Market access and agricultural productivity across the Habsburg Monarchy at the end of the 19th century

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Abstract

This paper explores the patterns of agricultural productivity across the Habsburg Monarchy around 1900. For this purpose, a unique historical cross-sectional dataset on county level from censuses and cadastre sources were constructed and the transport network of the Monarchy were digitized and georeferenced. The hypothesis that agricultural productivity in the Habsburg Monarchy were driven mainly by access to urban demand is tested by a cross sectional OLS model. The results show that market access was a main determinant for agricultural productivity. In addition, there is some evidence that land concentration had a negative effect on agricultural productivity.

Keywords: Habsburg Monarchy, Agricultural Productivity, Market Access, Railroads

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1 Introduction

The Habsburg Monarchy at the beginning of the 20th century was characterized by a regional uneven development. The development pattern has followed the European development gradient. The Economic Growth began to emerge in the monarchy's western regions in the late eighteenth century and diffused gradually to the less advanced regions in the east and south (Good 1984). In contrast to Europe, the Habsburg Monarchy formed a custom and currency union. Thus, the allowance of factor mobility should enable the Monarchy to follow a more regional balanced development path due to the implied convergence process. But one the eve of World War I there were still huge regional differences in development and living standards within the Monarchy (Cvrcek 2013, Schulze 2007). Around 1910 the richest province, Lower Austria, had a per capita income that was about three and a half times that of the poorest province, Dalmatia (Schulze 2007).

This paper evaluates the role of agriculture for the uneven development process in the Habsburg Monarchy. In literature, the interaction between agricultural and wider economic development is explained in different ways. In the classical view, an agrarian revolution has been the precondition for industrialization and thus modern economic growth. Agriculture growth was achieved due to institutional changes towards free labor and private ownership of land introducing a capitalist mode of production (Bairoch 1985). Under this condition, large farms are considered superior to small farms because it is assumed that they have a higher preference for market production and better access to capital and knowledge. Small farms survived primary because of the possibility of subsistence farming and self-exploitation (Boserup 1972).

However, there is also an alternative argumentation. In this view industrialization goes hand in hand with agricultural growth. The demand from industrialized urban centers for food and raw materials created incentives for famers to extend market production, which led to productivity growth due to specialization. Hence, in this view, a dynamic large domestic urban sector is crucial to experience an acceleration of agricultural productivity. Furthermore, it has been argued that the industrialization process in nineteenth century European provided conditions favorable for family farming. The implementation of the agricultural innovations during this period were mainly labor intensive and family farms had the advantage of lower management cost of labor, whereas large landholdings could not benefit from returns of scale (Van Zanden 1991, Hayami 1998).

Recent empirical studies detangled the relationship between market access and agricultural productivity and brought support for the thesis that gains in agricultural productivity was a merely demand-induced process caused by urbanization and not vice versa (Allen 1992, Kopsidis and Wolf 2012, Martinelli 2014, Pfister and Kopsidis 2015). For the Habsburg Monarchy, the effect of urban demand on agricultural productivity nor the impact of institutions for agricultural development has been evaluated systematically yet, although the Habsburg Monarchy would be an interesting case due to its heterogeneous character. Located in the centre of Europe, the Habsburg Monarchy encompassed a huge part of the European continent with a variety of institutional, social and cultural arrangements.

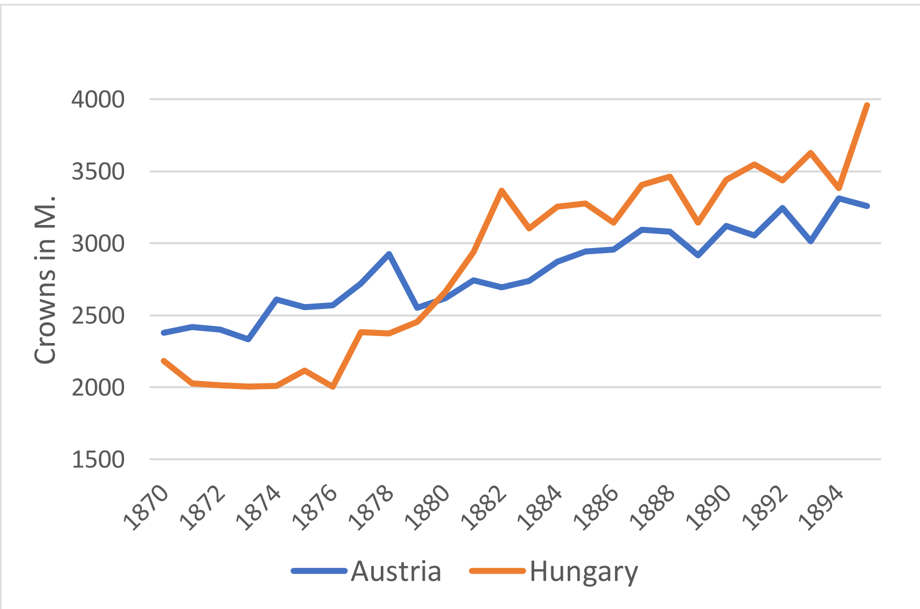
This study aims to evaluate the effect of market access on agricultural productivity. Following the approach of Kopsidis and Wolf (2014) a cross-sectional OLS-model is used to test the impact of market access on land rents and to explore the mechanism through which market access effects agricultural productivity. For that purpose, this study relies on a new historical cross-sectional dataset from censuses and cadastre sources originating from around 1900 and on georeferenced historical railroad maps from both parts of the Monarchy.

The remainder of the paper is structured as follows. The next section gives an overview over the agricultural development in the Habsburg Monarchy in the 19th century and its potential determinants, followed by a brief section putting the agricultural development of the Habsburg Monarchy in the context of urbanization and railroad construction. Section four describes the construction of the dataset and gives a descriptive overview of the variables. The empirical model and results are presented in section five and section six concludes.

2 Agricultural Development in the Habsburg Monarchy and its determinants

The development of the Habsburg Monarchy in the 19th century is usually described as a catch-up failure. At the beginning of the century the Habsburg Monarchy were economically on a par with the territories of Germany and possibly in a better position than Prussia but could not sustain its position during the century. Comparing the two halves of the Monarchy shows that the poor performance was mainly a result of the lack of growth in Imperial Austria not in Imperial Hungary (Schulze 2000). This applies also for the agricultural development. Around 1840 the western parts of the empire had still the same level of agricultural productivity as Germany or Switzerland but fell back afterwards (Sandgruber 1978). From 1871 to 1913 Austria's agriculture grew only by 1.40 % per year. In contrast, Hungary could achieve a yearly growth rate of 2.05 % in the same period (Schulze 2000). Figure 1 illustrates that Hungarian extraordinary performance was primarily the result of a great spurt in the 1870s. The agricultural growth in Hungary materialized not only in absolute terms but also in terms of labour productivity. After Hungary overtook Austria, it subsequently expand its lead so that by 1910, the value added per agricultural worker were already 14 % higher as in Austria (Schulze 2007).

Figure 1: Total value added in agriculture (1871-1913)



Data: Schulze 2000

According to literature, the outstanding performance of Hungary was an export-induced process. Since the end of the 18th century, Hungary has been specialised in producing raw materials. This pattern intensified due to the establishment of a common market within the Monarchy in 1850 and the expansion of the railroad network afterwards (Komlos 1984). Until 1870 most of Hungary were connected to the network providing access to the Austrian market. Subsequently, the Austrian market became more and more important for Hungary's agriculture (Katus 1983). At the end of 1870s Hungarian grain and flour were nearly completely diverted into the Austrian market (Eddie 1977). A clear west-east difference emerged reflecting the proximity to the Viennese market with Transdanubia and the Danube-Tisza basin as the leading regions in agricultural productivity (Puskás 1965).

