Watkins, 1986), have not found statistical evidence for this. Instead they have proposed a "diffusion" explanation, which assumes that methods of fertility controls were not practiced, either because they were not known or because they were culturally unacceptable. So in their view culture, secularization and communication were the most important factors in fertility decline. (Cleland and Wilson, 1987)

More recent results cast some doubts on the methodology of the Princeton project. It is now believed that the failure to show the link between modernization and fertility decline was probably due to the high level of aggregation, as the project used county level data, and most counties included both urbanized and rural areas. (Brown-Guinnane, 2007) Recent studies, re examining the modernization-fertility link using smaller units of analysis, and more advanced statistical methods, arrive at the conclusion that while the Princeton project was correct in identifying cultural factors, it has underestimated the socio-economic factors in fertility decline. (Galloway, Hammel and Lee, 1994; Brown and Guinnane 2002, Dribe 2008) My research may be considered as a small-scale contribution to this wave.

2.1.1. Land availability

My interest regarding land availability is due to the fact that many researchers consider this to be the most important factor in Hungarian literature. (Andorka 2001, Pakot, 2008) We may also refer to the fertility decline in North America, where frontier areas in the west had higher fertility, while inability to increase cultivated land in eastern states caused fertility decline. (Schapiro, 1982) Due to this theoretical importance and the key role of agriculture in Transylvania, land availability will be considered separately, even though it could also be regarded as just another socio-economic factor.

2.1.2. Transylvania

Transylvania is known internationally as "the home of count Dracula". In my view it is more truthful to consider it as a cultural treasure land, where Rumanian, Hungarian and German nationalities, having Catholic, Protestants and Orthodox religions lived together for centuries, strongly preserving their own, colorful cultural identities. Many villages preserved their folk

costumes, dances, embroidery and pottery, the list of cultural treasures would be endless. Just one well known example: Bela Bartok collected folk music between 1907 and 1909 in Transylvania, both among Hungarians and Romanians, and discovered some old folk songs that struck him with their ancient motifs and structural simplicity. The influence often appeared in his famous works, like the „Rumanian Dances" and "Evening with the Szeklers".[4]

Although artists and ethnographers discovered Transylvania a long time ago, it has received relatively less attention from historical demographers. We may only hope that the recent efforts of the team of Babes-Bolyai University mark the beginning of a new era in this respect. They have recently started a major project to digitalize and re-publish historical data sources on a village level. I am grateful that they have made available some of these data for my study.

Transylvania provides a special testing ground for examining the interrelationship of culture and fertility. Many theories and empirical studies have stated that culture was an important determinant of fertility in Europe. In Transylvania, there are no clear language boundaries; the different ethnic and religious groups live closely together. On a county level we often find a large mix. Consequently, many differences were "aggregated out" in earlier studies, which took the counties as unit of analysis. (Demény 1968, Lengyel Cook and Repetto 1982, Dányi 1977, 1991) In our village level analysis it is worthwhile to re-check the known relationships, like the higher fertility of Catholics.

Few other datasets provide similar opportunities to examine a country at such an early stage of fertility transition. In addition, most existing information is about countries with late marriage patterns. It is more difficult to find good quality data about Eastern Europe, where marriage was early, and control of pre-transition fertility consequently followed a different logic. As Demény noted, "elsewhere in Europe data of similar standards became available only at a substantially more advanced level of economic and social development". (Demény, 1968)

[4] Source: Ferenc László : Bartók Erdélye - Erdély Bartókja

2.2. Research question

The main research question is: What were the determinants of regional differences in fertility in Transylvania during the period of 1900-1910 on settlement level? This is meant in the context of the debate about innovation or adjustment. Are these differences primarily explained by regional differences in socio-economic factors (modernization and industrialization), or were cultural and religious differences more important in determining the level of fertility?

Although land availability was often proposed as a key factor in the Hungarian literature, this hypothesis is mainly based on case study evidence, and it has not yet been tested on a village level using econometric methods.[5] My dataset makes this possible, although only using a crude measure, population density.

A cross-sectional dataset has been gathered for Transylvania on a settlement level, which includes 4112 settlements, for the period between 1900-1910. As I am going to show on county level maps for the 1880-1910 period, the differences in fertility by region are mainly the result of recent changes, as modernization triggered large increases in some areas, and large declines in some others. Therefore, I think that we may infer some things about fertility decline from the data, although obviously not without caution. We may also get an indication regarding which theory fits to the Transylvanian data the best.

My initial assumption was that ***both*** economic ***and*** cultural factors are important in case of Tranylvania. For this reason I have selected the integrative framework of Easterlin-Crimmins (1985) which has in fact turned out to fit very well to the data on hand. This model is primarily a microeconomic model of fertility, so an "adjustment" theory, seeing fertility as the result of the interplay of three main factors, demand, supply and cost of fertility regulation. But it also integrates sociological approaches in the notion of "cost of fertility regulation", so it enables me to include variables like secularization and religion as well. The model also helps to explain why fertility may increase shortly after modernization, as it happened in North Transylvania.

[5] The work of Őri (2003, 2006, 2007) uses econometric methods, but it concentrates on one county, Pest Pilis Solt in more detail. Other authors, like Lengyel Cook and Repetto (1982) have used county level data only, which would make density measures very crude.

2.2.1. Out of scope

Detailed analysis of individual villages is out of scope. Deeper analysis of county level data is also out of scope. Due to the small scale of this project, I could not think of extending the dataset by data entry, even if the existing variables could only be used with some compromise. It is out of scope to analyse in detail the differences between the content of Catholic, Orthodox and Protestant religious teachings in contemporary Hungary, and the effect of this on fertility. This would require a qualitative approach. However, I plan to review relevant research and include a measure of secularization in this respect.

2.2.2. Uniqueness

To my knowledge, no one has analyzed these village level data from the point of view of fertility transition on such a large scale. The data has only recently been digitalised, with a different purpose in mind (to re-publish the old statistics according to the new territorial units). So the research may provide an interesting insight into the historical demography of Hungary and Romania.

3. Background

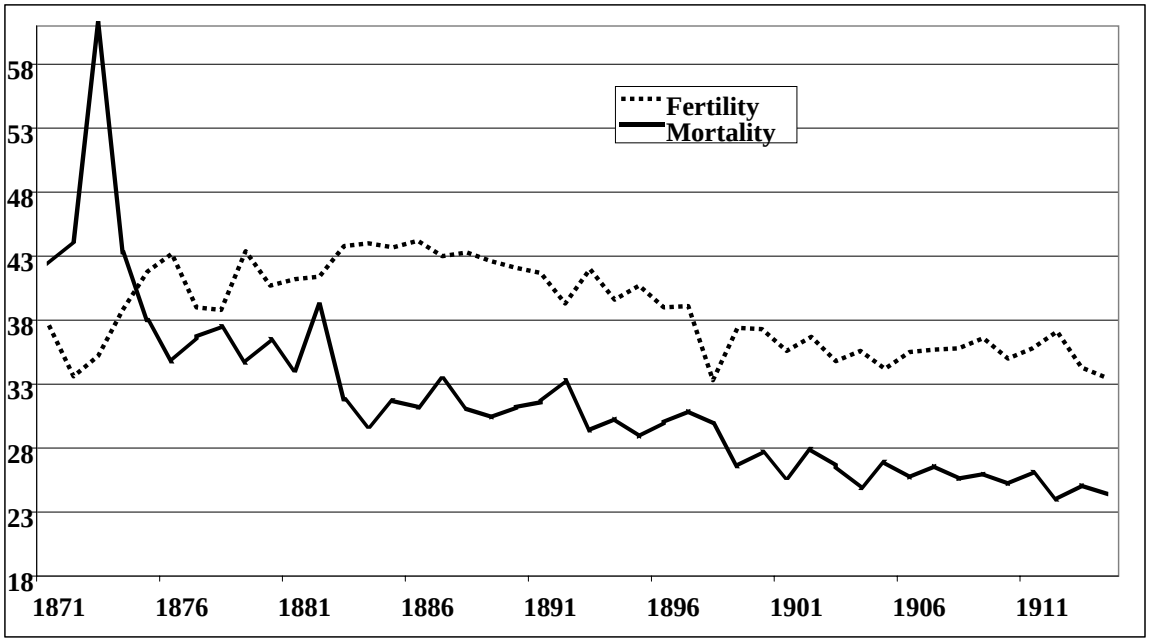
Before engaging in more detailed analysis using settlement level data, it is worthwhile to have a look at the general picture on a county level. Princeton indexes for Hungary have already been used in several other papers, but as not specifically for Transylvania. Besides the fertility maps, I have prepared some more maps showing economic and social variables for Eastern Hungary. Although putting these maps side-by-side is a rather simple approach, it is a useful starting point, because it helps to nail down some basic facts about fertility decline in Transylvania, which are fundamental, but not easily available from other papers.

3.1. Fertility decline

The data of Ghetau show, that after the 1873 cholera epidemic[6] there were no country-vide infections, and mortality declined steadily. Fertility first increased, than also started to decline, but the gap between the two has allowed a fast natural population increase over our period, which amounted to 0,9-1% per year (Varga, 1998)

[6] Int he last Cholera epidemic of 1872-73, 2,18% of the Transylvanian population got sick and 0,88% died. (Bolovan and Bolovan, 2003. pg 129)

Figure 1. Crude birth rate and crude mortality rate in Transylvania 1871-1914



Source: Gheţău 1997. ; Csata-Kiss 2007

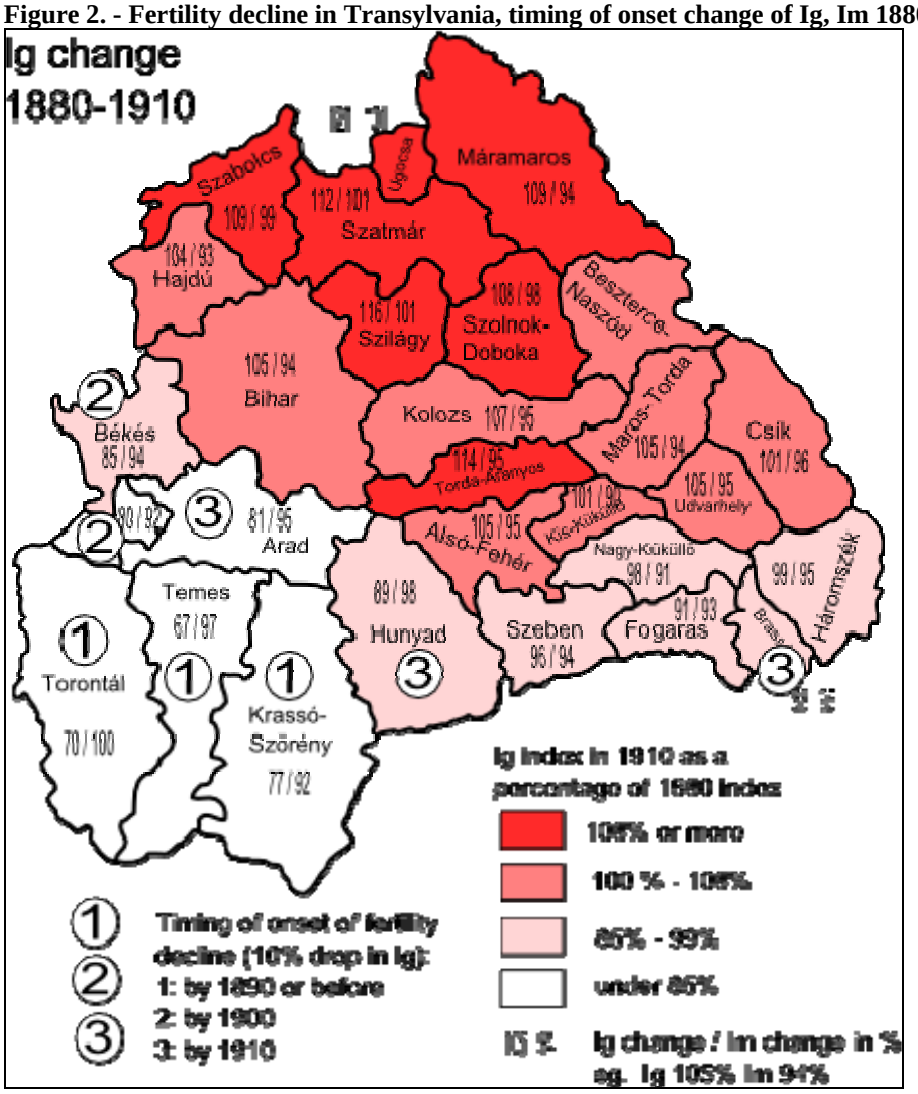
According to the estimate of Gheţău, the decrease of crude birth rates shown above corresponded with a decrease of total birth rate from 6 (in 1880) to 5 (in 1910).

3.2. Historic maps, telling the story of fertility decline

There were large regional differences both in the initial level and the pace of fertility decline. First of all, we have to note that for about two-thirds of Transylvania, fertility decline did not start until 1910. The onset of decline, using the Princeton definition, is the decade when marital fertility (I_g)[7] first drops by 10%. I have calculated this in case of each county. The decline started in the south (Torontál, Temes and Krassó counties) in the decade 1880-1910. As the initial level in Krassó was rather low, it is possible that the decline there started before our study period. After 1890, the decline spread to some neighboring counties on the southwest, and Brasov.

[7] Ig is the index of marital fertility, which compares the fertility of a given population to a theoretical maximum, the fertility of the Hutterits, who did not exercise any birth control. This benchmark was required, because often we do not know the age of mothers at birth, but we do know the age distribution of married woman. Similarly, Im compares the intensity of marriage (or marriage postponement) to the Hutterits, weighted with Hutterite fertility by age group. For an explanation of Princeton indexes, see the Data appendix.

Figure 2. - Fertility decline in Transylvania, timing of onset change of Ig, Im 1880-1910



(Source: see Data appendix.)

The map shows clear vertical clustering.[8] There are four sub-regions, showing different demographic strategies in this period. The four regions may be described as follows:[9]

1. Southwest: big drop in marital fertility, with some postponement in marriage
2. Southeast: moderate drop in marital fertility, with significant drop in marriage index
3. Middle part: increase in marital fertility is balanced by a similar drop in nuptiality
4. North: large increase in marital fertility, while nuptiality is stable

The following map shows the level of fertility achieved as a result of these changes. The two maps are quite similar. (Figure 3.) We see the biggest difference in case of Beszterce Naszód,

[8] While the settlement level dataset used in later sections is limited to the areas now belonging to Romania (current Transylvania), here I have included also those counties in full which were cut to two parts by the Trianon border. So here we are analyzing a somewhat broader territory, the east part of historic Hungary.

[9] For the explanation of Ig and Im, see Data appendix

where the initial level of fertility was very low – we will see some case study evidence that this was probably due to early fertility decline in some social groups. From this low level, here was no further decline in our period in Beszterce-Naszód.

Figure 3. – Marital fertility by county in 1910

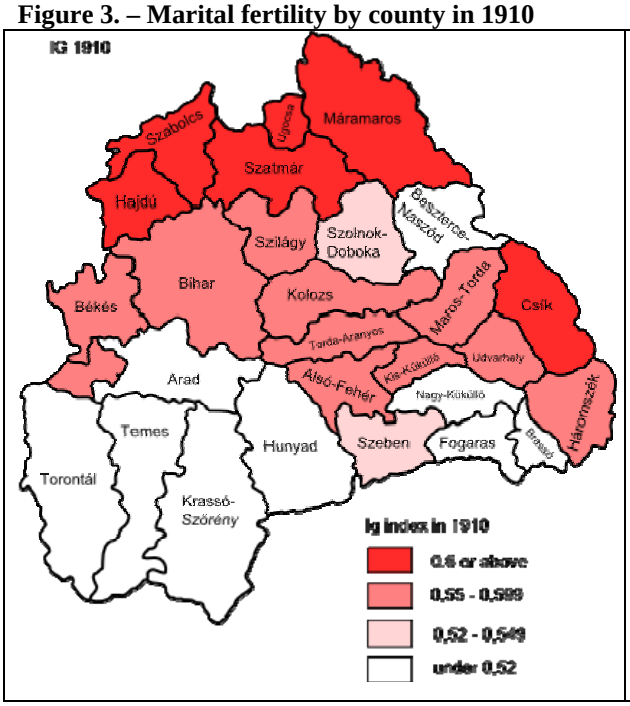
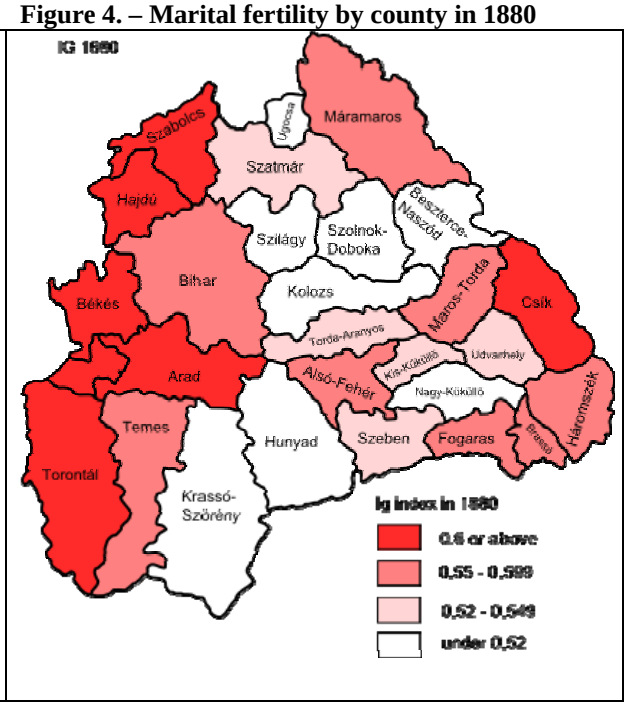


Figure 4. – Marital fertility by county in 1880



(source: see Data appendix)

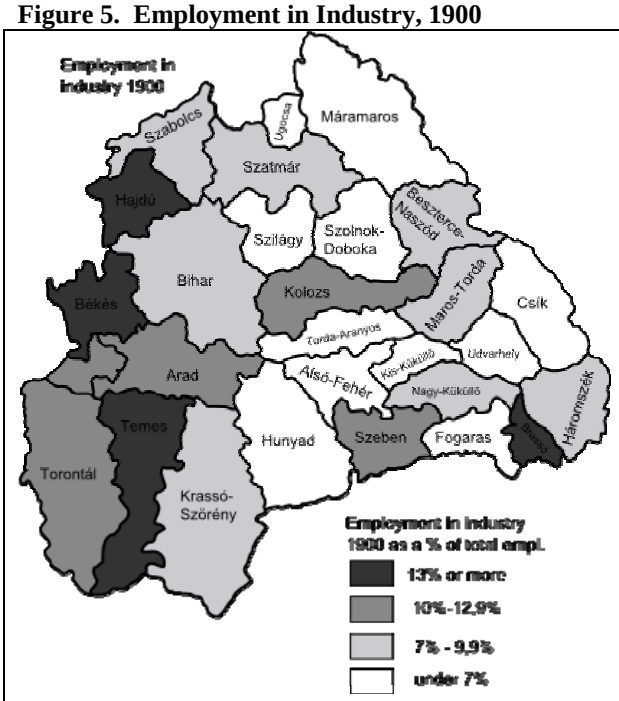
3.2.1. Socio-economic background

Now we turn to the picture of socio-economic development. There are several indications that the industrial revolution started in the south, and the northern part lagged behind. So there is some match with the picture of fertility. Let us look at this in some detail.

The period of 1967-1910 was one of the few golden ages of Hungary. Modernization was late, and only partial, especially in Transylvania. After the abolition of serfdom in 1848, the capitalist development could finally speed up, although the aristocracy remained strong and the country remained predominantly agricultural. Agriculture still dominated employment with a 70-80% share. During the second half of the 19th century the development of the road system and train network speeded up. The development was generally faster in the southern part than in the northern part. In 1860 there was a 230 mile road network, two-thirds of which was in the southern part. As a result, Vienna could be reached in 3-4 days, where earlier it took due to the bad roads. (Szász 1986, pg. 1513-1515) There were two competing routes for the first train line, one in the south (Arad-Gyulafehérvár) and one through the center (Kolozsvár-Brassó). The southern line gained the support of the Rotschilds, and it was built first, and had reached the mines of the Krassó-Szörény region by 1870. The second major

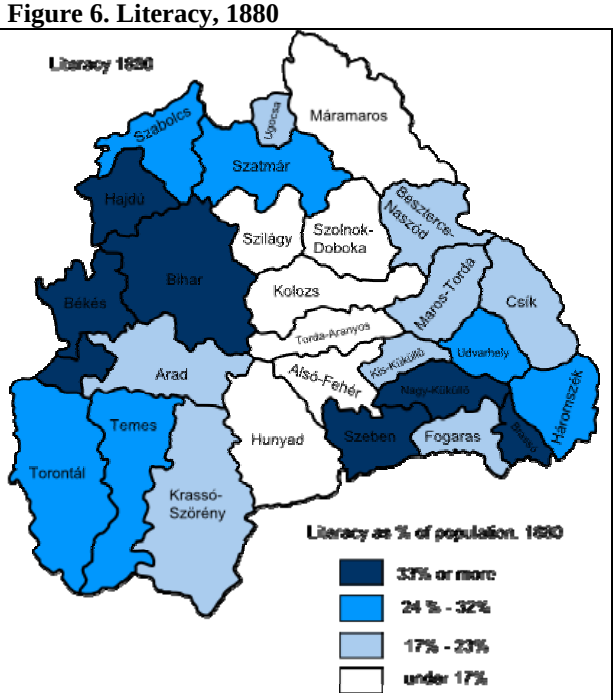
line was built parallel, and had reached Brassó by 1873. The banking system also rapidly developed. (Szász 1986, pg. 1513-1515) After 1850 a large program was started to cultivate rivers and regain land, increasing the available land area substantially.

Figure 5. Employment in Industry, 1900



Source: Magyar Stat. Közl. 64. pg 215

Figure 6. Literacy, 1880



Source: Census 1881, see data appendix

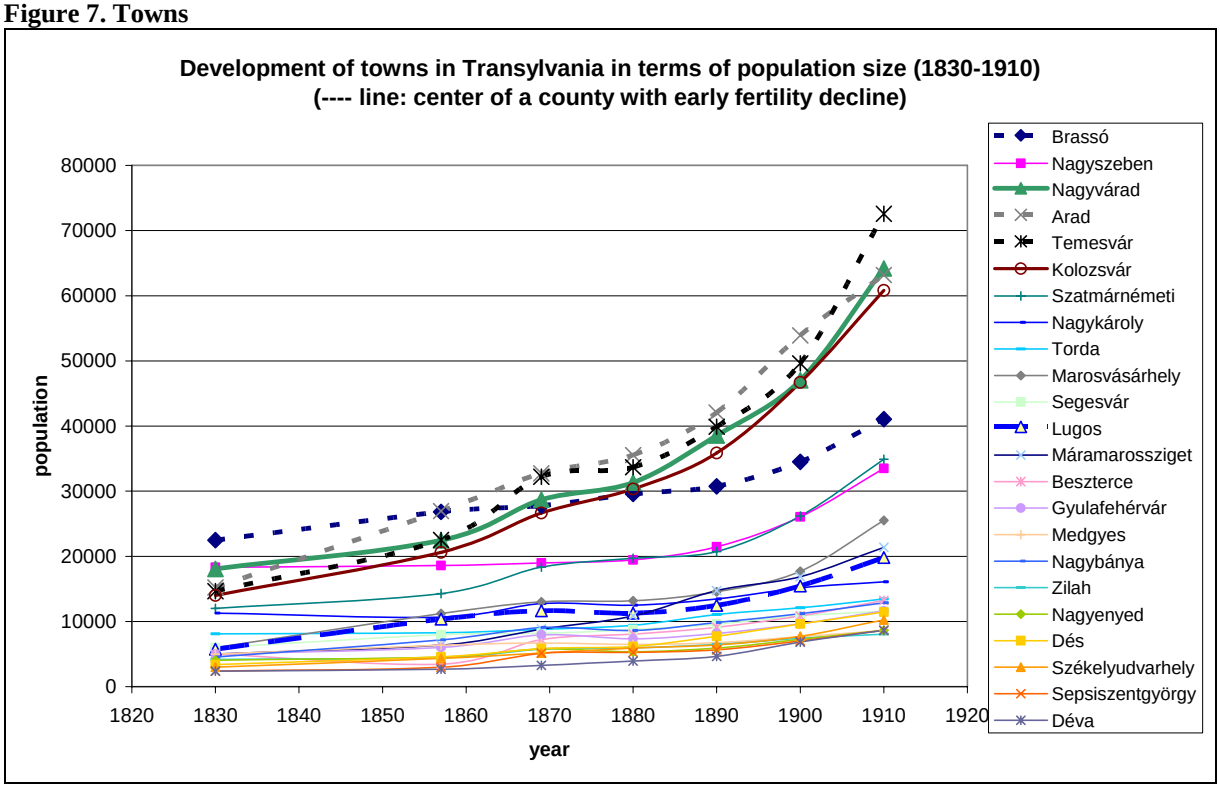
On the industrial map of Hungary (Figure 5.) we see that in the southern part of our study region, industry had a higher share in employment. Although this map does not show the type of industry, I would like to note that heavy industry, based on local coal and iron mines was strong in Krasso and Hunyad, while Temesvar and Arad were important, fast growing industrial towns. So even though in the southern fertility decline area the rate of industrial employment was still moderate, the sectors which were critical for the industrial revolution were concentrating here within Transylvania.

However, there were still many isolated villages, which remained unaffected by these developments directly. North and middle Transylvania were among the most underdeveloped regions of Hungary.

Literacy had increased from 21% to 42% in historic Transylvania over the period. (Figure 6.) The literacy map is very dissimilar to what we have seen in case of fertility.

In 1870 low-priced American wheat began to reach Europe, depressing exports from Hungary. Although protective customs of the Monarchy were favorable for farmers, demand was fluctuating. As these changes required a shift towards animal production and more labor-intensive methods, this has benefitted small and middle sized farms, which were more abundant in the South. (Lengyel-Cook and Repetto, 1982) The efficiency of agriculture also improved; the wooden plough was replaced with an iron-bladed version, and a new type of cattle became widespread. With the new plough and oxen, one pair of animals were enough for the work that earlier could only be done with two or three pairs. (Sebestyén, 2007)
There was rapid urbanization during the period, mainly due to internal migration. (Bolvan, 2003) The following chart (Figure 7.) shows population development of major towns. Many, but not all of the fast growing towns were in the southern early fertility decline region. Out of the **five** fastest growing towns **three** were the centers of southern low fertility regions: Temesvar, Arad, Brassó, shown with broken line on the graph)

Figure 7. Towns



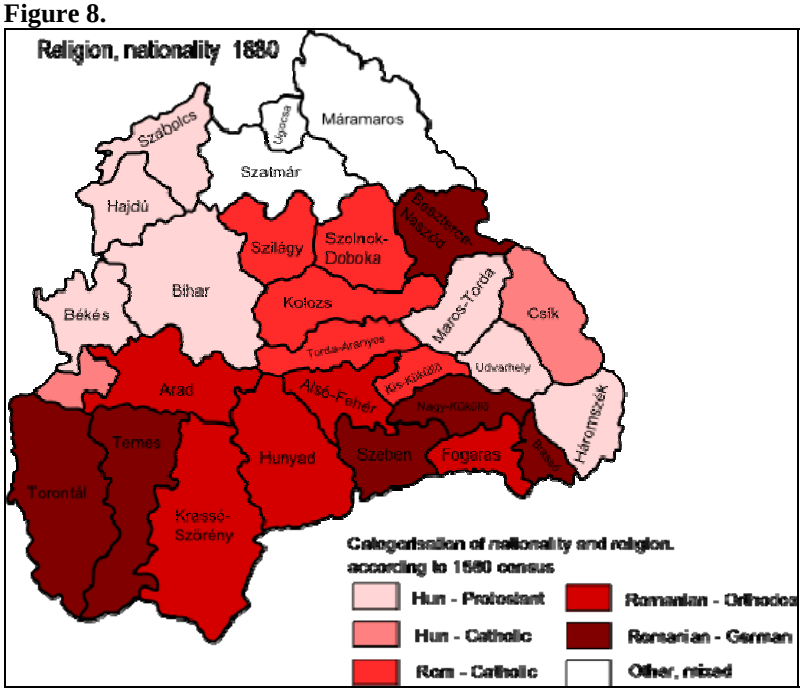
(source of data: Pomogáts, 1993)

3.2.2. Religion

Finally, I would like to show the map of religious and ethnic breakdown. The diversity is so large that it was difficult to make categorization, so the following map includes some simplification. Interestingly, there is some coincidence with the fertility map. Especially

striking is the correspondence of the Romanian-Orthodox and Romanian-German areas with the early fertility control region.

Figure 8.



source: Census, 1881 (see data appendix)

3.2.3. Summary of county-level analysis

To summarize, within our study period fertility decline only started in the southern part of Transylvania, while fertility increased or stagnated in the other two-thirds of the counties in the north and middle part of the region.

Fertility increase in the north was probably connected to improvement in living standards due to more efficient agriculture, starting from a high level of poverty.

Fertility decline in the south coincided with the southern polarization of the industrial development. Looking at these maps it seams to be likely that the spread of decline was probably faster within homogenous ethno-cultural regions. This is quite in line with theory, as we will see in the next section.

4. Theory

As Demeny put it, fertility decline is the central preoccupation of Historical Demography. (Demeny, 1968) This attention is justified by the fact that fertility transition was one of the most profound demographic changes that had affected our ancestor's lives on both macro and micro level. On macro level the fact that fertility decline often lagged behind mortality decline, caused a period of swift population increase, which in turn enabled fast urbanization.

On a micro level it had initially put pressure on families as more children survived to adulthood, and finally it has reduced family size. (Davis, 1963)

Fertility transition is an elusive phenomenon. Demographers naturally want to explain why these changes took place, but this appears to be an extremely difficult task. As Hirschman stated: “broad empirical generalizations were perhaps simpler tasks in an age with little empirical data”.(Hirschman 1994 pg. 204) There is no consensus about the correct theory. Often there is an empirical counter-evidence against the ground rules that once were thought to be universal.

In this section I would like to give a very brief overview of the main theories, and discuss some of the key debates. Following this I am going to introduce the Easterlin-Crimmins (1985) model in more detail as the rest of the paper is mainly based on this approach.

4.1. Overview of theories

4.1.1. Malthusian checks, and the link between living standards and population

As with other plants and animals, humans beings have a tendency “to increase beyond the nourishment prepared for it”. (Malthus, 1803 pg. 14) In other words, in pre-industrial societies population had a tendency to grow at a higher rate than the available food supply. Malthus mentioned two mechanisms which keep population in line with the available food supply: positive checks and preventive checks. Positive checks are “vice and misery”, higher mortality due to famine, wars and bad living conditions. The only way to avoid this is to apply preventive checks, through later marriage and restraint within marriage. (Malthus, 1803) This is what we call the “Malthusian trap”.

More recent research, comparing the real wages and food prices on longer time series for the UK and Sweden show, that regarding pre-industrial societies Malthus was indeed right, but during the 19th century, technological revolutions opened the trap, and resources were no longer a constraint to population growth. (Wrigley-Schofield 1981; Bengtsson 1992) This change is sometimes referred to as “modern economic growth” (Kuznets, 1973)

4.1.2. The classic model and sequence of demographic transition

Although demographic transition has many variants, it is useful to show what the classic model is briefly. In the pre-transition societies mortality was high, and it also fluctuated due to infectious diseases. A break in this respect occurred at the beginning of 19th century in Western Europe, and around 1880 in Transylvania, when infectious deceases were brought under control. This meant more surviving children, which caused population pressure: the reaction could be out-migration, increase in cultivated land, extension of the family size, and finally, fertility control. (Andorka, 2001; Bengtsson 1992, Davis, 1963, Dribe 2008; Lee 2003)

According to this classic view, the introduction of fertility control was a major breakthrough, because in pre-transition societies marital fertility was "natural", in other words fertility was outside the "calculus of conscious choice". (Wrigley 1981) This means that only social and biological factors affected fertility, the couple did not deliberately increase birth intervals (spacing behavior) or did not aim at a certain family size (stopping behavior). (Friedlander, Okun, and S. Segal, 1999)

4.1.3. Innovation or adjustment?

The main debate is about as old as the demographic theory itself: the question of innovation or adjustment (This classification has been developed by Carlsson, 1966).