Within Imperial Austria, the agricultural growth pattern was not as clear cut as in Hungary. At the beginning of the century the Alpine Lands were the agricultural most developed part of the Monarchy. But during the 19th century, Bohemia overtook Austria in terms of agricultural productivity. The implementation of new crops, especially the sugar beet, spread quickly through the Bohemian Lands and met the demand of the growing food industry (Sandgruber 1978b). The high level of agriculture in the Bohemian Lands is also reflected in the low share of fallow and the dominance of stable feeding in this region (Bruckmüller 2010).

In literature, the relative decline of the Alpine Lands in comparison to the Bohemian but also to Hungary has been explained by the farm structure. In the Alpine Land, small and medium farms were dominating agriculture, whereas in Bohemia and in Hungary large landowners were more prevalent. It has been argued that the small and medium farms could not compete with the large estates due to lack of capital and knowledge. Moreover, peasant farms had also a preference for subsistence farming and therefore a lower degree of market production. Hence, the characteristics of peasant farms, prevented the Alpine Lands to benefit from the urban demand created by the Viennese market in the same degree as the Bohemian and Hungarian Lands did. (Freudenberger 2003, Sandgruber 1978, Bruckmüller 1979, Hoffmann 1979, Dinklage 1973).

For the Habsburg Monarchy, the relationship between farm structure and market production were not tested systematically yet but some descriptive studies started challenging this dogma. For Lower Austria, there is evidence that in some regions smallholdings were the most specialised and most market-oriented type of all operational units (Langthaler and Landsteiner 1997). In Hungary, the increase in agricultural output between 1880-1910 was mainly driven by vegetables and fruits usually cultivated by peasants suggesting that peasants adjusted to the increasing demand for high value-added animal and horticulture products. (Kopsidis 2013). Furthermore, Puskás (1982) showed that intensive grain farming was widely adopted by peasants as well.

3 Access Urban market, Urbanization and Transport Development

This paper refuses the thesis that large landowners had a positive impact on agricultural productivity. Instead the paper will show that the market access played a crucial role for agricultural development and can explain the differences in agricultural development within the Habsburg Monarchy. The paper's hypothesis is that the agricultural productivity growth in Hungary and the stagnation in the

Alpine Lands was an outcome of shifts in relative access to urban markets during the second half of the 19th century. The relative decline of the Alpine Lands was primarily a consequence of the expanding railroad network of the Monarchy which favoured the integration of the Hungarian plains into the Viennese market whereas the Alpine Lands suffered from less accessibility. I provide in this section some excursive evidence that the shift of market access was due to evolution of the railroad network and was not driven by the increase of the domestic urban consumer base in Hungary. Section 5 provides then the second step and shows how market access is related to agricultural productivity.

Table 1 shows the urbanization rates comparing the two halves of the Monarchy. As you can see, urbanization rates differed regionally and increased during time. For Hungary, the most dynamic phase of urbanization was not in the 1870s but in the last decade of the century. Whereas in Austria the largest increase was in the 1870s. This suggest that that the urbanization in Hungary was not the driver for the agriculture boom in the 1870s.

Table 1 Urbanization rates (share of population living in towns with 10,000 inhabitants or more)

Region	1869	1880	1890	1900
Imperial Austria	10%	14%	16%	18%
Danube Lands	31%	37%	44%	48%
Alpine Lands	6%	8%	8%	10%
Bohemian Lands	7%	11%	13%	15%
Adriatic Lands	19%	22%	19%	20%
Carpathian Lands	5%	8%	9%	10%
Imperial Hungary	13%	15%	16%	20%
Upper Hungary	7%	9%	10%	11%
Hungary	19%	22%	23%	27%
Transylvania	6%	7%	8%	10%
Croatia-Slavonia	5%	6%	7%	9%

Sources: Author's own calculations based on Magyar MSKS 1901, ÖSH 1901, ÖSH 1882

The Vienna region was not only outstanding in regard of the number of urban consumers – accounting for 20 % of the total urban population - but also by its accessibility via railroads. This was a result of path dependency. At the beginning of the railway era in the 1840s, Vienna was the capital of the entire Monarchy. Thus, the first lines converged all to Vienna. These lines became later the central core from where all other construction radiated. This applies also for the lines built in Hungarian territory before the compromise 1867 and for the first decade afterwards. In Hungary, the railroad boom of the 1870s which coincide with the agricultural boom was deepening the existing network fostering the accessibility to Vienna not to Budapest. During the boom, the largest share of new railways was constructed in the western part of Hungary. Alone, in the region Danube Right bank 1,400 kilometres were laid out, accounting for 20 % of total railroads which were built in this decade. Only after 1880, when the initiative for railroad construction got into government hands (Good 1984), new tracks stretching out from Budapest were constructed and the centre of the Hungarian network shifted to Budapest. The specific evolution of the Hungarian railroad system ensured that Hungary could profit from a high degree of accessibility to the largest urban market of the Monarchy. However, improving the accessibility to its own urban market might had also a contributed to the shift in agricultural productivity in favour of Hungary. Further research has to be done To detangle the domestic demand from the Viennese demand effect.

4 Data Source and Data critique

To analyse the impact of market access on agricultural productivity I constructed a cross sectional county dataset derived from census and cadastre sources and historical maps from both halves of the Monarchy. As time frame for the analysis I have chosen the years around 1900 because of the good data situation in this period. The only agricultural censuses for Austria (1902) and for Hungary (1895) date back to this period. Moreover, the only monarchy-wide comparable cadastres for Imperial Austria were completed in this period.

Although Austria and Hungary were two separate entities at these times, the sources created by these two countries are largely comparable because both part were relying on the methods developed before the compromise of 1867 and the statistical offices cooperated afterwards. For instance, this is reflected by the same method used to determine the land tax or by the common record date for the population censuses. The dataset is georeferenced by using the geo-referenced administrative boundaries provided by Rumpler and Seger (2010). The following sub sections describes the data construction and presents some descriptive statistics.

4.1 Measuring Agricultural Productivity

In this paper, agricultural productivity is proxied by the so-called Katastralreinertrag (KRE) derived from Austrian and Hungarian cadastral sources. The KRE is defined as the income from agrarian use of land less all input cost. The calculation was used by the tax administration to stipulate the land tax. To assess the KRE, the tax administration first divided the country in homogenous classification districts and then pinpointed in these districts some representative parcels of land (Mustergrundstücke) for every category of land use[2] (Kulturgattungen) and for every of the up to eight quality classes (Bonitätsklasse) representing different soil qualities. The KRE was than calculated by evaluating the output and input per hectare in terms of the average market prices by assuming a common (gewöhnliches) farm management.[3]

The KRE corresponds to the concept of land rent which is generally defined as the difference between the value of outputs and inputs. According to several studies land rents roughly reflect secular developments of agricultural TFP (Clark 2002, Allen 1992). However, while the KRE will be highly correlated with TFP, the correspondence is imperfect by definition: The KRE is calculated by monetized output minus monetized input; whereas TFP is usually calculated monetized output divided by monetized input. However, in the Austro-Hungarian context, the KRE has its advantages compared with other possible TFP calculations because it has been assessed on the basis of a wealth of data which has not survived to this day. To calculate the input side of the KRE the tax administration considered information about wages, hours worked and capital employed based on local inquiries.

2 The different kind of land uses are: arable, horticulture, viticulture, meadow, pasture, reed and forest.
3 See Imperial Act of May 24th, 1869 and July 12th, 1896 for Imperial Austria and Act VII of 1875 and Act XXII of 1885 for Hungary.

Information we could not exploit from other sources in order to reproduce this calculation. The same applies for the output calculation used to estimate the KRE.