Innovation

The idea that fertility transition was an innovation or diffusion process, may be traced back to the 1925 study of W.H. Beverage, who claimed that fertility transition should be understood as another case of technology spreading. (Szreter, 1996 pg 13.) A more recent development in this area is the "ideatational theory" of Cleland and Wilson (1987). This argument essentially says that fertility control was either not known, or was not acceptable culturally before the transition, and to understand it we need to examine the way the new ideas spread in society. If we take this approach, cultural and language barriers are important, as well as geographical position, social networks, communication due to improved traffic and mass media. However, Schultz argues that this theory "has not yet evolved to a form that is empirically distinguishable". (Schutz 2004, pg 5578)

Adjustment

The idea that fertility transition is a process of adjustment to changed social and economic circumstances may be traced back to a 1944 article by Frank Notestein, the father of Demographic Transition Theory. Notestein argued that the whole process of modernization is responsible for fertility decline, because it has changed the context in which decisions about childbearing are made, and this process is more important than mere knowledge of fertility control methods. (Szreter, 1996 pg 19-20) He argued that there is evidence that these methods were known earlier, but "not widely used until the incentive for birth restriction became strong". (Hirschman, 1994, pg 211) The weakness of this initial theory is that it allowed a large spectrum of variables under the umbrella of "modernization", and did not say much abut their interrelationships and relative importance.

The role of the Princeton Project

The old idea of "innovation" gained new strength when the Priceton European Fertility project could not demonstrate a relationship between the onset of fertility limitation and development (socio-economic modernization), and found instead that spatial variations are often due to differences in culture. (Watkins, 1986) Their basic argument was that fertility decline occurred within a few decades in most of Europe, in spite of very different levels of economic development and urbanization. However, most recent studies demonstrate that they may have underestimated the importance of economic variables due to the too high level of aggregation, and incorrect handling of the time dimension. (Galloway at al 1994; Brown and Guinnane, 2003, 2007) Using smaller units of analysis they could confirm the relationship between modernization and fertility decline.

Economic theories of fertility decline

Demand theories of fertility (or "New home economics") can be regarded as a further development of the adjustment approach. Gary Becker applied microeconomic theory to the decision of childbearing, and likened the decision involved with that of purchasing consumer durables. In this context, fertility would grow with income, other things being equal. Decline may be due to the availability of alternative goods, and the increase in the opportunity cost of mother's time, and the substitution of child quality to quantity. (Cleland and Wilson, 1987 pg 8-9; Friedlander at al 1999 pg 502-503)

In this paper I am going to use the Easterlin-Crimmins model, which is an attempt to integrate economic theories of fertility with sociological approaches and the notion of proximate

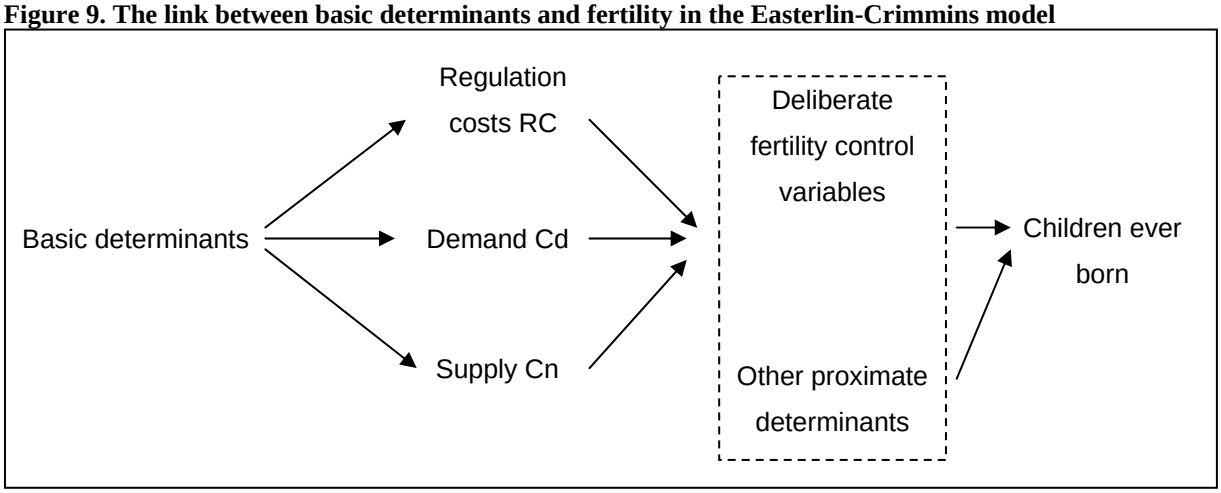
determinants. Although Easterlin recognizes the role of culture as effecting supply, demand and cost of contraception, he sees economic change as the primary force behind fertility transition. (Friedlander at al 1999 pg 504-505; Easterlin,1985) This is fully in line with how I see the transition in Transylvania.

4.2. The Easterlin-Crimmins model

4.2.1. The theoretical model

Easterlin's model integrates previous theoretical approaches, although it is primarily an economic or demand model of fertility. While the traditional approach was to seek direct links between modernization and fertility, he adds two more layers in-between, which help to show how modernization effected the micro-economic decision making process, and how this relates to the number of children ever born.

Figure 9. The link between basic determinants and fertility in the Easterlin-Crimmins model



source: Easterlin and Crimmins, 1985 pg. 13.

The first layer comprises of the elements of the economic decision: regulation costs, demand for children, a supply of children. (Figure 9.)

1. Demand means demand for *surviving* children, or desired family size. As we have seen in case of Becker's microeconomic theory, demand for children is determined in a similar way as that for consumer durables. It is a function of income, and the relative preferences for other goods. Fertility may decline in spite of the raise of income, either because other goods appear, which are more attractive, or because the opportunity costs of mother' time and with that the cost of childrearing increases, which induces parents to substitute child quantity with child quality.

2. Supply is the number of *surviving* children a couple would have if they made no deliberate attempt to control fertility. This builds in notion of natural fertility into the model, but it is also influenced by infant and child mortality.
3. Cost of fertility regulation includes both the subjective factors, like norms prohibiting birth control, and economic ones, like time and money required to exercise family planning.

Supply and demand has to be equal in "perfect contraceptive societies", where contraception is costless, both financially and morally. So this is where Easterlin built in the "ideatational" approach: the costs of fertility regulation may be high in a society, which may mean that unwanted children are born. (Freadlander et al, pg 504-505, Easterlin and Crimmins, 1985 pg. 15-17)

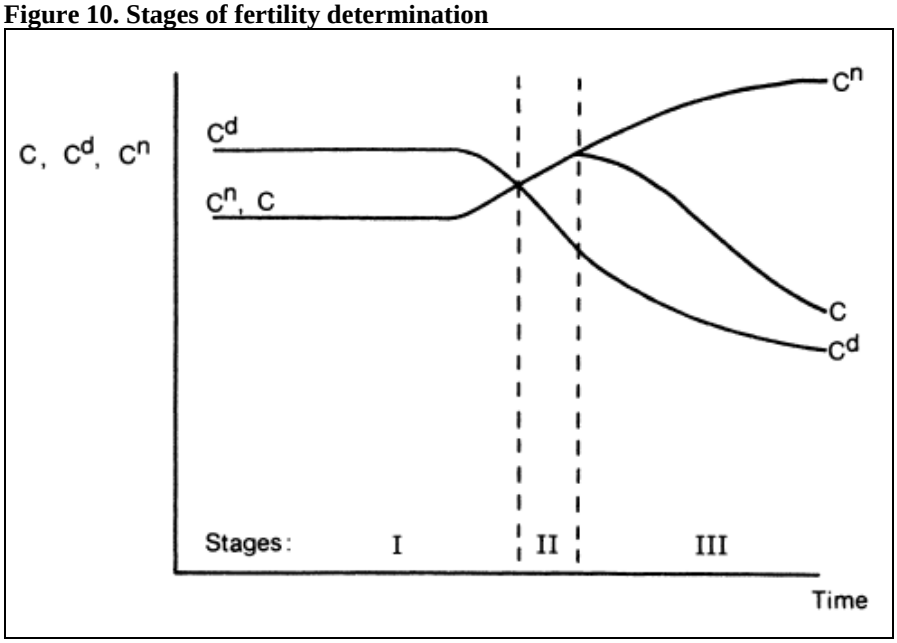
The second layer of the model comprises of the biological factors that determine fertility directly. This integrates the "proximate determinants" approach of Davis&Blake and Bongaarts into the model. Proximate determinants are exposure to intercourse, fecundability, duration of postpartum infecundability, spontaneous intrauterine mortality, sterility, and deliberate fertility control, like contraception and induced abortion. (Easterlin and Crimmins, 1985 pg 13).

If there is a big gap between supply and demand, then there is a strong motivation for adoption of deliberate fertility control, and once this resistance is broken the costs of fertility regulation tend to decrease, opening the way for further decline.

The following graph (Figure 10.) shows a hypothetical sequence, how modernization may affect fertility in this model.

I. In traditional societies the supply is below demand, so there is no need for fertility control within marriage.
II. As modernization both reduces the demand (Cd) for children, and increases supply (Cn) due to better nutrition and lower infant mortality, so an excess supply condition emerges. The number of surviving children (C) corresponds supply (Cn).
III. This generates motivation for fertility control, and when it is large enough to offset regulation cost, deliberate restriction starts, the number of surviving children (C)falls and gets closer to demand. As fertility control becomes accepted, the number of children becomes determined by demand, and C and Cd become nearly equal.

Figure 10. Stages of fertility determination



source: Schapiro 1982. pg 59

4.3. Application of the Easterlin-Crimmins framework to the data about Transylvania

In the following sections I show demand, supply and fertility regulation factors in some more detail, linking them more closely to what we know about Transylvania in this respect. I also touch upon the issue of measurement: what variables were available for me to measure these effects in my fertility model. A single "basic determinant" may have multiple effects. For example education increases supply due to better health, decreases demand due to higher opportunity costs and decreases the costs of fertility regulation. I am going to close this chapter with a comprehensive table which summarizes this information.

4.3.1. Proximate determinants

In my view, the three main proximate determinants in Transylvania were the following: "coitus interruptus", social norms reducing frequency of intercourse and to a lesser extent, abortion.

Coitus interruptus

The European fertility transition has been mainly achieved using coitus interruptus. (Lee, 2003 pg. 174) Lesthaege(1977) considers the various contraceptive methods available before the 20st century, and concludes that most methods were either not widespread (like condoms)

or ineffective (like some folk methods). Coitus interruptus however, was effective on aggregate, and it was known in Belgium. The problem with it of course was, that both Catholic and Calvinist clergy prohibited it, labeling it as the "crime of Onan". (Lesthaege, 1977 pg 98-100) An early study of the appearance of one child system in Hungary refers to the "French method", which was supposedly brought into Hungary by Napoleon's soldiers, settled in Hungary after the occupation of Vienna in 1805, and this knowledge spread from their families in the whole area. (Buday, 1909) Although this story may or may not be true, this early study documents that coitus interruptus was also known among Hungarian peasants.

Social norms effectively reducing frequency of intercourse

The Eastern European marriage pattern meant that although early marriage was allowed, the young couple often had to stay with the parents, forming an extended family. The age of becoming household head was later than in Western Europe. (Paládi-Kovács 2002 /VIII.-465. pg) In connection with this, there were a number of social norms which could affect the exposure to intercourse. Sociologists believe in a kind of functionalist explanation, which says that there was a coordinating force, operating well beyond the level of individual choice, helping to achieve demographic homeostasis. (Lesthaege, 1980 pg 528)
We know that in Western Europe this balance was mainly achieved through postponement of marriage. We have limited understanding of how this may have worked in Hungary, where early marriage was usual, and celibacy rare. It may have worked through taboos regarding the period of lactation, or the length of lactation. The couple may have been temporarily separated due to the needs of seasonal agricultural work or social custom. From ethnographical sources we know that the village gossip often punished those who had too many children. In Csikszentdomokos village[10], Balazs notes that in the community targeted 5-6 children, and both those having less, and those having more were sanctioned by the norms.(Balázs, 1999)

Abortion

Davis (1963) contrasted Europe with Japan, and stressed that the role of abortion in fertility decline may have been high in Europe, just the records do not show it because it was illegal.

[10] Csikszentdomokos is in Csik county, East Transylvania, with predominantly Hungarian Catholic population, where fertility was traditionally relatively high, and late to decline

In Barannya County in Hungary[11] Kéri (1995) reports some interesting documents about the methods of fertility control in 1885. This evidence comes from reports Calvinist priests sent to their Bishop about morality. According to these reports, abortion was frequent; it had been reported from several villages, like Old, Nagyvatyi, Kovacshida, Kolked. As abortion was performed by midwifes and not doctors, it often cost the life of the mother, as the methods were dangerous. Prevention by "coitus interruptus" was reported less frequently, only the priest of Szaporca mentioned this practice. (Kéri, 1995)

Balazs Gemes (1987) ethnographer studied the methods of fertility control in Hungary in the 19th and 20th century based on archives, legal documents and his own interviews. He concluded that in most villages the fetus was not considered living until it had moved for the first time, so the **village norms usually allowed abortion**, it was not considered a sin. He documented a large number of methods that were used, like sitting into hot soapy water, using boiled herbs and roots or sharp objects. This indicates that induced abortion had a highly developed and refined culture. However, it is not likely that abortion had a major share in achieving fertility decline, because the technology was so basic that it could not be exercised in large numbers.

4.3.2. Cost of fertility regulation

We may talk about psychic costs and market costs of fertility regulation. These depend on the attitudes of society towards fertility control, and the availability of information and techniques. (Easterlin and Crimmins, 1985 pg 18) Although it is debated that diffusion is the main determinant of fertility decline, it is accepted that some populations may have higher levels of fertility because their culture places higher value on children. (Hirchman, 1994 pg 216) Methods of birth control can diffuse more quickly in culturally homogenous populations. "After a significant proportion of the population has already engaged in innovative behavior, the cost of those who follow are much less." (Hirchman, 1994 pg 224)

The role of religion

European studies often show higher fertility and later decline for Catholics than Protestants. (Derosas &Poppel 2006 pg 2-3) On the aggregate level, this is also true for Transylvania. (Bolovan, 2003) It is less clear, however, if this is only a **spurious correlation**, caused by

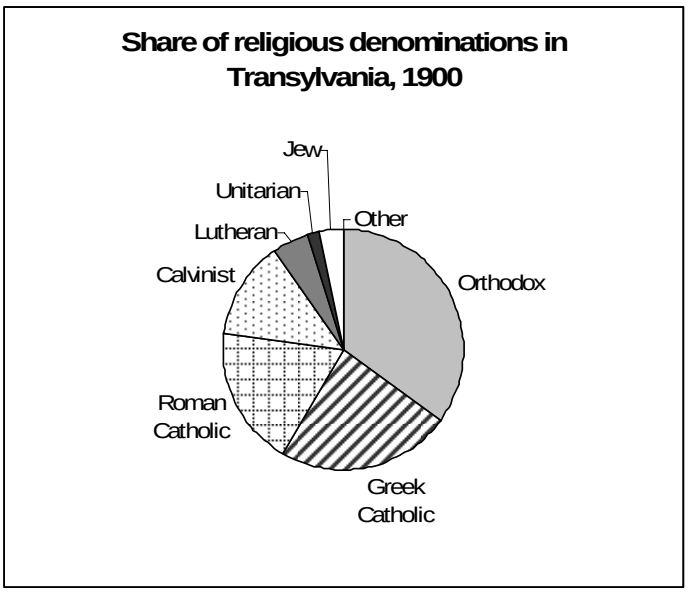
[11] Barany county is in Southern Transdanubia, outside of the study region, but practices in Transylvania were probably similar, in the lack of similar evidence I have quoted this one

some unmeasured economic differences between Catholics and Protestants, or a genuine effect.

The earlier belief that "birth control within marriage was unthinkable in pre-modern societies" cannot be upheld according to more recent research. (Lynch, 2006) New evidence suggests that the control of religion was weak. The approach of Protestant clergy did, in fact, differ in some aspects: the abolition of celibacy broke down the barriers between clergy and laity. Protestant priests did not seek intervention into married people's sex lives, but sought to regulate public life. Catholic clergy-lay relations followed a different path. Confessions were a vehicle to make more aggressive inquiries into the sexual lives of married couples. Although Catholic doctrine prohibited any form of fertility control within marriage, it was a problem for the priests to understand this doctrine and to articulate it to the congregation in full. During the Catholic Mass, they could only speak indirectly, using coded language about sexual matters, so the only effective vehicle was the confession. However, it is unlikely that the confession was used effectively either. This means that before the 19th or 20th century the viewpoint of the church may have been ambiguous for the laity in terms of coitus interruptus. (Lynch, 2006 pp 24-29)

What caused then the delay of Catholics in fertility decline, that we see in many countries of Europe? Praz (2009) gives an interesting answer to this question. She compares the content of religious communication in two Swiss cantons, a Protestant and a Catholic one around 1900. She finds that Catholic communication supported the right of husband to frequent sexual intercourse, and trusting Providence to bring up many children, while it was not open about sexual matters. Protestant discourse was much more open, and it targeted men, with the aim of changing their views regarding the norms of "respectable fatherhood". This has meant that man should take care to limit their offspring according to their ability to maintain children. As "coitus interruptus" required their active co-operation, this difference in norms was very important. This qualitative result is also confirmed with a quantitative approach using individual data for four villages: the differences in bargaining power of woman were much more important in case of Catholics than in case of Protestants, because Protestants fathers were more "enlightened" and followed the norms of respectable fatherhood anyway. (Praz, 2009)

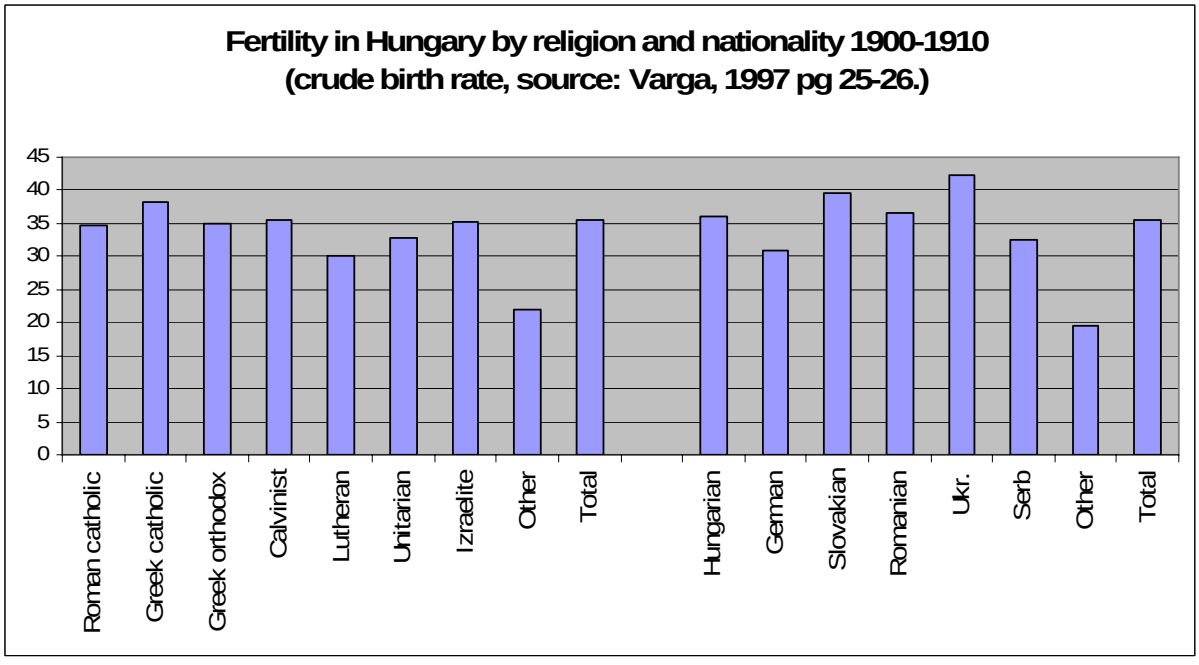
When we look at Roman Catholicism in Transylvania, we should note that the counterpart is not Protestantism, as in many European countries, but two other, more similar religions: Orthodox and Greek Catholic. Protestants had a minor share. (Figure 11.)



Data source: Varga E., 1997.

The main approach of Romanian Orthodox religion to fertility-related matters is highly similar to Catholics: marriage is regarded as a sacred institution, with the primary goal giving birth to children, and abortion is condemned. On the other hand, Orthodox religion is slightly more permissive in some areas. Priests are not allowed to be single, only monks may live in celibacy. As long as the idea of reproduction is not denied, sexual relationship between husband and wife may have different goal than producing offspring. (Ioan, B. Astarastoae, V 2006) Aggregate fertility data by religion and mother tongue are shown in the figure below.

Figure 12.



Bolovan states that the norms which regulated marriage and family matters in case of Ortodox and Greek-Catholics were the identical. (Bolovan 2008, pg 109)

Secularization in the literature

Besides the differences among the religions, it is also important to consider that the control of the church over the daily life of people decreased with modernization. Lesthaege(1977 pg 41.) defines secularization as the "breakdown of traditional religious authority". More generally, using the terminology of Max Weber (1887) we may refer to a change from value-rational (wertrational) to goal-rational (zweckrational) social behavior, because only this gives room to the economic explanations of fertility decline. Lesthaege (1977 pg 156-158) has shown that secularization, measured as the percentage vote for non-catholic parties was highly correlated to both the level and the change in fertility in Belgium around 1910.[12]

The question of measurement

A recent article by Bolovan and Bolovan (2008) gives some very interesting insights into the relationship of religion, secularization and fertility in Transylvania. The authors show a clear trend for secularization. On the other hand, the indicators show that the church was very powerful in mid 19th century, and retained large part of it's influence even in 1910. Bolovan uses three indicators to prove that secularization was gradually increasing in Transylvania in our period: mixed marriages, marriage seasonality, and divorce rates.

Although the proportion of mixed denomination marriages increased it still remained around 10% . [13] Considering the large geographical mix of denominations, these rates appear to be very low.

The other indicator suggested by Bolovan is the discrepancy of the monthly distribution of weddings. This has partly been caused by observance of norms prescribed by the church, which banned marriage ceremonies during religious feasts (Easter and Advent), and partly by the needs of agricultural work. Bolovan observes that there is a clear tendency towards a more smooth monthly distribution of marriages during the period of 1885-1910. (Bolovan 2008, pg 115)

Based on these results I have decided set up an indicator to show regional differences of secularization on county level.

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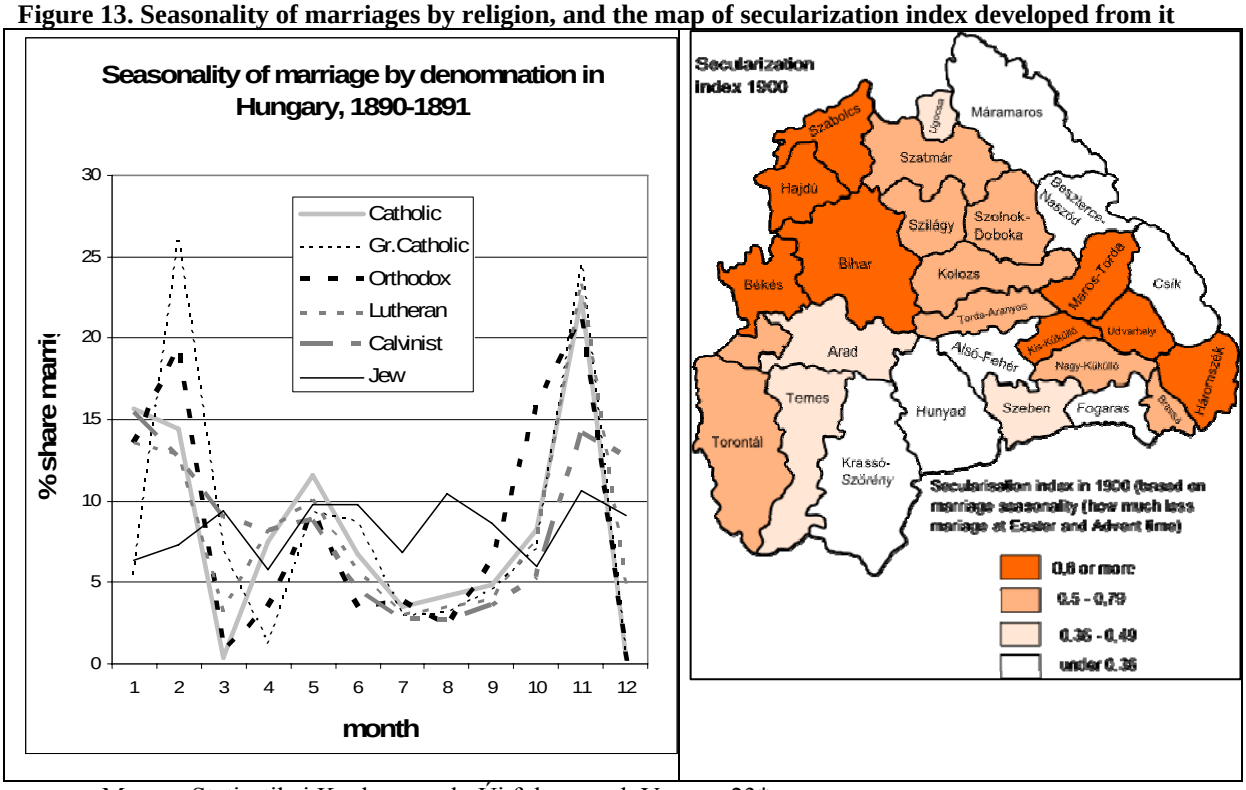
[12] Correlation coefficient between secularization and Ig 1910 was -0,8, while between Ig change and secularization it was +0,8 (Flanders) and 0,9 (Wallonia) between 1880-1910. (Lesthaege, 1977 pg 158)

[13] Bolovan shows that the rate of mixed denomination marriages have increased after the implementation of civil marriages in 1885. In some counties this only meant an increase from 0,8% to 2,8% in the share of mixed denomination marriages, but even in the most liberal ones the peak was 16-17%. (Bolovan 2008, pg 111)

As the following graph shows, during Christmas time, only Calvinist Protestants and Jews married, the three other religions were similarly conservative in this respect. During the Easter period the situation is similar. As fertility tends to be low in Orthodox communities it is interesting that this measure of secularization does not show any difference in their case compared to Catholics. (Figure 13.)

Figure 13. Seasonality of marriages by religion, and the map of secularization index developed from it



source: Magyar Statisztikai Közlemenyek, Új folyam vol. V. page 23*

The mapped ratio is defined as: (marriages in March +April +December) / (25% of yearly marriages) by county.

However, this variable was not successful in the model, because differences in seasonality were mainly due to the presence of Calvinists, and the variable produced the "wrong sign" when regressed with fertility.

Measuring secularization by **divorce ratio** (divorced *100/ married population) was easier, and it could be done on a village level. In spite of the fact that divorce was very rare, it clearly relates to secularization. So finally, I have used divorce ratio to measure secularization, not marriage seasonality. This variable performed well in explanatory model.

Variables used in our models

It is out of the question to include all religions, because if the percentages would add up to 1, that would create perfect multicollinearity. I have selected those about which we have clear

previous knowledge. The proportion of Roman Catholics, Greek Orthodox, and Germans. This leaves out Greek Catholics, and Lutheran and Calvinist Protestants, so multicollinearity is avoided. [14] I have represented the religions with percentages in the final model. This assumes that each religion has its inherent fertility level. Previously I have also experimented with measuring majority religions with several dummy variables, saying that 80% is the limit of majority. This has left 1/3 of villages in the mixed category. The final result was quite similar as the one shown in the main part, but I preferred the percentage representation, as some information is lost with creating the dummies.
I have used census data to calculate divorce ratio as an indicator of secularization. (divorced *100/ married population).

Hypothesis

Roman Catholic religion is expected to be positively related with fertility, because I assume based on the literature that it increases the costs of fertility regulation. Orthodox religion is known to be associated with early fertility control, so I expect a negative relationship. Secularization makes the adoption of fertility control easier, so I expect a negative effect on fertility. Germans were a privileged nation in Transylvania, having a more saving and accumulating attitude according to common belief, so I assumed lower fertility for settlements inhibited by more Germans.

4.3.3. Supply

As we have seen above, there is a debate in Hungarian literature whether fertility was natural before the transition. In the international literature dichotomy between natural and controlled fertility is now questioned. The idea that fertility was "not in the calculus of conscious choice" (Watkins 1986) in traditional societies, which was one of the cornerstones of historical demography since Henry, seems to collapse under the weight of empirical counter-evidence, that spacing often took place. (e.g. Bengtsson and Dribe 2006) It is now believed that there has been more continuity in the use of fertility control than previously thought,, especially in some cultures. (Mason 1997 pg 447, Hirschman pg 208)

[14] In the context of Transylvania, Lutheran and Orthodox religion was often associated with early fertility control, while Calvinist less so. This is why I have not included both Protestant religions.

Although the assumption of natural fertility is a key part of Easterlin's model as well, I think that it is used as a theoretical point of reference, so the theory may be used for Transylvania, even if we are not able to prove that natural fertility was general before modernization. Child and infant mortality greatly decreased during the period in Transylvania, fewer live births were required than before to achieve the same number of surviving children. Mason warns theorists that they should not forget about this old argument of fertility transition theory, because it is supported with ample empirical evidence. (Mason, 1997) However, Davis (1963) shows, that out-migration may eliminate the tension caused by low mortality, so the reduction of fertility is not the only possibility. This effect was indeed important in Transylvania. High emigration might have been the reason why the industrially more developed south-eastern districts were relatively late in fertility transition. Over the period of 1899-1913 the rate of emigration was above 1% in 4 counties: Nagy- Küküllő (1,65%), Kis-Küküllő (1,31%), Szeben (1,1%) and Fogaras (1,1%). [15] Lengyel Cook and Repetto (1982) suggest that internal migration from north to south increased due to market changes in agriculture benefiting the south, and due to greater poverty of mountain villages. This may have helped to keep fertility high in the north.

High out-migration may be a sign for scarcity of land, and this would suggest negative association with fertility. On the other hand it may also allow a delayed fertility decline according to Davis's (1963) framework. The work of Levente Pakot (2009), focusing on Udvarhely county, and Peter Őri(2007) focusing on a Pest-Pilis-Solt county in Hungary suggest that out-migration was often an important factor to retain population balance. It is likely that in most cases the first reaction to population increase was out-migration, and fertility decline only came in a later stage, which happened after our study period for most Transylvanian villages. Pakot (2009) shows, that in Udvarhely county, migration balance was negative in villages, but it was positive in towns. For these reasons I expect negative correlation between fertility and migration. (higher out-migration – higher fertility)

Variables used in our models

I use infant mortality and net migration on a village level. The issue of endogeneity may arise, but I am going to address this later. Migration was included as a variable effecting demand. We do not have separate data for emigration and internal migration, but we have "net migration" as a balancing figure for each settlement.

[15] Source: Magyra Stat Közl 67. pg2

Hypothesis

Lower infant mortality is expected to increase supply in Easterlin's model, so the effect is negative. However, I am measuring not the number of surviving children (as in the model) but birth rates. For this reason I assume a positive effect overall: lower infant mortality is expected to reduce fertility, as fewer births are needed to get the same family size.

4.3.4. Demand

Modernization may change the demand for children by raising income, by increasing the opportunity costs of mother's time, and by changing the relative value of children compared to other goods. Parents may also want to have less children in order to substitute child quality for quantity, as costs of child raising increase due to higher educational requirements. (Easterlin and Crimmins, 1985)

One of the most consistent findings of empirical research is the negative relationship between woman's education and fertility. (Hirchman, 1994 pg 224) Woman's employment opportunities raise the opportunity cost of childbearing, and in this respect modern sector urban employment is especially important, because it is often incompatible with raising children. (Galloway at al 1994 pg 136-137)

Caldwell's intergenerational wealth flow theory highlights an important aspect of the economic value of children. Society undergoes a transition from "familial to capitalist mode of production" which includes the extension of compulsory schooling and the decrease of the possibilities to involve children in work around the household. In the absence of other forms of insurance, children are regarded as an "asset", a form of insurance for old age. With modernization the direction of economic flow changes, children cost more than what they produce. (Friedlander pg 505)

Regarding Transylvania there is some well documented case study evidence about the economic importance of child work around the 1880s. In Körösfő village, the absenteeism of children from school was so frequent, especially among poorer families that the church decided to penalize absenteeism with 1 Forint from 1800. In 1893 the school board exempted 74 children, and as the reason they mentioned poverty and the need to work as a shepherd. Kalman Tekse (2007) estimates that during the last quarter of the 19th century, 71% of 6-12

year old children 59% of 13-15 year old children attended school in Kőrösfő. (Körösfő is a protestant Hungarian village in the Kalotaszeg region 43 km from Kolozsvár /Cluj)
We also know that Transylvanian households were mainly self-sufficient in the 18th century, but with urbanization the possibility of women to raise money by selling goods at regional fairs had increased. As transport improved, more and more families could start to produce for market. (Szász, 1986; Sonkoly 1996, 2003)

Hypothesis and measurement issues

As more exact measures were not available in the dataset, I had to make some compromises in this area. I include literacy, occupational structure and population density.
Literacy is used as a "proxy" of both opportunity cost of mother's time, and cost of raising children. Higher literacy is expected to reduce demand due to substitution effects and higher opportunity costs.
Indicators of **occupational structure** were only available on county level, and I have included the % of industrial workers, and the % of landless by county. Higher industrialization is expected to reduce demand, partly through making mother's time more valuable, and partly through lower costs of fertility regulation. I assume that landlessness increases demand for children in comparison with small holders, who were more motivated to reduce fertility to avoid further sub-division of their land.
As a general indicator of **urbanization** I use (log of) population density, this has been calculated by settlement, dividing average 1900-1910 population with the area of the settlement reported in the 1910 census. This is a very important variable, because it is related to availability of land in the case of villages, and urban density at the other end of the scale, in the case of towns. As we will see in the next section, land availability is believed to be the key determinant of fertility transition. Higher density is expected to relate to fertility negatively. However, we may note that what we are measuring here is total area, not only fertile, cultivatable area.
In the extended database, in case of four southwest counties we may also include further variables indicating the progress of industrialization and urbanization: bank capitalization per settlement, presence of a train station, post office and telegraph office in the settlement. These are all expected to be negatively associated with fertility. As these factors also effect communication, and the spread of information about fertility control, I also assume a negative effect on cost of fertility regulation.