Besides the differences in definition of KRE and TFP there is a second caveat in order. The KRE does not consider animal production and yields from livestock farming in a direct way. The impact on animal production is reflected in the KRE only in some degree by the impact of husbandry on arable farming and the profitability of grassland. The omission of direct effects will tend to limit rather to overstate the effect of urban demand on agricultural productivity.

Map 1 shows the agricultural productivity measured by KRE per hectare of agricultural land at county level. As you can see, agricultural rets differs between counties forming a geographical pattern. Areas achieved a high productivity were located mainly in the north-west and were situated next to urban areas. In the Austrian halves three clusters with high productivity standout: A cluster of counties with a productivity two times above the average was located in northern Bohemia between Prague and Hradec Králové. A second region with outstanding performance stretched from Vienna to Olomouc following roughly the Morava river. A third region forms a cluster around Linz in Upper Austria. In Hungary, the most productive areas are found within the Great Hungarian Plain, an area with particular good soil quality. The counties with the lowest productivity are Dalmatia, where only one tenth of the average KRE was achieved, followed by some Galician counties and the alpine regions in Tirol and Salzburg.

4.2 Estimating Market Access

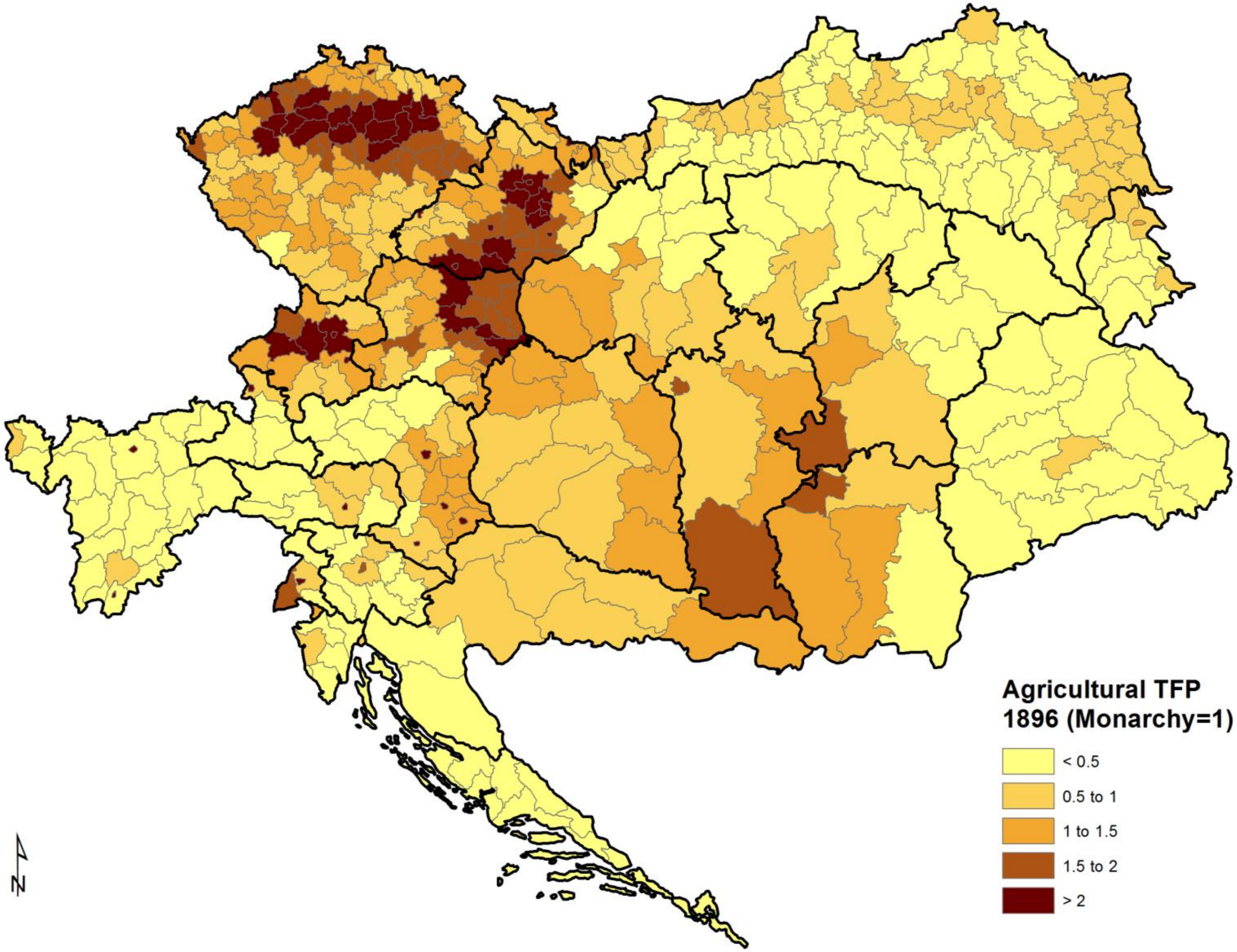
To measure the impact of urban demand on agricultural productivity, I constructed the variable Market Access in the spirit of C.D. Harris (1954). The variable captures the plurality of demand foci for a given location as a weighted average, where the weights are given by the respective distances to all other locations. The variable is calculated as following:

$$MA_i = \sum_{j=1}^{n} \frac{Urban\ Population_j}{Distance_{ij}} \tag{1}$$

where the subscript i denotes the i-th county for which the access to markets is to be measured.

There are several ways to measure potential urban demand empirically. I consider two definitions: the amount of population living in urban areas above 10,000 inhabitants and the population not engaged in agriculture. The first approach has the advantage, that only demand in concentrated form (that creates thick market externalities) are taken into account but has the disadvantage that it might overstate the impact of urban demand especially in the eastern regions where in urban agglomerations a large amount of the population was engaged in agriculture (Banik-Schweitzer 2010). In turn, measuring urban demand by non-agricultural population has the advantage that it captures the demand of semi-urban areas with high population density as it existed in in the northern Bohemian mining regions which were neglected by the first approach but has the disadvantage that demand from scattered areas is considered too. Both variables are collected from the population censuses of 1900.

Map 1 Normalized land rents (KRE) per hectare (1886)



A simple form to measure distance is to calculate the air distance between the centroids of any city-county pair. In the case of the Habsburg Monarchy applying this approach would distort results due to regional different accessibility to transportation infrastructure. The market access for Northern Bohemia or the Hungarian Plains, where the railroad network was dense, would be underestimated and for the Alpine Lands overestimated. That is why this paper use freight costs as and distance measure. For that purpose, the historical transport network of the Habsburg Monarchy was constructed. Historical railroads lines were digitized and georeferenced using historical railroad maps. The results were crosschecked relying on official railroad statistics where every track with its opening date is listed. Furthermore, rivers navigable for steam ships were digitized and georeferenced and the main harbours in the Adriatic Sea were connected.

The freight rates for the railroad were derived from the tariff schedule of the state-owned k.k. österreichische Staatsbahn (kkStb).[4] The kkStb was the market leader in the Habsburg Monarchy controlling 82% of railroad net in the Austrian part of the Monarchy. Both, Austria and Hungary used the market power of their state-owned railroad companies as a vehicle to unify freight charges (Eddie 1989). The freight structure which as a result emerged in both countries was characterized by relatively expensive short- and medium-distance charges and lower long-haul charges, compared to other European countries. The Hungarian tariff-system gave a higher discount on longer distances then the Austrian tariff system but had on average approximately the same charges (Pearson 1909). Using the kkStb tariff scheme for both parts of the Monarchy therefore slightly underestimate the market access of the Hungarian halve of the Habsburg Monarchy. The cost of the kkStb tariff ranged from 3.7 kreuzer to 2.1 kreuzer per kilometre depending on the distance and a terminal charge of 40 kreuzer supporting the shipment to areas further away (see Table in Appendix). The water rates are taken form Schulze (2007) and set to 0,02 Kreuzer per ton-kilometres and terminal costs to 68,8 kreuzer.