4.4. Previous research

4.4.1. Previous research about Transylvania and Hungary

Hungary supplies a "remarkable proof" according to Demény

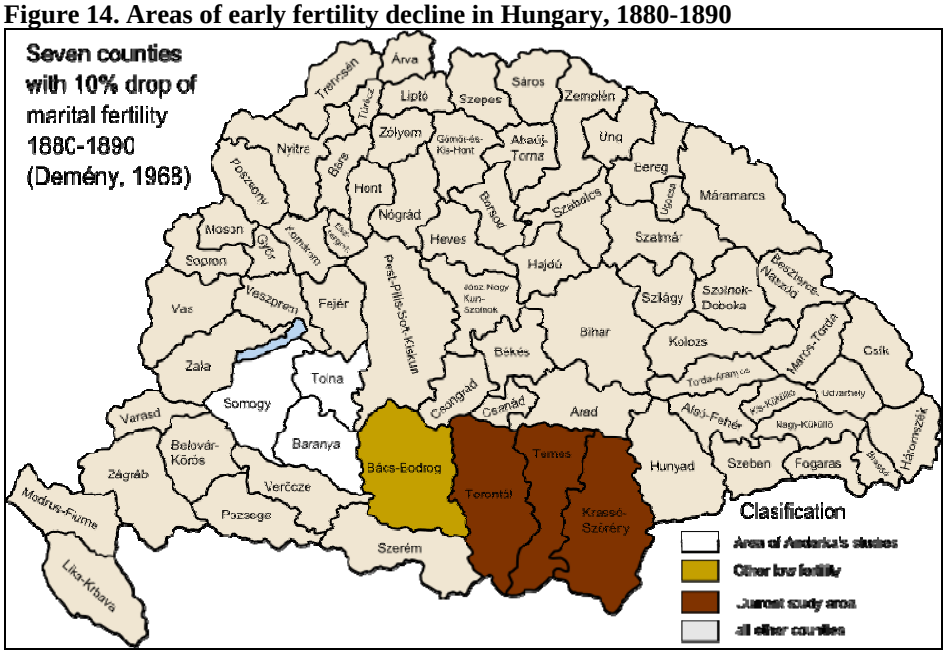
In the framework of the Princeton project, Paul Demény published an extremely interesting article about fertility decline in Austria-Hungary. He pointed out that while the provinces of Austria largely fit the conventional picture of demographic transition, Hungary provided some unusual examples. Marital fertility of Krasso-Szörény county was so low in 1880, that similar level in Vienna only been reached 20 years later. He identified a southern belt in Hungary, consisting of seven counties, where 10% marital fertility decline already incurred between 1880-1890, whereas only one Austrian county had experienced so early a decline. (Figure 14.) He pointed out that in these seven counties there was almost entirely no industrialization yet, they remained predominantly agricultural. [16]

Demény concluded that:

- Hungary supplies a remarkable proof that control of marital fertility may take place in the absence of fundamental modernization. (Demény 1968, pg 519)
- The variance of marital fertility was so large, that the assumption of natural fertility is highly questionable. (pg. 520)

[16] However, we may also note that the characteristics of "the seven" early decline counties are more different then Demény stated. Krasso-Szörény had early industrialization, and already low fertility in 1880, Sothern Transdanubia was agricultural, and it also had low fertility in 1880. The remaining three counties, laying in-between however had high fertility in 1880, and this makes the idea of "spread" less likely. It is more likely that every area had it's own economic reasons for early decline of fertility around 1870-1890, and decline before 1850 was probably rare.

Figure 14. Areas of early fertility decline in Hungary, 1880-1890



Source: Demény (1968); drawing by the author

Analysis of regional fertility patterns by Dezső Dányi

Dezső Dányi compared the Princeton indexes of historic Hungary with other European countries. We know that the typical way of fertility control in Western Europe before transition was exercised through late marriage. (This is what Malthus called "preventive check".) In Hungary, falling east of the Trieste-St Petersburg line of John Hajnal (1965), late marriage and celibacy was much less frequent. In Hungary age at first marriage was 21-22, while in Austria 27 around year 1880. (Demény 1968) The low level of marital fertility in Hungary compensated for this to some extent.

In 1880 due to early marriage, I_m (0,69) was high in Hungary compared to Europe, but I_g (0,59) on the other hand was low. However, by 1910 there was a large drop in Western Europe in terms of marital fertility, and a more moderate decline in Hungary. When we make a comparison in 1910, Hungary still had high I_m, and middle range I_g. As a result, the overall level of fertility was high compared to western Europe. (Table 1.)

Table 1. Comparison of marital fertility, nuptiality and overall fertility with selected countries of Western Europe, using Princeton indexes, 1880-1910

	Martital fertility index I_g 1880	Martital fertility index I_g 1910	I_g decrease 1910/1880	Nuptialityindex (I_m) 1880	Nuptiality index (I_m) 1910	I_f decrease (- increse) 1910/1880	Overall fertility index (I_f) in 1880	Overall fertility index (I_f) in 1910	I_f decrease 1910/1880
Danmark	0,686	0,522	23,9%	0,456	0,486	-6,6%	0,348	0,286	17,8%
Germany	0,735	0,542	26,3%	0,501	0,524	-4,6%	0,404	0,312	22,8%
England	0,674	0,467	30,7%	0,501	0,479	4,4%	0,355	0,234	34,1%
France	0,460	0,315	31,5%	0,538	0,591	-9,9%	0,267	0,204	23,6%
Austria	0,677	0,588	13,1%	0,509	0,517	-1,6%	0,402	0,345	14,2%
Hungary	0,589	0,529	10,2%	0,692	0,665	3,9%	0,442	0,388	12,2%

source: Danyi, 1991, and my own calculations, note that for some countries years 1881 and 1911 were used

The biggest merit of Dányi's research is that he has shown that there is a marked spatial clustering in Hungary, there are larger regions which show similar fertility behavior. This shows that location is an important driver of fertility. Notably Eastern Hungary (and Transylvania) has shown a demographic trend which was different from the rest of Hungary between 1880 and 1910. (Dányi 1977, 1991) What is especially striking is the development between 1890 and 1910. In a research supervised by Dezső Dányi, it has been shown that during this period all the three Princeton indexes (I_g, I_m, I_h,) have dropped in Hungary, in almost all counties, with the notable exception of North and Middle Transylvania, where I_g increased. (Ajus-Henye 1992 pg 87) It is also interesting, that the maps showing the direction of change were much more clustered than the initial levels. In other words there were bigger regions showing the same **trend** in I_g and I_m, even though the initial levels of fertility were different and less uniform.

Using correlation analysis and tabulations on a county level, Dányi could detect a significant relationship between fertility and percentage of **industrial workers**, and also **religious composition and nationality**, while he **could not statistically confirm relationship with literacy, infant mortality**, and income from agriculture. (Dányi 1977 pg 79-85, 1991)

Andorka's family renconstitutions

The family reconstitutions of Rudolf Andorka provided evidence that birth control may be exercised in pre-industrial societies. (Andorka, 1982, 1994) His research became highly cited in the literature, as it is one of the evidences against the universality of natural fertility in pre-transition societies (Hirschman, pg 208). The phenomenon of one child system already had had an extensive literature in Hungary which was often not free from moralizing and nationalistic tones, comprising of statistical, sociographical and religious approaches. (e.g. Széchényi 1906, Buday, 1909; Kovacs A., 1923; a full research review is in Andorka 2001 pg

13-57) This literature had described some areas and villages where early birth control was practiced, but Andorka was the first researcher who used family reconstitution methods to analyze some of these villages with proper historical demographic methods. His results show that in some villages of southern Transdanubia exercised birth control in the marriage cohort 1790-1820, well before modernization.

He investigated the reasons of early fertility decline by comparing the result of family reconstitution of 15 Hungarian villages. His main conclusions were as follows:

1. The early onset of fertility decline only characterised those villages where the development had started, and then halted. After the end of Turkish occupation there was a period of quick development and low population density in the south. But as land become scarce, there were no alternative working opportunities, and peasants stared to control fertility to keep their living standards. In other areas like the Grate Plain where land was plenty, or where a town was near, there was no clear decline of fertility until the 1870s. (Andorka, 1982, 1994) This corresponds with numerous evidences from "one-child-system" literature, which say that peasants adjusted their fertility to avoid further division of parcels, applying the "one parcel, one child" principle. (Buday, 1909; Széchenyi, 1906; Kovács 1923)
2. There is a link between extended family and birth control. Based on the case study of Sarpilis (Andorka and Balazs-Kovacs, 1986) he set up the hypothesis that when land became scarce, at the first family size increased, meaning that more family members lived from the same land. Although this prevented further division of land, this method also had it's limits. When it has been reached, families started to control fertility.

As we are talking about case study results, it may not be generalized, it is better to regard them as hypothesis. Although none of these villages were in our study region, it is important to note that Andorka clearly attributed key role to economic factors in the explanation of fertility in Hungary, while he considered religion less important. His explanation is in line with the theory of Davis, that "it is the possibility of betterment (or holding onto recent improvements) during the modernization process that provides the central motivation." (Hirschman, 1994 pg. 212)

A more recent study analyses settlement level data for Pest-Plis-Solt county, for the period of 1901-1910, using cluster analysis. The author concludes that occupational structure only

explains the decline in Budapest and nearby villages, while the early decline of some rural areas is better explained using Andorka's hypothesis. (Őri, 2007 pg. 46)

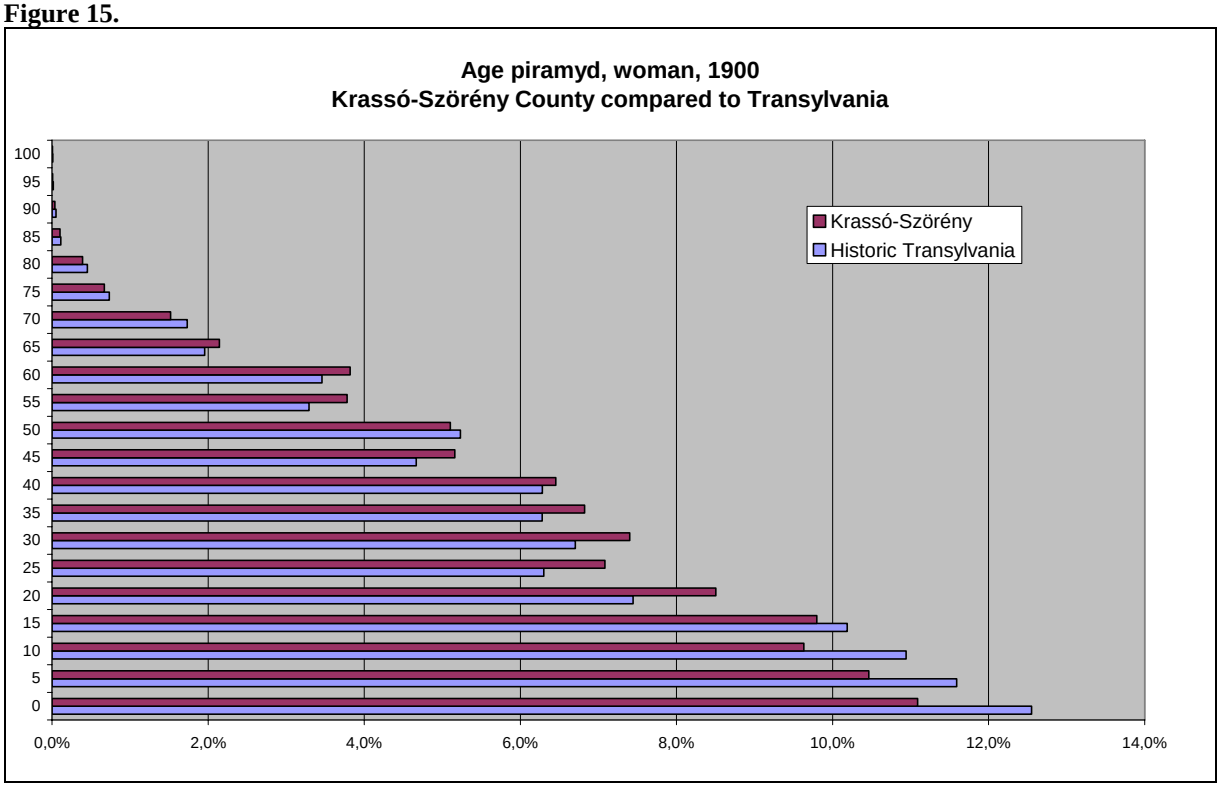
Was early fertility control in Southern Transdanubia an exception?

Both Demény and Andorka hinted at the possibility that the "one child system" may have existed outside of Southern Transdanubia, in the other four counties shown on the above map (Figure). So this phenomenon may also effect Transylvania. However, as before 1880 there was no official statistics, this question may only be examined using other sources, like parish registers, and therefore we have very little information about this.

I could only find one family reconstitution in the territory of Transylvania which touches upon this subject. Bogdan Craciun (2008) undertook the analysis of a Lutheran Saxon village in Beszterce county, Vermes. The reconstitution shows that parity-specific control has probably been exercised already in the beginning of the period (1850) – but as infant mortality was higher, the average number of children could be 4,1 if the families planned for 2-3 children to survive.

To my knowledge, there are no other studies which could prove early 19th century fertility control. As a direction of further research I would suggest that a study in Krasso-Szörény in an orthodox Romanian village would probably help to answer many questions. (For a review of historical demography in the Babes-Bojai University of Culuj, see: Pakot, 2002)

Figure 15.



source: MSK, new series vol. 5 pg, 146

I have examined the age distribution of Krasso -Szörény county and compared it with Transylvania in 1900, and is just a bit older. Assuming widespread birth control in Krasso-Szörény strating around 1860, we should see lower cohort sizes in the 20-40 age group in 1900, but instead, we see somewhat higher proportions there in Krasso, than in Transyvania. This shows, that early 19th century fertility control could not be widespread, it is more likely that the decline in Krasso started between 1870 and 1880.[17] (see Figure 15.)

4.4.2. Explanations for the increase in marital fertility before transition

We have seen that marital fertility increased in Northern Transylvania as a result of modernization. Sometimes the fall of birth rates is preceded with a clear trend of initial increase. Although this phenomenon is relatively rare in Europe (although there are some other examples), while in developing countries it is quite common. (Nag, 1980)

[17] This naturally assumes that there was no major difference in mortality trends between the two compared areas, but I am not aware of any evidence to the contrary.

The pattern of the increase in Transylvania was peculiar: in the first decade there was a large increase in most counties, which was followed by a moderate increase or some decline. An error in statistical records, under-reporting of birth in 1880 is possible, but unlikely, given this large, consistent pattern in a major territory, covering several counties. So we have to look for other explanations.