A substantial share of transport costs of a farmer is induced by bringing the goods with cart and horse form the farm to the next railroad or port. To account for this kind of overland transport I followed Donaldson and Hornbeck (2016) and created with GIS-software 200 random points in every county simulating the location of the agricultural holdings.[5] Then, the transportation on the road network were estimated by measuring the shortest linear distance from these points to the next port and railroad. Following Fogel (1964), the waggon rate is set to 18.06 kreuzer which corresponds to the 8-fold of the average railroad rate. Thus, the overall transportation costs are to an extensive part shaped by the level of endowment of a region with railroads or waterways and the corresponding costs of cart and horse transportation.

On basis of the above described specifications and the constructed multi-modal transportation network a lowest- freight cost analysis was carried out. The OD matrix solver of ArcGIS were used to identify the least cost paths from each of the 83,600 random points to the 241 urban agglomerations.[6]

[4]The stated-owned kkStb was the railroad company with the largest network within the Monarchy controlling 82.1 % of the railroad net in Austria in 1896. In Hungary, the state-owned Magyar Államvasutak (MÁV) controlled over 83.2 % of the Hungarian net and introduced a similar tariff schedule as the kkStb in 1894 but with higher terminal cost but lower variable costs (Strach 1898).

[5]I excluded all areas above 2000 meters, because this area was in general inhabited, before assigning the random points to the counties areas.

[6] Because of the gradual tariff scheme of the railroads, OD matrix solver could not be directly used to identified the least cost-path. Therefore, alternatively, the OD matrix solver were used to calculate not the least cost path but the shortest paths along the network in three scenarios: First using only railroads and carts, second using only waterways and carts and third using all three modes of transportation. The obtained kilometres were used to calculate the freights costs on basis of the parameters in table A1 for each scenario. Finally, the lowest freight cost scenario was chosen for every point-city pair.

An average of the freight costs of 200 point-city pairs in each county were taken to derive the specific freight costs of each of the 418 rural counties of the Habsburg Monarchy. The same methodology was applied for market access to non-agricultural population by using not cities but the centroid of every county as market destination.

4.3 Market access around 1900

Railways heavily dominated the internal good traffic in the Habsburg Monarchy and the network was already dense around 1900. Colum 5 of Table 2 gives an overview of the endowment with railroads and waterway on a regional level in terms of the "average" distance in kilometres to the next port or railroad. The highest endowments on railroads enjoyed the Danube lands because this region includes with Vienna the centre of the network, followed by the Bohemian Lands and the Hungarian plans. Croatia, Transylvania and the Carpathian Lands had the lowest endowment. Also, the Adriatic Lands showed a low access to transport infrastructure because Dalmatia was not connected to the railroad network of the Monarchy. This drawback was not compensated by the littoral character of this region and the corresponding access to ports because of the high fix cost of this mode of transport. The minor role of waterways is reflected in the freight statistic. Freights transported between the empire's Mediterranean accounted only for a half per cent of the freight volume in the Monarchy. This minor role applies also for river navigation. The volume of goods transported via Danube and Elbe and its tributaries, was only one per cent of the railway traffic in terms of ton-kilometres (ÖSH 1901, MSE 1902).

Map 2 presents the market potential given relative to the sample average by using access to urban population as demand factor and freight costs as variable for distance. The data shows a clear centre periphery pattern, with the highest market access around Vienna and the lowest market access for Dalmatian counties and counties located in the East. Moreover, counties lying on main transport corridor tends to have a higher market access as counties lying besides, which is most visible in the pattern in southern Bohemia. The first four columns of Table 2 show the relative market access to calculated by geographical distance in comparison without freight costs. As you can see, the variation of market access is smaller when considering the transport network. This is a result of an increasing market access in the periphery. On the other hand, the transport network reinforces the position of Vienna and its surroundings as the most important market of the Monarchy at the expense of the other agglomerations such as Prague and Budapest (comparing Map 2 with Map A3 in the appendix).

For the calculation of market access external demand is neglected. The economic policy of the Habsburg Monarchy was directed towards self-sufficiency and trade within the custom union. This policy is reflected in the low share of 7 % on total European exports around 1900. This was considerably smaller as the share of Germany (19.6) and France (14.4) (Eddie 1989). Only 11 % of the value added in agriculture were exported. The main export partner was Germany where 78 % of total exports were directed to, followed by Italy with a considerably lower export share of 5,5 % (figures from trade statistics of 1900). Furthermore, external demand potential was reduced by tariff policy towards protectionism in most of the neighbouring countries. Although the most important trading partners lowered agrarian tariffs after 1890, by 1900 they were still higher than in the era before protectionism (Eddie 1989). Considering the trading pattern of the Habsburg Monarchy and urbanisation rates of the neighbouring regions an inclusion of external demand would increase the market access of the

Bohemian region; a region with already high domestic market access. Thus, introducing external market access is unlikely to change regions the relative position within the Habsburg Monarchy.

Table 2: Transport Infrastructure and Market Access

	Relative Market Access to urban agglomerations		Relative Market Access to non-agricultural Population		
Province/ Region	Geographical distance	Freight costs	Geographical distance	Freight costs	"Average" Distance to next port or railroad in km
Imperial Austria					
Danube Lands	145%	142%	145%	125%	2.75
Alpine Lands	95%	95%	86%	96%	9.29
Bohemian Lands	115%	117%	126%	116%	4.90
Adriatic Lands	60%	58%	66%	60%	8.85
Carpathian Lands	92%	93%	83%	93%	10.68
Imperial Hungary					
Upper Hungary	112%	106%	121%	113%	7.81
Hungarian Plains	114%	116%	114%	116%	6.55
Transylvania	81%	82%	75%	90%	16.00
Croatia	86%	89%	84%	91%	10.92
Min	30%	29%	43%	31%	0.69
Max	389%	301%	236%	271%	47.72
μ	100%	100%	100%	100%	7.16
σ	39%	29%	30%	22%	5.75

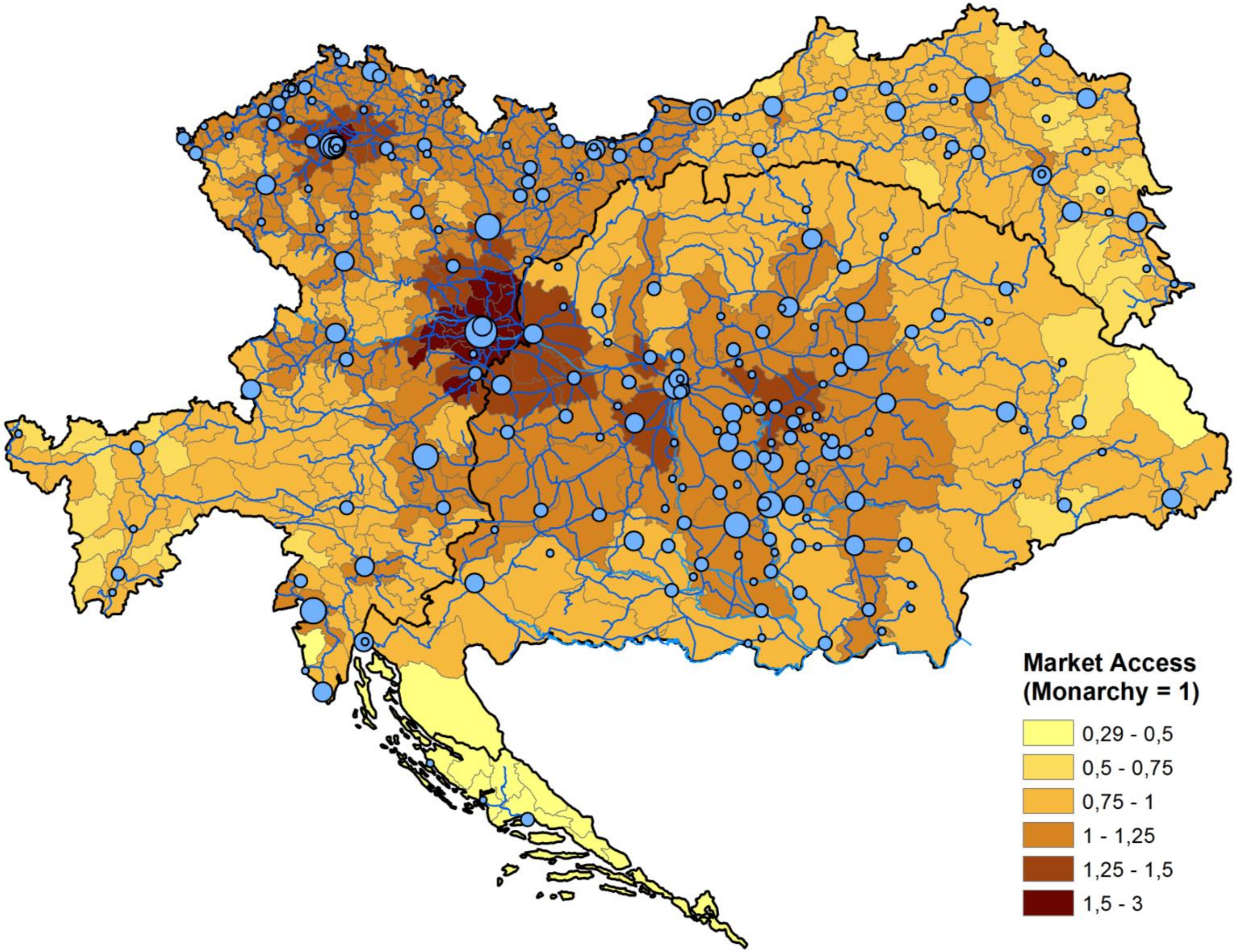
Sources: see text

4.4 Farm structure

The institutional framework is considered as one of the most relevant aspects which determined the agricultural productivity. The differences in the institutional framework is best reflected by the farm structure. As pointed out in section 2, traditional literature argue that large estate relying on day labourer operates the most efficient. However, this has not been proofed on a broad empirically basis yet, also because the data on farm size are limited.

In the case of Austria, the only source providing information about the farm size distribution for all provinces is the agricultural census of 1902. This census includes frequency tables categorised by farm size classes for agricultural and horticultural farms and forestry operations, as well for mixed agricultural holdings including farm land and forestry. Based on this information in combination with information about the total amount of land for each category of land collected from the cadastre I

Map 2 Market Access to urban agglomerations measured by freights costs



estimated the amount of land hold by each farm size class.[7] Table 3a presents the estimated value aggregated on province level suggesting that large landholdings are located mainly in the southern provinces whereas in productive regions - like Lower and Upper Austria - medium farms predominated. That is also true for the Bohemian Lands. This contrasts with literature, which describes the Bohemian Lands as predominated by large landowners. However, this data is based on the possession of land and not on the property titles, which suggest that in Bohemia landlords rented a share of their property out.

For Hungary, the agricultural census provides frequency tables categorised by farm size classes with information about the amount of land corresponding to each farm class.[8] Unfortunately, the census did not differentiate between types of farming and pure forestry operations were excluded completely from the census. That is why the farm structure showed in Table 3b includes holdings possessing farm land as well as holdings with farm land and forestry. This could distort the distribution if large land holdings are related with a dominance in forestry. That is why Column 5 of Table 3b displays the share of forest on total agricultural land for every region. These figures suggest that the share of large landholdings does not correlate with the amount of forest.[9] There are regions with a high share of large landholdings while having a relative low share of forest like the Right Bank of the Danube and the Danube-Tisza basin.

4.5 Other control variables

In addition, to market access and farm structure other variables could affected agricultural productivity as well. Population density could affect agricultural productivity because of the induced local demand. Moreover, human capital could play a crucial role for the diffusion of new innovations in agriculture. In fact, Austria as well as Hungary tried to improve agriculture productivity by investing in education. Both countries supported the foundation of agricultural associations, journals and colleges (Bruckmüller 2010).

To measure the effect of human capital two variables were introduced into the model. First, the illiteracy rate is used as a proxy to measure the ability of farmers to acquire knowledge about new cultivation techniques propagated by agricultural associations and journals. Moreover, this variable reflects also the counties level of development in a more general way. The illiteracy rate follows a clear north-west to south-east gradient with rates around 5 % in the Bohemian and Alpine Lands and rates above 60 % in the southern and eastern periphery. The second variable measuring human capital are agricultural white-collar workers per 1000 hectares agricultural land. This variable is a proxy for graduates from agricultural colleges, which were mainly hired by large landowner to supervise and manage the operation and were engaged mainly in the Bohemian Lands (Freudenhofer 2003).

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[7] The census differentiates between 15 size classes, whereas the largest size class includes all farms greater than 1000 hectares. To estimate the share of land for each size class, I take the middle of the size range for the first 14 size classes and multiply this value with the corresponding numbers of farms. The result is subtracted by the total amount of land given by the cadastre receiving the share of land belonging to the largest farm size class.

[8] For Hungary, the directory of landowners of 1893 would provide us with more accurate picture about the land concentration (Eddie 1967). However, this data is not comparable with the Austrian data, because the Austrian data took the farm as the basic unit and not the property owner as it is the case for the directory.

[9] The overall correlation between agricultural land owned by large estates and share of forestry on agricultural land on county level is 0.33.

Table 3a: Farm structure in Imperial Austria – percent of farm land owned by farm class

Province	Part Time Farms < 2 ha	Small Peasant Farms 2-5 ha	Medium Peasant Farms 5-20 ha	Large Peasant Farms 20-100 ha	Estates > 100 ha
Lower Austria	4%	9%	53%	26%	9%
Upper Austria	4%	8%	53%	36%	0%
Salzburg	1%	2%	21%	23%	53%
Styria	6%	14%	48%	22%	10%
Carinthia	2%	5%	28%	29%	36%
Carniola	5%	13%	51%	15%	17%
Littoral	4%	8%	17%	4%	67%
Dalmatia	6%	9%	10%	3%	72%
Tyrol	5%	9%	19%	11%	56%
Vorarlberg	4%	11%	21%	14%	49%
Bohemia	7%	15%	42%	21%	15%
Moravia	9%	16%	46%	17%	13%
Silesia	7%	16%	42%	19%	16%
Galicia	9%	24%	29%	7%	32%
Bucovina	11%	19%	22%	10%	37%

Sources: Author's own calculations based on ÖS 83 (1909) and Gemeindelexikon (1902)

Table 3b: Farm structure in Imperial Hungary – percent of agricultural land owned by farm class and share of forest on agricultural land

Regions	Part Time Farms < 2 ha	Small Peasant Farms 2-5 ha	Medium Peasant Farms 5-20 ha	Large Peasant Farms 20-100 ha	Estates > 100 ha	Share of forest on agricultural land
Danube Right Bank	6%	8%	27%	6%	52%	18%
Danube Left Bank	7%	10%	28%	9%	46%	32%
Danube-Tisza Basin	5%	6%	30%	18%	40%	7%
Tisza Right Bank	5%	9%	24%	7%	54%	37%
Tisza Left Bank	5%	7%	26%	11%	51%	27%
Tisza-Maros-Basin	6%	12%	37%	11%	34%	23%
Transylvania	7%	12%	42%	11%	28%	14%
Croatia-Slavonia	8%	17%	43%	6%	26%	36%

Sources: Author's own calculations based on MSKF XVI (1897)

Beside human capital, the access to pecuniary capital could determine agricultural productivity. For this reason, the variable draft animals in terms of livestock units per km of farm land is added as proxy for working capital to account for the fact that low productivity agriculture is due to the lack of capital access (Van Zanden 1991). However, this seems not to be the case by looking at column 4 in table 4 which shows the aggregate numbers on province level. In terms of draft animals, Galicia has almost the same endowment with working capital as the Czech Lands. The high endowment of Galicia could reflect the high degree of subsistence farming (Wolf 2013). Furthermore, the figures do not adjust for the quality of the cattle. For that reason, the figures might be overstated for the poorer regions of the Monarchy, especially for Galicia and Bukovina.