Wrigley, analyzing the increase of marital fertility in England in the long 18th century, mainly attributed it to a marked reduction of stillbirth rate. (Wrigley, 1998) The likely explanation to this improvement is the higher birth weight due to the better nutrition of women. Stillbirth rate was 1,18% in Transylvania between 1900-1910, while in England Wrigley calculates with 3,59%. Although an improvement in stillbirth rates may have caused some part of the increase in Transylvania, I have decided not to use this variable, as according to the explanatory text the stillbirth data were probably often not reported in case of more remote and smaller villages, so the records are not reliable.[18]

Nag (1980) reviews how proximate determinants may cause this increase. Fecundity is affected by decreased breast-feeding, because it causes the earlier resumption of menstruation and ovulation. In Europe, artificial means of feeding typically replaced breast feeding after fertility decline has already started, so on aggregate it's positive effect was not seen. However in developing countries shorter breast feeding often causes shorter birth intervals, and in some cultures it's effect is amplified, because postpartum abstinence taboos are attached to the period of breast-feeding.

Similar pre-transition increase in marital fertility was observed in Bavaria: an increase in the 1870s was followed by a steep decline after 1900 (Brown and Guinnane, 2002). As possible reason behind this they mention temporary factors, like abolition of financial barriers to obtaining marriage licenses, the post-war baby boom[19], but they also mention the possibility that earlier fertility controls were relaxed.

Regarding Transylvania, it is noticeable that the increase characterized mainly under-developed, highly agricultural counties. I do not have data about changes in breast-feeding, so

[18] Source: MSK vol. V.; MSK vol. 46.; see also: Data appendix

[19] The Franco-Prussian war, 1870-1871

we may not exclude this possibility. We may also consider the increase as a temporary boom after the recent cholera epidemic, but this does not explain why it was limited to the North, as the pattern of the epidemic did not correspond with this (Bolovan and Bolovan, 2003). Given the relatively low levels of initial marital fertility in 1880, the explanation which assumes that fertility control was exercised earlier, and it was partially relaxed, appears to be more likely. In my view this control was probably more a social control, than an individual one. (Lesthaege, 1980) The mechanisms of this control could be a subject of further research.

4.4.3. Earlier research on the effect of socio-economic factors on fertility

The Princeton European Fertility Project (EFP) was "one of the first and most ambitious large-scale scientific research project ever undertaken". It collected data from more then 700 provinces of Europe(Friedlander and Okun, 1999 pg. 497) Although their initial approach was to use classic demographic transition theory, they have concluded that a socio-economic explanation is not consistent with the data. Their main argument was that fertility transition started within a few decades in provinces which greatly differed in terms of economic development and urbanization. So their explanation gradually shifted towards regional and cultural factors. (Wrigley, 1998; Szreter, 1996)

In spite of the skepticism towards socio-economic factors in the summary volume of EFP, several, but not all country monographs also presented historical evidence pointing to their importance. (Friedlander and Okun, 1999) In the EFP country monograph on Belgium, Lesthaeghe concludes that both "industrialization-urbanization", and secularization are important to explain fertility decline. These two factors explain two-thirds of the regional variation of fertility in his regression model. (Lesthaeghe, 1977)

More recent studies, which have analyzed the time dimension using more elaborate methods, than what was available at the time of EFP, or used smaller units of analysis, tend to "rehabilitate" socio-economic factors. (Brown and Guinnane, 2007)

Galloway, Hammel and Lee (1994) analyses the effects on fertility decline using 407 districts of Prussia from 1875 to 1910. They use pooled cross-section time-series approach, relying on a dataset which is rich in time dimension and economic variables. Similarly to the present study, they use the Easterlin-Crimmins (1985) model as a theoretical framework. They main

conclusion is, that the explanatory factors are different, when they model fertility level, as opposed to when they model fertility decline. Differences in fertility level are primarily explained by religion and ethnicity. However these factors are not too helpful in explaining the decline. Instead, they found that standard structural variables (education, female labor force participation, health, income, urbanization) and financial and communication factors were much more important. In the fixed effects model, R^2 was 0,92, and they show, that a carefully selected set of socio-economic variables predict the decline that occurred almost exactly.

For Sweden, real wage index and "proportion urban" were significant in a fixed effects model predicting marital fertility on a county level from 1880 to 1930. Among women over 35, increasing female relative wages were associated with declining fertility, which is probably due to higher opportunity costs. (Dribe, 2008)

Brown and Guinnane (2002) have studied the fertility decline in Bavaria between 1880 and 1910, using data on 138 rural districts, modeling fertility using a panel regression framework. They show the impact of Catholicism and secularization[20] as well as the Princeton Project had done, but they can also show the strong impact of socio-economic factors. Urbanization had an initially positive, later strongly negative impact on fertility. Occupation, namely textile employment, which provided off-farm employment opportunities for women, had a strong, negative effect on fertility. The proportion of smaller farms (below 5 hectares), which rely primarily on family labor, was associated with higher fertility.

It can be concluded that with better explanatory variables, and with proper treatment of the time dimension, the effects which were hidden for the crude methods of the Princeton Project may become visible.

My research, due to it's small scale also struggles with some of these methodological problems: I could not extend the time dimension, and the explanatory variables are somewhat less strong than in the above quoted papers. However, the large number of observations is a

[20] Secularization is measured as % of votes to SPD party. Please note that Unlike Transylvania, non-Catholics are mainly Protestants in Bavaria and Prussia, therefore the meaning of "Catholic" variable is different.

clear advantage over Princeton data. In the selection of variables and methods I heavily rely on the ideas presented in the above papers.

4.5. Summary of hypothesis

The main hypothesis is that the Easterlin framework will be suitable to explain fertility in Transylvania. Based on the theories and previous research above, I expect that the differences are mainly due to economic factors, which are affecting demand and supply of surviving children, but culture also plays an important role in determining the cost of fertility regulation. Among economic variables, we may assume that land availability will have a significant relationship with fertility, as low land availability is expected to go together with low fertility. Higher levels of literacy are expected to coincide with lower fertility, as it reduces demand. Catholic religion and low secularization are expected to be positively correlated with fertility, due to higher costs of fertility regulation.
Further hypothesis regarding individual variables will be shown in the summary table at the end of the section.

4.5.1. Summary table

It is useful to summarize the theoretical part and variable selection in a single table. (Table 2.) The classification is shown according to the Easterlin-Crimmins model, and I also make a hypothesis regarding the overall effect of the variable. Some basic determinants may affect both supply and demand, as shown in the table. The structure fully adopts the method used in the source, (table 2.1 in Easterlin and Crimmins 1985, pg 21) but as the variables there are only illustrative, I had to work out the assumptions for the given variables mainly on my own. I have done this in line with the logic of the model, and my previous knowledge about these variables.

Table 2.
Link of the variables to the theoretical model, hypothesis regarding overall effect on fertility
Dependent variable: Crude birth rate average of years 1900-1910

Basic determinants	Data year	Settlement / County level	Effects in E-C Model*				Hypothesis about overall effect on birth rate
			Cost of fertility regu-lation	De-mand	Supply		
Share of religions(%)							
Share of Roman Catholic religion	1910	S	+				+
Share of Orthodox religion	1910	S	–				–
Share of German mother tongue (%)	1910	S	–				–
Secularization (divorced ratio *100)	1900	S	–				–
Infant mortality rate	1900-10	S			–		+
Net migration rate	1900-10	S		–			–
Population density (as an indicator of urbanization and land availability)	1910	S	–	–	+		–
Literacy (%)	1910	S	–	–			–
Employment in industry (%)	1900	C		–			–
Percentage of landless (%)	1891	C		+			+
Extended database (four counties)							
Literacy (%)	1880	S	–	–			–
Literacy : improvement	1880-1910	S	–	–			–
Indicator of banking	1880	S		–			–
Indicator of communication (telex)	1880	S	–				–
Indicator of transport (train station)	1880	S	–	–			–

* Using table 2.1 in Easterlin-Crimmins 1985, pg 21, applying the model to the available variables
% variables are expressed on a 0-1 scale; demographic rates are per thousand population
See also data appendix on details of calculation.

5. Data and methods

5.1. Overview of the research design

My primary approach is to analyze census and vital statistics data using statistical methods. According to Hakim (2000), this would be classified as a research using „Administrative Records and Documents". The disadvantage of using administrative records is that the researcher has to take the data as he finds them. This also applies to my research: I need to work with a limited array of variables, I only have crude birth rates, and most importantly, there is a shortage of economic variables. However, I also borrow some tools from complementary methods to overcome this problem. I have completed a secondary analysis of Princeton data, included case study evidence and used research review techniques. This is shown in more detail in the appendix.

5.2. Data

This section provides a summary of the main data sources, and some considerations about their quality.

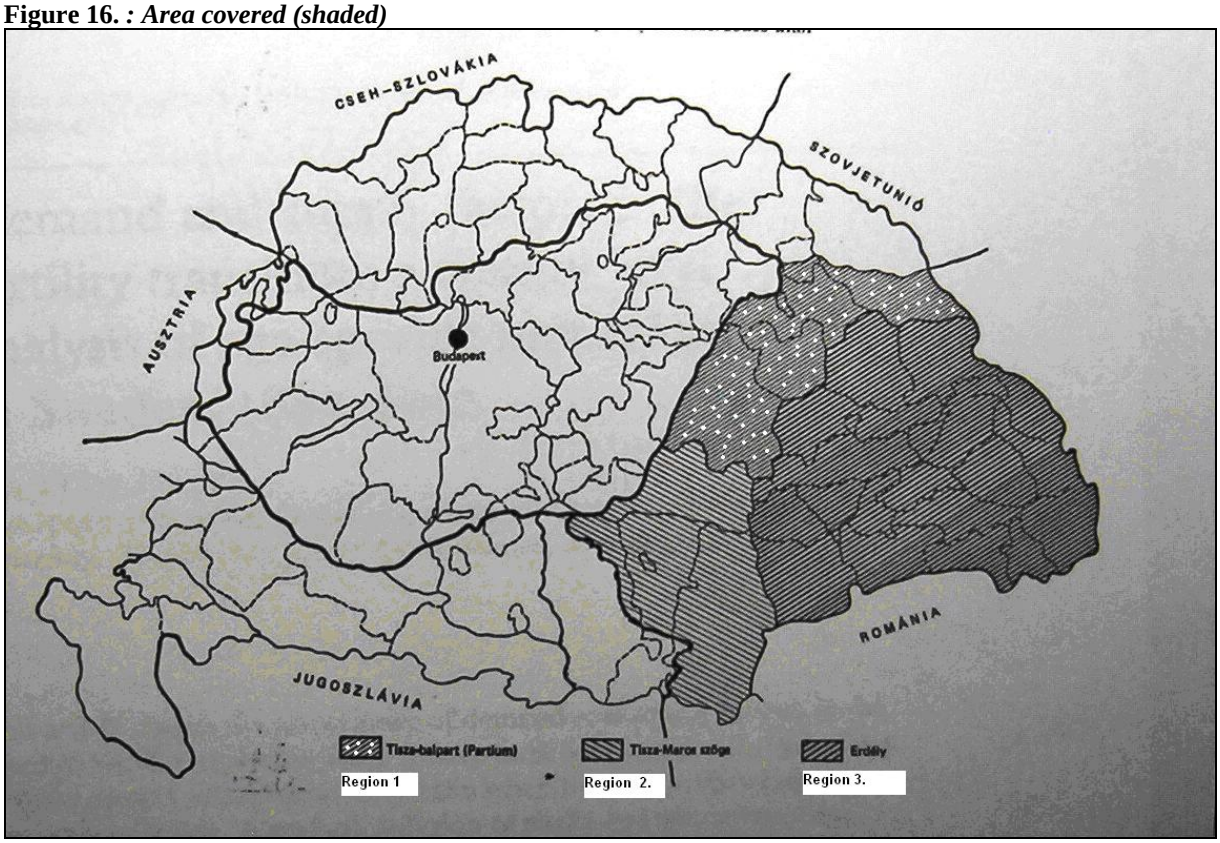
5.2.1. Data sources, units of analysis

Princeton indexes on county level 1880-1910 were used for introduction.
In the main part, matched census and vital statistics records will be used, for each settlement of Transylvania.

The units of analysis:

- The social unit is the settlement
- The time period is: 1900-1910
- The area covered: the current Transylvania in the broad sense (including all areas which used to belong to Hungary, not only historic Transylvania)

Figure 16. ***: Area covered (shaded)***



Consists of three regions, Historic Transylvania (east), Left bank of Tisza (north), Tisza-Maros angle (south) – source: Klinger, 1991

1900-1910 is the first period for which we have official vital statics on a settlement level for the "Countries of the Hungarian Crown". For Transylvania, this includes 4116 entities (settlements). The department of Sociology at Babes Bolyai University of Kolozsvar have digitalised and re-published the data contained in these old books. I have matched these with census data for the same entities. The final dataset has been created in three steps, as follows:

1. Match census and vital statistics records by settlements
2. Collect some more data on county level, and mach it using county ID-s to the main dataset
3. Match modernization indicators from 1880 census data individually (as it was very laborious, only for 4 southern counties)

I collected data on three levels. Firstly, the biggest effort, as stated above, was directed towards putting together a settlement level database. Secondly, I downloaded the Princeton dataset for Hungary, which contains fertility indexes for the period of 1880-1910, but no explanatory variables. (However, I have collected some data on county level from official

statistics.) Thirdly, I collected case studies regarding fertility and economic background of specific areas or villages.

The time dimensions of these datasets and the main variables are summarized in Table 3.

Table 3. Summary of sources and data used

Signs

y – used in core part (M1)
x – available, but matching was only done for 4 counties
a - available, but not digitalised

On a village (settlement) level - crude rates	1850	1880	1890	1900	1910	1920
Census						
Population by language, religion		x			y	
Literacy		x			y	
Secularisation (divorced / married population)					y	
Population density		x			y	
Modernization indicators (transport, telegraph, banking)		x			a	
observation units	N:	600			N:	4116

Vital statistics				1900-1910		
mortality (yearly death, crude rate)				y		
fertility (yearly birth, crude rate)				y		
opening and closing population size				y		
natural increase				y		
net migration				y		
infant mortality				y		

On a county level						
If, Im, Ih, Ig (from Princeton database)	y	y	y	y		
Secularization (based on marriage seasonality)			y			
Employment in industry (%)		y	y	y		
Counties having an urban centre with 25 th. + population (dummy variable, 1/0)			y			
observation units					N:	28

5.2.2. Data quality

The quality of the source

Austro-Hungarian statistics are usually regarded to have good quality, many historical demographic research have been made using the 1900-1910 census and vital statistics data, although usually not on a settlement level. The instructions for the field workers have been gradually refined, so while there may have been some problems with the first census of this kind in 1880, by 1900 the methods have improved. (Varga E., 1998)

5.2.3. Some known methodological weaknesses or dangers

The use of 1910 census instead of 1900

The use of 1910 census data involves some compromise: it is a bit clumsy to use explanatory variables that are dated later than what is explained. It would have been better to use 1900 census data. As I have received these data "gratis", I did not have a choice in this respect. However, the actual problem is minimal, as we are mainly measuring static things like religious proportions, for which 10 years do not make a big difference. The exception is literacy, which was improving quickly. But even in this case the data are suitable for measuring the relative differences between settlements.

The time dimension

The time dimension in my explanatory variables was not sufficient to use panel approach, even though it is now believed to be more appropriate to examine fertility decline. I actually analyse level of fertility, as opposed to the decline of fertility. This means that strictly speaking, **the main results say nothing about fertility decline**. However, I do try to give a picture of fertility decline using county level data and literature review. We could see that the 1910 fertility level is more a product of recent changes, then of earlier traditions. Once fertility declines 10%, it usually does not stop to decline until it reaches a very low level. (Watkins, 1986)

5.3. OLS regression model with interactions

A cross-sectional OLS regression model will be used to analyse settlement level differences of crude birth rate. The following equation will be estimated:

$$fertility_{crude\_rate} = b_1 + b_2 x_2 + b_3 x_3 + ... + b_n x_n + b_{n+1} d_1 + b_{n+1}(d_1 x_2) + error$$

In order to test causality, I apply dummy variable technique with interactions. This technique is described in Hill, Griffiths and Lim (2008 pg 175-179). In this model, d_1 is the dummy for two different regional sub-samples, and x_2 is the proportion of the first religion (Rom. Catholics). The essence of the approach is, that if the effect of religion is the same in both regions, than the coefficient of the interaction term $(d_1 x_2)$, should not be significantly different from zero. So we may test this way, if the model has the same result with regards to Catholic religion in the regional sub-samples.
In reality I have two dummies for the three sub-regions, and three religious effects (Catholic, Orthodox, and Secularization) were tested, so there are more interaction terms than shown above, but the idea is the same.