Other determinants of agricultural productivity which are considered are geophysical variables as soil quality, latitude, altitude and roughness.[10] This data is derived from contemporary GIS-Rasta data sources. Soil quality is measured by the share of clay soils derived from the soil-map of the European Soil Data Centre.[11] There is a lot of variation in the Hungarian soil-texture, whereas the Imperial Austria shows a high degree of homogeneity.

Table 4: Other Determinants for agricultural productivities

Region	White collar workers per 1,000 km of farm land	Illiteracy Rate	Population Density in km	Draft animals per km of farm land
Imperial Austria				
Danube Lands	0.49	0.05	122.95	0.67
Alpine Lands	0.57	0.15	50.93	0.52
Bohemian Lands	1.76	0.05	115.97	0.65
Adriatic Lands	0.39	0.26	42.74	0.32
Carpathian Lands	0.85	0.64	69.93	0.56
Imperial Hungary				
Upper Hungary	0.53	0.36	57.53	0.48
Hungarian Plains	0.49	0.35	66.11	0.40
Transylvania	0.24	0.59	43.27	0.29
Croatia-Slavonia	0.24	0.55	57.70	0.48
Min	0	0.01	12.28	0.00
Max	16.09	0.92	880.06	1.26
µ	1.23	0.26	89.22	0.40
σ	1.61	0.26	70.12	0.17

Souces: Author's own calculations based on ÖS 64-66, (1902-1905) and MSKS I-II (1902-1904)

5 Empirical Strategy and Results

To determine the impact of urban demand on agricultural productivity a cross sectional OLS model is estimated including all rural 418 counties of the Habsburg Monarchy in boundaries of the year 1900. The model is specified as follow:

$$\ln y_i = a + b \ln MP_i + x'\delta + u \quad (2)$$

[10] Altitude and Roughness were calculated relying on the SRTM 90m Elevation Database provided by CGIARCSI.

[11] The soil-texture which is the physical composition of the soil together with climate (which is here proxied by elevation and latitude) are the main exogenous determinants of soil quality. However, soil quality is also heavily dependent on the cultivation regime, which is here captured by the human capital variables. Topsoil is defined as soil consisting of more than 35 % clay or with less than 35 % clay but only up to 15 % sand.

where y_i is agricultural productivity measured in terms of KRE in the county *i*. The KRE is determined by Market Access and $x'\delta$ is a vector of county-specific control variables that includes demographic, socioeconomic and regional characteristics for each county. These variables were transformed to their natural logarithm only if it was necessary to get a linear relationship. Furthermore, a dummy distinguishing between the two halves is introduced to account for the fact that the agricultural censuses collected at different times in Austria and Hungary. Finally, *u* it is the error term that captures any remaining unobserved determinants or measurement error in y_i.

Table 5 displays the effect of market access on agricultural productivity for different definition of market access. In all variations, the coefficient for market access is positive and statistical significant. The effect of market access is higher by using non-agricultural population excluding the possibility that population engaged in agriculture are supplier and demander in one person. The coefficient is also higher for the models using freight costs instead of linear distance. In all cases the access to markets seems to be a main driver for agricultural productivity, explaining around 50 % of the variation in agricultural productivity throughout the Monarchy according to the adjusted R square.

However, these results could be biased upward since some relevant explanatory variables were not included. That is why as a robustness check further variable were introduced in the model. In a first step, I include population density in the model to consider the role of local demand for agricultural productivity. Moreover, farm structure and human capital might be some crucial factors shaping the agricultural productivity pattern of the Monarchy. To account for farm structure, I used the share of land owned by large landholdings. Human capital is measured by illiteracy rate and by agricultural white-collar workers per 1000 hectares. Furthermore, the share of forest is introduced to the model to control for the possibility that forestry might reduce agricultural productivity. Finally, a Dummy for the Hungary halve is introduced to account for the fact that data for this part derived from different sources and especially that the agricultural censuses were not conducted at the same year.

Table 6 reports the results. Introducing variables of local demand, farm structure and human capital reduce the coefficient of market access by one half but the coefficient is still significant on a 1 % level. The variables measuring human capital have the expected sign but effect of agricultural white-collar workers is only significant at 10 % level. The farm-structure variable has a negative sign and is significant.[12] The negative coefficient for the share of latifundial land suggest that land concentration has a negative impact on agricultural productivity. This challenge the traditional view that large landowners were a driving force of productivity gains in the Habsburg Monarchy but is in line with recent studies suggesting a negative relationship between land concentration and agricultural productivity (Vollrath 2007; Martinelli 2014).

Two additional robustness checks were done. First, I controlled for environmental features. This hardly effects the coefficient access to markets but reduces the impact of forest on agricultural productivity and increases the significance of the agricultural white-collar workers. As another step, I introduced

[12] For the regression, for both, Austria and Hungary the share of latifundial land were calculated considering the land of pure farms as well as the operations with farm land and forestry. The regression was also estimated by using the GINI instead of the share of latifundias and this confirms a negative significant impact of farm structure on agricultural productivity.

Table 5: Access to markets (non-agricultural individuals) and agricultural productivity

Dependent variable: KRE per hectare (log)	OLS (1)		OLS (2)		OLS (3)		OLS (4)	
Access to market (log): Urban population - linear distance	1.728***	(0.078)						
Access to market (log): Urban population – freight costs			2.029***	(0.099)				
Access to market (log): non-agricultural individuals – linear distance					2.030***	(0.095)		
Access to market (log): linear distance – freight costs							2.361***	(0.119)
Constant	-15.369***	(0.763)	-17.088***	(0.909)	-21.413***	(1.069)	-22.280***	(1.200)
R^2	0.537		0.498		0.521		0.482	

Notes: Standard errors in parenthesis; *significant at 10 percent, **significant at 5 percent, and *** significant at 1 % percent

Table 6: Access to markets (urban agglomerations > 10,000 inhabitants) and agricultural productivity

Dependent variable: KRE per hectare (log)	OLS (1)		OLS (2)		OLS (3)		OLS (4)		OLS (5)	
Access to market: urban agglomerations (log)	**2.028*** **	**(0.099)**	**0.949*** **	**0.098**	**0.973*** **	**0.087**	**0.849*** **	**0.081**	**0.805*** **	**(0.081)**
Population density (log)			0.587***	0.051	0.378***	0.051	0.231***	0.046	0.241***	(0.045)
Illiteracy rate (log)			-0.259***	0.023	-0.262***	0.021	-0.330***	0.019	0.340***	(0.019)
White collar worker per 1000-hectares farm land			0.042	0.027	0.052*	0.026	0.086***	0.025	0.077***	(0.025)
Share of forest					-1.218***	0.162	-0.237	0.165	-0.115	(0.166)
Share of latifundia land					-0.629***	0.127	-0.633***	0.106	-0.505***	(0.110)
Share of topsoil							0.000	0.001	0.000	(0.002)
Roughness (log)							-0.089***	0.031	-0.075**	(0.031)
Elevation (log)							-0.366***	0.044	-0.374***	(0.044)
Latitude (log)							-0.835**	0.363	-1.234***	(0.374)
Draft animals per hectare farm land									0.508***	(0.137)
Dummy: Hungary			0.317***	0.070	0.087	0.067	0.029	0.062	0.091	(0.064)
Constant	-17.088***	(0.909)	-9.127***	0.873	-7.787***	0.790	8.841*	5.036	14.834***	(5.219)
R^2	0.498		0.721		0.778		0.845		0.849	

Notes: Standard errors in parenthesis; *significant at 10 percent, **significant at 5 percent, and *** significant at 1 % percent the draft animals per hectares of farm land as a proxy for working capital to account for the fact that low productivity agriculture is due to the lack of capital access. This variable is significant as expected and reduce the negative impact of forest further, whereas the effect of market access is still stable. The elasticity of the market access coefficient is near unity, which is in line with other studies about the effect of market access on agricultural. An increase of one per cent in market access leads to an increase in total factor productivity measured in KRE by 0.8 per cent.