Endogeneity

Infant mortality may be classified as endogenous variable, because the relationship may work in both directions: low fertility may also cause lower infant mortality, as it may mean that more time is devoted to one child. In more technical terms this means that infant mortality is probably correlated with the error term, and this makes our estimate for $b_{\text{infant mortality}}$ biased. This may be overcome with the use of an instrumental variable. However it is often difficult to find a suitable instrument, a variable that is correlated with infant mortality, but not correlated with fertility. (Dribe, 2008) Some researchers successfully used elevation above see level as instrumental variable for infant mortality.(Brown and Guinnane, 2002) Unfortunately I could not find a suitable instrument in the database, so I could not implement the IV technique. This means that the coefficient of infant mortality has to be interpreted with care. The same relates to migration, which is also possibly endogeneous.

5.3.1. Results of econometric testing

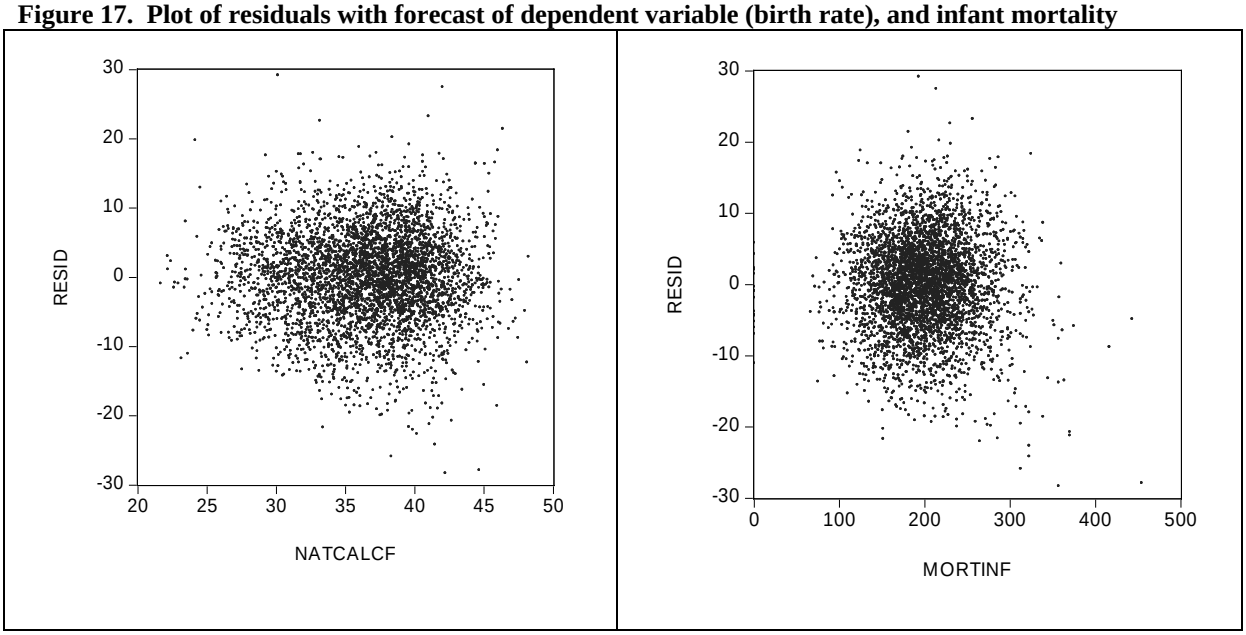
Omitted variable

My initial model was rejected by Ramsey RESET test, which may be either due to non-linearity or omitted variable. Omitted variable bias is a serious problem; it would affect the estimated coefficients of all variables. Luckily, I could eliminate this by adding more variables (secularization, industrial employment, landlessness) and by taking the log of population density variable. After this, the RESET test did not reject the model any more.(P=0,803)

Heteroscedasticity test, residual plots

Cross-sectional regressions often have heteroscedasticity problem, violating an important assumption of the classic linear regression model. My main model also suffered from this problem. I have used Breusch-Pagan-Godfrey and White's test (Kennedy, 2003), which were both highly significant, and plotted the residuals and the dependent variable, which also shows disturbance terms tends to have higher variance when fertility is higher. I have used White's robust standard errors to solve this problem for all results quoted below.[21]

Figure 17. Plot of residuals with forecast of dependent variable (birth rate), and infant mortality



I have also graphed the residuals with explanatory variables, to detect non-linearity, but these plots did not indicate any problem. The plot of residuals with forecast birth rate ("y hat") and infant mortality variable with the residuals is shown above.

[21] I have used e-Views for modeling and SPSS for merging, checking the data and producing basic statistics.

6. Results

6.1. Cross-sectional OLS regression of crude birth rate

I show the result in the same structure as I used above in the theory section. The model fits relatively well, all variables are highly significant. In the "Hypothesis" column I show the original hypothesis, and I highlight those where there is a "wrong sign": the coefficient was significant, but it had the opposite direction than expected.

The main model is shown on Table 4.

Table 4. Cross-sectional OLS regression of crude birth rate (1900-1910) by settlement (Main model)

Basic determinants	Settlement / County level	Hypo-thesis	Coefficient	p
Constant			28,703	0,000
Share of Roman Catholic religion (%)	S	+	2,194	0,000
Share of Orthodox religion (%)	S	–	-1,456	0,000
Share of German mother tongue (%)	S	–	-2,774	0,000
Secularization index (divorced*100/married)	S	–	-0,507	0,000
Infant mortality rate	S	+	0,045	0,000
Net migration rate	S	–	-0,110	0,000
(Log of) Population density	S	–	1,660	0,000
Literacy (%)	S	–	-12,228	0,000
Employment in industry (% in the county)	C	–	0,095	0,018
Percentage of day labourers (% in county)	C	+	0,261	0,000
N:	**4112**			
R-squared			0,313	
Adjusted R-squared			0,311	
Overall probability (F-test)			0,000	
Ramsey RESET test (probab. F-test)			0,803	

White Heteroskedasticity-Consistent Standard Errors & Covariance
The instances where the estimated coefficient differs from the hypothesis are highlighted.
Data sources: see data appendix. Area1, Area 2: see Figure 16.

As stated in the methods section, I have also included a control dummy for region, and re-run the model to check interactions. For control dummies and interactions I originally assumed that the coefficients are not significantly different from 0. This is shown in Table 5. I only interpret the model with interactions in more detail, as the results for the common part are similar.

Table 5. Cross-sectional OLS regression of crude birth rate (1900-1910) by settlement, with control variables and interactions

Basic determinants	Settlement / County level	Hypo-thesis	Coefficient	p
Constant			30,463	0,000
Share of Roman Catholic religion (%)	S	+	2,127	0,000
Share of Orthodox religion (%)	S	–	-2,304	0,000
Share of German mother tongue (%)	S	–	-2,797	0,000
Secularization index (divorced*100/married)	S	–	-0,531	0,001
Infant mortality rate	S	+	0,033	0,000
Net migration rate	S	–	-0,116	0,000
(Log of) Population density	S	–	1,236	0,000
Literacy (%)	S	–	-9,311	0,000
Employment in industry (% in the county)	C	–	0,120	0,004
Percentage of day labourers (% in county)	C	+	0,167	0,000
Control variables				
Area 1 :Located within Northwest region (Y/N : 1/0)	S	0	2,073	0,000
Area 2: Located within Southwest region (Y/N : 1/0)	S	0	1,829	0,232
Interactions				
Area1 * Roman Catholic (%)	S	0	8,653	0,000
Area2 * Roman Catholic (%)	S	0	-2,905	0,131
Area1 * Orthodox (%)	S	0	7,138	0,000
Area2 * Orthodox (%)	S	0	-3,197	0,044
Area1*Secularization index	S	0	0,111	0,674
Area2*Secularization index	S	0	0,053	0,913
N:	**4112**			
R-squared			0,408	
Adjusted R-squared			0,405	
Overall probability (F-test)			0,000	

(Using White Heteroskedasticity-Consistent Standard Errors & Covariance)
The instances where the estimated coefficient differs from the hypothesis are highlighted.
Data sources: see data appendix. Area1, Area 2: see Figure 16.

6.1.1. Infant mortality, net migration, literacy – strong relationship

I start with those variables which are easy to interpret, because their effect is **stable**[22], **significant**, and **in line with the theory**. (see Table 5.)

Crude birth rate measured per thousand of population, the average for all settlements is 36,5, so the **constant** 30,47 is reasonable, as most variables have positive values. (Due to the two regional dummies, this is now the intercept for the East region, Historic Transylvania)

Higher **infant mortality rate** tends to go together with higher fertility, as expected. The coefficient is moderate, because both variables are measured per thousand of population, so

[22] By stability I mean that the effect was resistant to stability tests, which will be explained in turn.

100 unit increase in infant mortality rate increases birth rate with 3,3, other things being equal.

Fertility tends to be lower in settlements which are lucrative for migrants. **Net migration** is measured as a crude demographic rate (per thousand) averaging -3,8 in the sample. 100 unit increases in this rate goes together with 11 unit decrease in crude birth rate.

When measured on a settlement level, **literacy** becomes an especially strong and stable predictor of fertility. The coefficient is not too high: 1% increase in the share of literates lowers birth rate with 0,093.

Finally, the share of day labourers in the county increases fertility, but due to the fact that this variable is measured on county level, the coefficient is small. (10% increase causes 0,01 unit increase in birth rate) This effect is also not very stable in sub-samples.

6.1.2. Land availability – reverse sign

Population density had a positive effect on fertility, which is very surprising. To some extent it contradicts our notions about the urbanization-fertility relationship, and also Andorka's theory about land availability. I have examined if this relationship is the same in three density categories. The result was that in normal density levels it is the same (for 3500 settlements), but in the top 600 settlements the direction of the relationship turns sign. This means, that in the regional centres and towns "urbanisation" has the expected effect, but in villages the effect is significantly the opposite of what was expected. A possible hypothesis that may explain this is that low density generally corresponds with higher poverty and this keeps fertility low, possibly through the continuing existence of traditional social controls. Medium and high density villages on the other hand relaxed these controls and allowed fertility to increase, as the improvement in efficiency allowed it, even if the land was scarce. In other words, this points to the idea that land availability was only important in explaining decline in a pre-industrial setting, but it is less important during modernisation, because modernisation has opened the Malthusian trap.

6.1.3. Religion and secularization

Regarding religion and secularisation every result matches with the hypothesis for the first sight. However, the basic question here, if we see a genuine religious effect, when religious norms influence childbearing, or instead, the presence of certain religions correlates with unmeasured socio-economic variables, that are important for fertility. Is Orthodox religion significant, because it had more tolerant norms regarding fertility control, or just because it is

had a high share in the fertility decline region, but elsewhere it was associated with high fertility? The basic idea is that if Orthodox religion has a certain negative effect, it should be present in all major areas of Transylvania. This can be checked applying the dummy variable technique. I have represented the two border regions with two dummy variables, Historic Transylvania remained the base case.

Control variables by area

The reader may see the difference in the *intercept* compared to the base case for each area under the heading "control variables". The coefficient for area1 is significant, the intercept in that area is higher with 2,07. Dummy variable for area 2 is not significant. This means that contrary to our expectation, region 1 (Partium) has some positive difference in fertility compared to Historic Transylvania, which is not explained by our model. Our variables did not explain fully, why is fertility higher there, a simple dummy variable can do better in this respect.

Area – religion interactions

The products of the dummies and religion variables are also called "slope dummies". Their coefficient shows, what the difference is in the slope of the given religious variable compared to the base case. If slope dummies are significant, then the difference of the slope compared to the base case is significant. For example, Orthodox religion had a -2,3 slope in the base case (a moderate negative effect in case of Historic Transylvania), in the two other regions the effect is significantly different, higher in region 1 (Partium) with +7,1 and lower in region 2 with 3,2. So orthodox religion has significantly different effect in the three regions (at 5%), and it is **positive** in the northeast, while I the other two regions it is **negative**. The two border regions had still enough observations (N1= 952, N2=818) and Orthodox religion was widespread in each, so we may exclude the possibility that this result is due to low number of relevant observations. This shows that Orthodox religion does not have a clear effect on fertility.

The effect of the Roman Catholic religion is also somewhat different, it is much higher in region one (and significantly so), but the difference is not significant (at 5%) in region 2. The direction of the effect remains positive in every case. So we can be more confident about our results regarding the Roman Catholic religion.

The effect of secularization appears to be stable in all areas; the interaction effects with secularization remained insignificant in both cases. The coefficient is -0,53, which means that

one percent increase in the ratio of divorced persons to married persons decreases birth rate with 0,53 units.

6.2. Stability tests of the main model

The model was run in several versions to check if the coefficients are stable or not.

6.2.1. Modelling dominant religions instead of using percentage share

As the effect of religion was lower than expected, the question may arise, that associations would be stronger, if I recode religion with dummies, so that we have the dominant religion for each village represented with 0/1 variables. To eliminate any doubt, I have done this version of the model. I selected 80% as a limit of dominant religion, which classified about ne third of the settlements as "mixed religion". The result was highly similar to what has been shown above, the effect of orthodox religion is not stable and significantly different in the three areas, while Roman Catholic religion and secularisation remains significant. I have concluded that this change in modelling method does not change the main conclusions.

6.2.2. Splitting the database by size of settlement and density

As we have plenty of observations, it is possible to split the database according to some variables, to see if the relationships are stable or not, and to detect any potential non-linearity. It is possible for example, that the effect of population density is different at low density and high density levels. The size of population may also matter: it is possible that we need a different model to explain fertility in small towns than in villages. The results appear to be stable for the main variables. Orthodox religion and population density were exceptions, but both were already mentioned above.

6.3. Using extended dataset with indicators from 1881 census

As the 1881 census dataset included some interesting variables, which tell something about modernization (banking indicators, train stations, literacy at an earlier date) it is worthwhile to re-run the model with this addition. Data record matching has only been done for 772 settlements in the fertility decline area in Southwest Transylvania (Area 2. on Figure), so the following table shows a smaller dataset then before. The results are similar, only population density had a different sign then expected. (Table 6.)

Table 6. Cross-sectional OLS regression of crude birth rate (1900-1910) by settlement - Extended dataset, for Area 2 only (Southwest Transylvania)

Basic determinants	Settlement / County level	Hypo-thesis	Coefficient	p
Constant			36,586	0,000
Share of Roman Catholic religion (%)	S	+	3,867	0,124
Share of Orthodox religion (%)	S	–	-9,075	0,000
Share of German mother tongue (%)	S	–	-2,790	0,206
Infant mortality rate	S	+	0,071	0,000
Net migration rate	S	–	-0,157	0,000
(Log of) Population density	S	–	1,042	0,004
Literacy - improvement (%in 1910-% in 1881)	S	–	-20,611	0,000
Train station (Y/N)	S	–	-1,413	0,084
Literacy in 1881 (%)	S	–	-20,703	0,000
Population is above 1306 (Y/N)	S	–	-1,644	0,004
N:	**772**			
R-squared			0,383	
Adjusted R-squared			0,375	
Overall probability (F-test)			0,000	
Ramsey RESET test (probab. F-test)			0,501	

White Heteroskedasticity-Consistent Standard Errors & Covariance
The instances where the estimated coefficient differs from the hypothesis are highlighted.
Data sources: see data appendix. Area 2: see Figure 16.

Some of the potential new variables, like bank capitalization were insignificant, their inclusion did not improve the model. The presence of train stations and telegraph was highly correlated, and both were correlated with the size of the settlement. When I included both the train station variable and the dummy for size, the former became insignificant. So we may conclude from this that in the presence of train stations was only important as a predictor of settlement size.

It is more interesting that besides literacy, the **change of literacy** in the previous 30 years was also a strong predictor of fertility level by settlement. Those settlements, where there was a larger improvement in the level of education, had lower fertility.

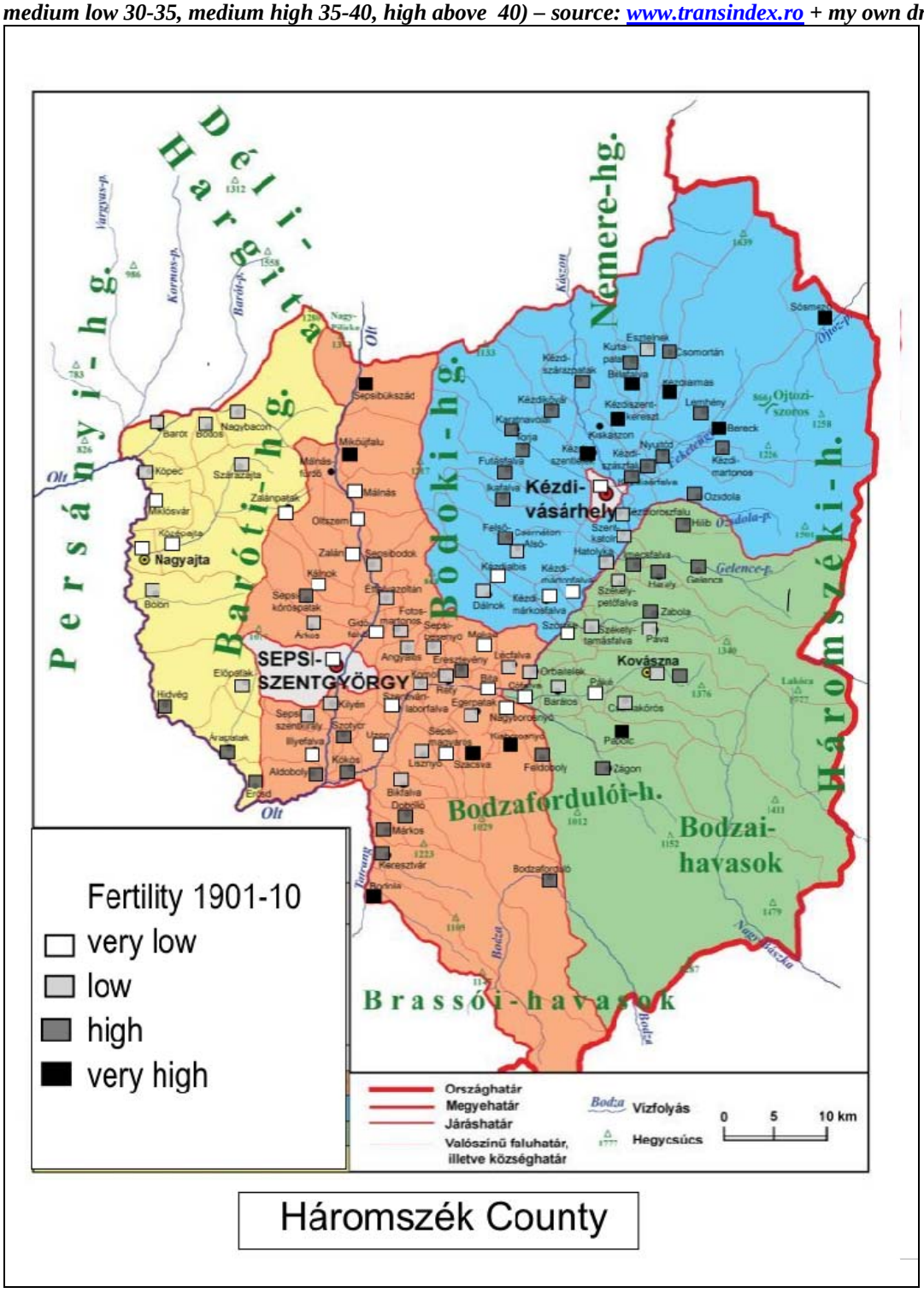
6.4. Remoteness and fertility

As we do not have co-ordinates in the database, I have used a simple approach to assess the impact of location on fertility. I have mapped the birth rates of a selected county, Háromszék, on a village level. Fertility levels are shown in four categories, with four different colours, dark rectangles represent high fertility, while white rectangles low fertility. (Figure 19.)

The map shows that fertility tends to be low in towns, in villages which are located near towns, and in river valleys, while it tends to be high in remote mountain villages. Although

statistical proof cannot be provided, we may regard this as case study evidence, which shows, what the nature of the spatial variance of fertility is. As the large part of this effect is probably not captured by our model, it also explains why a big part of variance was unexplained by the regression.

Figure 19. ***Crude birth rate by village in Haromszek county, 1900-1910 (four categories: low – below 30 , medium low 30-35, medium high 35-40, high above 40) – source: www.transindex.ro + my own drawing***



(Data source: Vital Statistics 1900-1910, see data appendix)

7. Discussion

In this section I intend to summarize, what the results say about the causes of regional differences in fertility around 1900, and how these results cast a new light on some of the frequently cited theoretical views regarding fertility decline.

7.1. Modernisation and fertility decline in Transylvania

Modernisation affected Transylvania during the study period mainly through the improvement of efficiency in agriculture, and development of towns, while the labour force remained predominantly agricultural, and the clergy remained powerful. Fertility decline only started in the southern part, while fertility stagnated in the middle part, and increased in some northern counties. The maps of industrialization and urban development indicate that this coincided with a southern polarization of the industrial revolution. Looking at the fertility map of Udvarhely County, which has shown no change on aggregate level, it is likely that changes have already started on settlement level. We see that fertility was low in towns and villages located near towns, but was high in remote villages. From the case study evidence provided by Levente Pakot (2008), it appears that high fertility of mountain villages was sometimes explained by the possibility to extend the village, as animal farming could be extended by moving to upper mountain farms, while the products could be sold on the local town markets. This shows that beside the factors that we could measure in the main model, modernisation has created a number of local economic opportunities and changes, which were important in determining the level of fertility.

7.2. Contrary to previous research, demand factors do explain fertility differentials

Earlier results of Paul Demény (1968) and Dezső Dányi (1991), reached in a county-level analysis suggested that socio-economic explanations often do not work in Hungary. Although Andorka (1994) preferred economic explanations, his focus on villages with very early fertility decline also suggests that the usual explanations do not apply for Hungary.
The village level analysis of Transylvania shows, that in a similar way to Prussia and Bavaria, the role of socio-economic factors was probably underestimated earlier due to the high level of aggregation of data. A county usually has both urbanized and rural parts, and adding these

together eliminates a big part of the variance, which may make statistical tests insignificant. Using settlement level data, a model designed according to the Easterlin-Crimmins (1985) framework fits well. Supply and demand factors explain a significant part of the regional differences in fertility. The effects of literacy (-) and infant mortality (+) on fertility were significant and very stable when I have split the model according to density, population size and area. This contradicts with the earlier results of county level studies of Dezso Danyi (1991) and Lengyel-Cook and Repetto (1992), which suggested that these traditional transition factors only had a minor role in Hungary.

7.3. What is the role of religion?

In the beginning of the paper I promised to look for relationships between the colourful culture of Transylvania and the pattern of fertility.
The three leading religions (Orthodox, Greek Catholic, Roman Catholic) had highly similar approaches towards the matters of childbearing. The similarity of marriage patterns by religion has shown that the power of the clergy to enforce these rules were similarly strong. Therefore it is not a big surprise that the regression model did not show the originally expected relationships. For most religions the effect was not significant, for Orthodox religion the effect was different in different areas of Transylvania. Catholicism was the only exception, which had a positive effect on fertility in each part of Transylvania, although the magnitude of this effect was significantly different.
I have measured secularization with divorce ratio using census data. As expected, higher secularisation was associated with lower fertility, which fits into the explanation of Easterlin, that lower costs of fertility regulation were important in the fertility decline.

7.4. Scarcity of land

Scarcity of land often appears in the literature, for example as a factor explaining fertility decline in the U.S. It has also been regarded as an important factor in Hungary, but mainly based on case study evidence. Andorka (1994) explained early fertility decline before modernisation with scarcity of land and narrowing down of economic opportunities.

I have measured land availability with population density. (the population of the village divided by the area shown in the census) Population density is a crude measure of land availability - besides the size of land; we would need to consider the share of smaller and

larger plots, land quality. However, it is important that this study could examine the effect on a larger database, and check the relationship statistically.

This analysis of the population density-fertility relationship has shown an effect in the opposite direction than expected. The most likely explanation for this is that the "rules of the game" have changed with economic development, as our settlements broke out of the "Malthusian trap". The results show that middle and high density villages may have had better opportunities to keep fertility high than small ones. In the Easrelin framework this may be explained so that other things being equal; if small density villages had lower efficiency gains, then lower income may have reduced demand, and the oversupply situation eventually resulted in a somewhat earlier acceptance of fertility control.

7.5. Did early 19th century fertility decline characterise Transylvania?

I have stressed the southern polarization of industrial development as a potential explanation of early fertility decline in the south. An alternative explanation exists, however: there was a low fertility belt in south Hungary, and it is possible that very early (before 1850) fertility decline occurred in some villages throughout this region, and the knowledge of fertility control spread over from these areas. Due to the nature of my data, and the scarcity of family reconstitution evidence for Transylvania, I could only make some small progress in this question. In my view it is more likely that each county on Figure 14. had a different set of reason for early decline. Some of them clearly started from a high level of fertility in 1880, and some of them, like Krassó-Szörény was more industrialized. The age distribution of Krassó-Szörény has shown that at least on a county level, fertility control could not start very early.

However, this question may only be answered properly using data from earlier decades, for example by a family reconstitution survey in an Orthodox Romanian village within Krassó-Szörény county. It is likely, that the scattered presence of early fertility control in some villages contributed to the faster spread of fertility decline in the south at the end of 19th century, when economic factors gave a stronger incentive.

8. Conclusion

I have undertaken a cross-sectional analysis using smaller unit of analysis than previous researchers have done regarding Transylvania and Hungary. This has lead to different conclusions in many respects.

I have used the Easterlin-Crimmins model, combined with previous research evidence to set up hypothesis regarding some of the main variables affecting fertility, and then checked these effects in the model. Most variables have shown significant relationship with crude birth rate, in line with the hypothesis.

This shows, that an explanation which puts demand and supply factors on the first place, but accepts the secondary role of innovation factors as the determinants of costs of fertility regulation, fits well to the data about Transylvania during the 1900-1910 period.

Earlier research results could not show the effect of some socio-economic variables on fertility, probably due to the high level of aggregation. They favoured cultural explanations, and showed Hungary as an exception to the rules of demographic transition. In contrast, this paper shows that the classic explanatory factors like infant mortality, migration, literacy, and secularisation do explain fertility differentials in Transylvania at the turn of the 20th century.

This result is in line with other papers, which have re-examined Princeton results for Germany using more disaggregated data, and with statistical methods which are more capable of handling the time dimension. Based on their results, as well as on the results shown above, we may conclude that the European Fertility Project was correct about the role of secularization, but in some cases underestimated the role economic modernisation in fertility decline.

9. Literature

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10. Appendix

10.1. Data appendix

10.1.1. Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
Fertility rate, crude, calculated, average of 1901-1910	4116	11,42	69,49	150236,11	36,5005	7,84361
Roman Catholic %	4116	,00	1,00	444,40	,1080	,23955
Greek Orthodox %	4116	,00	1,00	1629,42	,3959	,42826
German nationality %	4116	,00	1,00	276,41	,0672	,18700
Secularization (divorced/married *100)	4116	,00	13,75	2026,26	,4923	,73927
Infant mortality rate, average of 1901-1910	4116	,00	454,55	821781,85	199,6555	46,74851
Net migration rate	4116	-64,17	121,69	-15770,50	-3,8315	9,92492
Population density (pop./area)	4112	,02	36,32	1658,99	,4035	,98811
Literacy %	4116	,00	,85	1442,51	,3505	,20206
Industrial workers %	4116	3,50	19,91	33030,42	8,0249	2,81638
Day laborers % by county	4116	4,49	34,15	71728,46	17,4267	7,17906
Belongs to area1 (Nothwest)	4116	,00	1,00	952,00	,2313	,42171
Belongs to area2 (Southwest)	4116	,00	1,00	820,00	,1992	,39946
Rom.Cat. Dominance (above 80%)	4116	,00	1,00	239,00	,0581	,23390
Orth. Dominance (above 80%)	4116	,00	1,00	1319,00	,3205	,46671
Gr. Cat. Dominance (above 80%)	4116	,00	1,00	926,00	,2250	,41762
Calvinist Dominance (above 80%)	4116	,00	1,00	224,00	,0544	,22688
Lutheran Dominance (above 80%)	4116	,00	1,00	30,00	,0073	,08507
Mixed religion (no dominant rel.)	4116	,00	1,00	1378,00	,3348	,47197
Population above 1306	4116	,00	1,00	1029,00	,2500	,43307
Pop. Density is high	4116	,00	1,00	592,00	,1438	,35096
Pop. Density is low	4116	,00	1,00	2239,00	,5440	,49812
Population above 3th Y/N	4116	,00	1,00	214,00	,0520	,22204
Population above 10th Y/N	4116	,00	1,00	23,00	,0056	,07455
Valid N (listwise)	4112					

10.1.2. Measurement

Basic determinants	Data year	Settlement / County level	Measurement
Share of religions			
Share of Roman Catholic religion	1910	S	% of total population, from census
Share of Orthodox religion	1910	S	as above
Share of German mother tongue	1910	S	as above
Secularization	1910	S	Ratio of divorced *100 / married population in census
Infant mortality	1900-10	S	Infant mortality rate, average of years 1900-1910
Net migration	1900-10	S	(actual increase of population – natural increase) / average population for the period
Population density (as an indicator of urbanization and land availability)	1910	S	Average population / Area of the settlement as reported in the 1910 census
Literacy	1910	S	Proportion of population being able to read and write
Employment in industry (%)	1900	C	Percentage of industrial employees compared to all employees
Percentage of landless	1891	C	Percentage of day laborers within employed population
Extended database (four counties)			
Literacy	1880	S	Proportion of population being able to read and write
Literacy : improvement	1880-1910	S	Difference between the two literacy rates (1910-1880)
Indicator of banking	1880	S	Bank capitalization
Indicator of communication (telex)	1880	S	Is there a telex station in the settlement (Y/N)?
Indicator of transport (train station)	1880	S	Is there a train station (Y/N)?

source: all data are from official statistics, MSK (Magyar Statisztikai Közlemények), 1880-1910.

10.1.3. Sources

Data sources	Publication	Electronic data source
Data series		
MSK	Hungarian Statistical Announcements (Magyar Statisztikai Közlemények)	
MSK vol. V.	Fertility in 1890-91	
MSK vol. 67.	Emigration 1903-1912	
MSK vol. 64.	Industrial employment as a % of employed population, 1900 (pg 215)	
MSK vol. II.	Day laborers as a % of employed population, 1891 (pg 37*)	
MSK vol. V.	Seasonality of marriage 1890-91 (pg 23*)	
MSK vol. 5.	Age distribution of population in Transylvania and Krassó-Szörény county, 1900 - pg 146)	
Databases		
MSK 1.	Census 1900. (Magyar Statisztikai Közlemények. Új sor. 1. köt.: A magyar korona országainak 1900. évi népszámlálása. Első rész. A népesség leírása községenkint. Budapest, M. Kir. Központi Statisztikai Hivatal, 1902.)	received in a database from Elemer Mezei (Babes-Bolyai Univercity, Center of Population Studies) http://www.csp.ubbcluj.ro/members.html
MSK 46.	Vital statistics by settlement 1901–1910. (Budapest, Magyar Kir. Központi Statisztikai Hivatal, 1913.)	received in a database from Levente Pakot and Elemer Mezei (Babes-Bolyai Univercity, Center of Population Studies) http://www.csp.ubbcluj.ro/members.html
OMKSH 2.	Census 1881 by settlement (Budapest, Országos M. Kir. Statisztikai Hivatal, 1882.)	Széchenyi Library of Budapest (www.fszek.hu)
EFP data for Hungary	Fertility indices by county, 1880-1910 ; The Office of Population Research at Princeton University (OPR)	http://opr.princeton.edu/archive/pefp/demog.asp
Maps		
Map 1.	Map of Udvarhely County: Elekes database- Erdély közigazgatási térképei 1332-1968	http://elekes.adatbank.transindex.ro/
Map 2.	Blind map of the counties of Hungary in 1910 (used in maps drawn by author)	Wikimedia Commons

10.1.4. Explanation of Princeton Indexes

"A set consisting of four indexes - I_f, I_g, I_h and I_m - was devised especially for the Princeton European Fertility Project to provide measures that could be easily calculated for most populations given the paucity of data needed to calculate more precise measures.

- I_f = the ratio of the births the women in a given population actually have to the number they would have if subject to a maximal well-recorded age-specific fertility schedule (that of the Hutterites).
- I_g = the ratio of the births the **married** women in a given population actually have to the number they would have if subject to the maximal age-specific fertility schedule.
- I_h = the ratio of the births the **unmarried women** in a given population actually have to the number they would have if subject to the maximal age-specific fertility schedule.
- I_m = the ratio of the number of births married women would experience if subject to the maximal age-specific fertility schedule to the number of births all women would experience if subject to that same maximal fertility schedule. This is an index of the extent to which the marital status distribution would contribute to the attainment of maximal fertility in a population in which all births were to married women. "

(Source: OPR.princeton.edu, see above)

The indices have the following relationship:

$$I_f = I_m \times I_g + (1.0 - I_m) \times I_h$$