5.1 Exploring the mechanism

As a next step, I explore the mechanism behind market access and land rents. There are several possible mechanisms why access to urban demand could increase land rents and agricultural productivity. Here I consider a Smithian and a Von Thünen perspective.

According to Grantham (1999) there are three specific characteristics of access to urban markets which enhance land rents and agricultural productivity. First, selling their product in urban markets, farmers are facing a highly elastic demand curve. A farmer can thus sell as much as he or she produce without affecting the price providing incentives to extend market production. Second, because of the pooling effect, large urban markets are by nature more stable as rural markets. This results in lower sales risk fostering investment possibilities and encourage specialization. Third, the spatial concentration of consumers facilitates the marketing of agricultural products which lowers transaction costs. Hence, farmers exposed to growing urban markets typically became more specialised than more isolated farmers. The increasing specialisation further created opportunities to improve methods of cultivation, usually as a by-product of the increased scale of production of specific agricultural commodities. Moreover, farmers will specialize in crops best suitable to its soil quality, topographic and weather conditions allowing additional productivity gains.

The Von Thünen perspective focuses on transport costs as a decisive factor to explain spatial variations in land rents and agricultural output. Farmers close to cities facing lower transport cost and are therefore able to sell their products at higher farm-gate-prices. Thus, the closer the land is located to an urban centre the more valuable and expensive becomes land for its farmer. That is why, farmers will adapt more labour and capital-intensive modes of productions in the vicinity of cities. This means, farmers near cities will specialise in highly perishable commodities like milk and fresh vegetables; products with higher profit per hectare but higher transport costs. Further out, it will be more profitable to produce goods with lower transport costs and lower profits per hectare like grain and cattle (Kopsidis and Wolf 2012). Due to the fact, that the most innovations in the premodern agriculture were land saving the profitability of the implementation of these innovations become large towards the centre this innovations should diffuse more rapidly there than in the periphery.

To test the suggested channels, I rerun the regression (2) by adding variables which capture the above described effects of access to urban markets on land rents and agricultural productivity. First, I introduce the share of horticulture land and the share of meadows on total agricultural land into the regression. Given that horticulture products tend to have higher transport costs but have also higher value per unit the share of horticulture land should be higher in areas next to cities. For meadows, the opposite applies. The share should be higher in remote areas which implies a lower land rent. In addition, the variable labour intensity measured by unit of non-family labour per agricultural area in a county are added to capture the effect that farmers will substitution land for labour next to cities as a profit maximizing strategy. Furthermore, a measure of concentration is added to measure the degree of specialization in a county. Specifically, a Herfindhal index is calculated from the various categories of land use. The idea is, that counties with higher accessibility should be more specialized in products more suitable to their natural endowment.

Both theories predict that profit-maximizing farmers facing a higher market access a more willing to implement new technologies. In pre-modern era, the main innovation to improve output per hectare was the implementation of legumes into the crop rotations system. These plants have the capacity to fix nitrogen from the atmosphere and providing it to the soil thus improving the soil quality. Because legumes has been planted instead of the fallow this has also increased the area under cultivation (Allen 2008). I introduce the share of fodder plants on total agricultural land into the regression to capture the effect of this innovative farm management system and its effect on land rents and agricultural output.

Table 7 Exploring the Mechanism

Dependent variable: KRE per hectare (log)						
Access to market: urban agglomerations (log)	1.278	***	(0.112)	0.510	***	(0.072)
Share of horticulture	1.278	***	(0.112)	4.945	***	(1.381)
Share of meadows	18.050	***	(2.164)	-2.391	***	(0.235)
Herfindhalindex	-1.676	***	(0.301)	0.294	*	(0.176)
Labour intensity	1.470	***	(0.276)	-0.113		(0.108)
Cows per 100 hectares	-0.145		(0.124)	-0.001		(0.001)
Pigs per 100 hectares	0.001		(0.002)	-0.001		(0.002)
Share of fodder crops	0.000		(0.002)	1.034	**	(0.430)
Controls	3.103	***	(0.725)	Yes		
R^2	0693			0.906		

Notes: Standard errors in parenthesis; *significant at 10 percent, **significant at 5 percent, and *** significant at 1 % percent

Table 7 shows to what extent the effects of access to urban markets on agricultural rent can be explained directly by the channels described above. All significant coefficients have the expected sign. Differences in specialization and the implementation of fodder crops into the rotation system have a positive impact on agricultural rents. In addition, we can see that land use strongly effects agricultural rents. Counties with a larger share of higher value-added crops (the positive sign of the horticulture coefficient) generate a higher rent per hectare. Extensive forms of land use are related with lower rents shown by the negative meadows coefficient. The variable cows are not significant suggesting that an orientation toward livestock farming alone did not improve land rents. An explanation could be that the produced manure must be carried to the fields and allocated there in an efficient way so that the positive effect of manure could be materialized. These aspects are not captured by this variable as well as the fact that the quality of the manure could differ depending what kind of fodder the cows ate Labour intensity is also insignificant. This is most likely a measurement error because we have only data about the number of persons engaged in agriculture but not the hours worked, whereby the latter is actually that what we want to measure. In peripheral regions, it is plausible to assume that there was considerable underemployment in this sector. This biased the labour intensity coefficient in the regression downwards.

Overall, introducing all the variables reducing the coefficient of market access by 40 percent but market access continues to be significant. This probably is an effect of the limitations of the data. Most notably, the model omits organizational and technological differences besides the fodder-crop channel. Controlling for spill over effects from urban-industrial agglomeration to agriculture would improve the explanatory power.

5.2 Instrument variable approach

Some can argue that the location of urban centres might be determined by agricultural suitability and not vice versa. If this is the case urban demand would be endogenous to agricultural productivity and the OLS results would be biased. This problem is addressed by an instrumental variable approach. For that purpose, a variable is required which is correlated to both the size and the location of urban agglomerations (or non-agricultural population) but is not endogenous to agricultural productivity. I use the numbers of workers in the mining industry in the year 1890 as an instrument. This is an exogenous variable for two reasons. First, the location of mining jobs was dependent on the existence of mineral resources and not on agricultural suitability. Second, the time lag ensures that this variable cannot be determined by the dependent variable.

The result of the IV Estimation are displayed in Table 8. The variable is not a weak instrument: the correlation with Market Access measured by non-agricultural population is 65 % and measured by urban population 83 %. Furthermore, it has a reasonable explanatory power in the first stage regression (significance at a one percent level), and the F-statistic for joint significance is above ten. The 2SLS estimation confirms the positive significant effect of market access on agricultural productivity.

6 Conclusion

The results of this paper suggest that the pattern of agricultural productivity in the Habsburg Monarch were shaped by access to urban demand. This finding brings additional evidence for the view that the increase in agricultural productivity in the 19^{th} century was caused by urbanisation and industrial development and not vice versa. In addition, the paper highlights the importance of accessibility to urban demand for agricultural development. In the Habsburg Monarchy, the strong interaction between industry and agriculture within the industrialized regions, namely Lower Austria and the Bohemian Lands, facilitated agricultural development. In fact, these regions were most productive parts of the Monarchy not only in industrial terms but also in agricultural ones. But the high

Table 8 Instrumental variable estimation

Dependent variable: KRE per hectare (log)	Second Stage		Second Stage	
Access to market: non-agricultural individuals (log)	0.911***	(0.125)		
Access to market: urban agglomerations (log)			0.801***	(0.109)
Population density (log)	0.250***	(0.048)	0.241***	(0.048)
Illiteracy rate (log)	-0.344***	(0.022)	-0.340***	(0.022)
Clerks per 1000-hectares farm land	0.076***	(0.026)	0.077***	(0.026)
Share of forest	-0.157	(0.178)	-0.114	(0.176)
Share of latifundia land	-0.443***	(0.115)	-0.505***	(0.115)
Share of topsoil	0.000	(0.002)	0.001	(0.002)
Roughness (log)	-0.083***	(0.032)	-0.075**	(0.032)
Elevation (log)	-0.396***	(0.046)	-0.375***	(0.047)
Latitude (log)	-1.489***	(0.421)	-1.228***	(0.405)
Livestock per hectare farm land	0.472***	(0.146)	0.510***	(0.145)
Dummy: Hungary	0.098***	(0.068)	0.092	(0.069)
Constant	16.958***	(5.613)	14.778***	(5.534)
R^2	0.834		0.834	

Notes: Standard errors in parenthesis; *significant at 10 percent, **significant at 5 percent, and *** significant at 1 % percent; Access to markets is instrumented with access to people engaged in mining industry in 1890.

accessibility of the Hungarian Plains compensated Hungary for the relative low level of local industrial and urban demand. The expansion of the railroad network in the second half of the 19th century connected Hungary to the Viennese market. The dense railroad network provided a relative high degree of access to urban markets. This allowed Hungary, together with its favourable geophysical conditions, to have higher growth rates in agriculture in the second halve of the century as the Austrian part. In contrast to Hungary, the Alpine Lands topography was unfavourable for intensive agriculture which limited the possibility for gains in productivity. But the relative decline of the Alpine Lands can also be explained by the sparse infrastructure, resulting in a poorer market access. In this perspective, the dominance of small and medium farms was not impeding but favourable for sustaining a high level of agricultural productivity in this region.

This paper has some limitations, indicating directions for further improvement. First, by now I have focused my analysis of market access and agricultural productivity around the year of 1900. I choose this date because of the rich data base at this point of time. But this static view does not allow to proof my hypotheses of the importance of the railroad construction for the Hungarian take off in agriculture in direct way. To overcome this limitation, in future, I plan to gather additional information for the census years 1869, 1880, 1890 to turn the cross-section analysis in a panel analysis. A second issue may arise because of my dependent variable of interest. Although the KRE provide us with reliable figures its interpretation is ambiguous. Not only a Ricardian rent but different to total factor productivity by definition, the KRE is a measurement for profitability of agrarian land taken into account soil quality, proximity to market and the level of technology under the condition the landlord was able to appropriate at least a part of these rents contra labour and capital. That is why, I plan in future to calculate the TFP in agriculture on basis of alternative sources and to contrast it with the KRE.

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Appendix

Table A1 freight rates per ton-kilometre in kreuzer (1987)

	railroad	waterway per ton	road
from 1 to 50 km	3.7	0.02	18.06
from 51 to 150 km	3.4		
from 151 to 300 km	3.0		
over 300 km	2.1		
terminal charge	40	68.6	40

Table A2: Farm structure in Imperial Austria – percent of agricultural land owned by farm class and share of forest on agricultural land

Province	Part Time Farms < 2 ha	Small Peasant Farms 2-5 ha	Medium Peasant Farms 5-20 ha	Large Peasant Farms 20-100 ha	Estates > 100 ha	Share of forest on agricultural land
Lower Austria	4%	8%	39%	20%	29%	36%
Upper Austria	4%	9%	42%	25%	20%	37%
Salzburg	1%	3%	17%	17%	62%	39%
Styria	5%	11%	34%	20%	30%	52%
Carinthia	2%	5%	27%	25%	41%	49%
Carniola	5%	12%	40%	13%	30%	47%
Littoral	4%	8%	14%	4%	69%	31%
Dalmatia	5%	7%	7%	2%	79%	31%
Tyrol	4%	6%	15%	11%	64%	40%
Vorarlberg	5%	11%	20%	14%	50%	27%
Bohemia	7%	13%	35%	17%	28%	30%
Moravia	8%	13%	36%	14%	30%	28%
Silesia	6%	13%	31%	14%	35%	35%
Galicia	7%	18%	22%	6%	46%	27%
Bucovina	6%	11%	13%	6%	63%	45%

Sources: Author’s own calculations based on ÖS 83 (1909) and Gemeindelexikon (1902)

Table A3: Access to markets (non-agricultural individuals) and agricultural productivity

Dependent variable: KRE per hectare (log)	OLS (1)		OLS (2)		OLS (3)		OLS (4)		OLS (5)	
Access to market: non-agricultural individuals (log)	**2.344*** **	**(0.118)**	**0.998*** **	**(0.119)**	**1.048*** **	**(0.107)**	**1.079*** **	**(0.100)**	**1.020*** **	**(0.100)**
Population density (log)			0.608***	(0.052)	0.402***	(0.052)	0.236***	(0.046)	0.245***	(0.045)
Illiteracy rate (log)			-0.263***	(0.024)	-0.267***	(0.022)	-0.322***	(0.019)	-0.332***	(0.019)
White collar worker per 1000-hectares farm land			0.037	(0.028)	0.038	(0.027)	0.087***	(0.025)	0.079***	(0.025)
Share of forest					-1.321***	(0.167)	-0.549*	(0.165)	-0.198	(0.167)
Share of latifundia land					-0.548***	(0.130)	-0.312***	(0.106)	-0.441***	(0.110)
Share of topsoil							-0.000	(0.002)	-0.000	(0.002)
Roughness (log)							-0.096***	(0.031)	-0.084***	(0.031)
Elevation (log)							-0.379***	(0.044)	-0.386***	(0.043)
Latitude (log)							-1.357***	(0.381)	-1.661***	(0.387)
Draft animals per hectare farm land									0.445***	(0.138)
Dummy: Hungary			0.349***	(0.072)	0.108	(0.069)	0.023	(0.062)	0.081	(0.064)
Constant	-22.102***	(1.193)	-10.556***	(1.169)	-9.500***	(1.056)	13.555***	(5.114)	18.384***	(5.273)
R^2	0.482		0.707		0.766		0.847		0.850	

Notes: Robust standard errors in parenthesis; *significant at 10 percent, **significant at 5 percent, and *** significant at 1 % percent

Map A1 Provinces and Regions of the Habsburg Monarchy

Austrian Regions

Danube Lands: Upper and Lower Austria

Alpine Lands: Carinthia, Carniola, Salzburg, Tyrol, Vorarlberg

Bohemian Lands: Bohemia, Moravia, Silesia

Adriatic Lands: Dalmatia, Littoral

Carpathian Lands: Bucovina, Galicia

Hungarian Regions

Upper Hungary: Danube Left Bank, Tisza Right Bank

Hungarian Plains: Danube Right Bank, Danube-Tisza Basin, Tisza Left Bank, Tisza-Maros Basin

Transylvania: Transylvania

Croatia: Croata-Slavonia

Map A2 Transport Network and urban agglomerations above 10.000 inhabitants

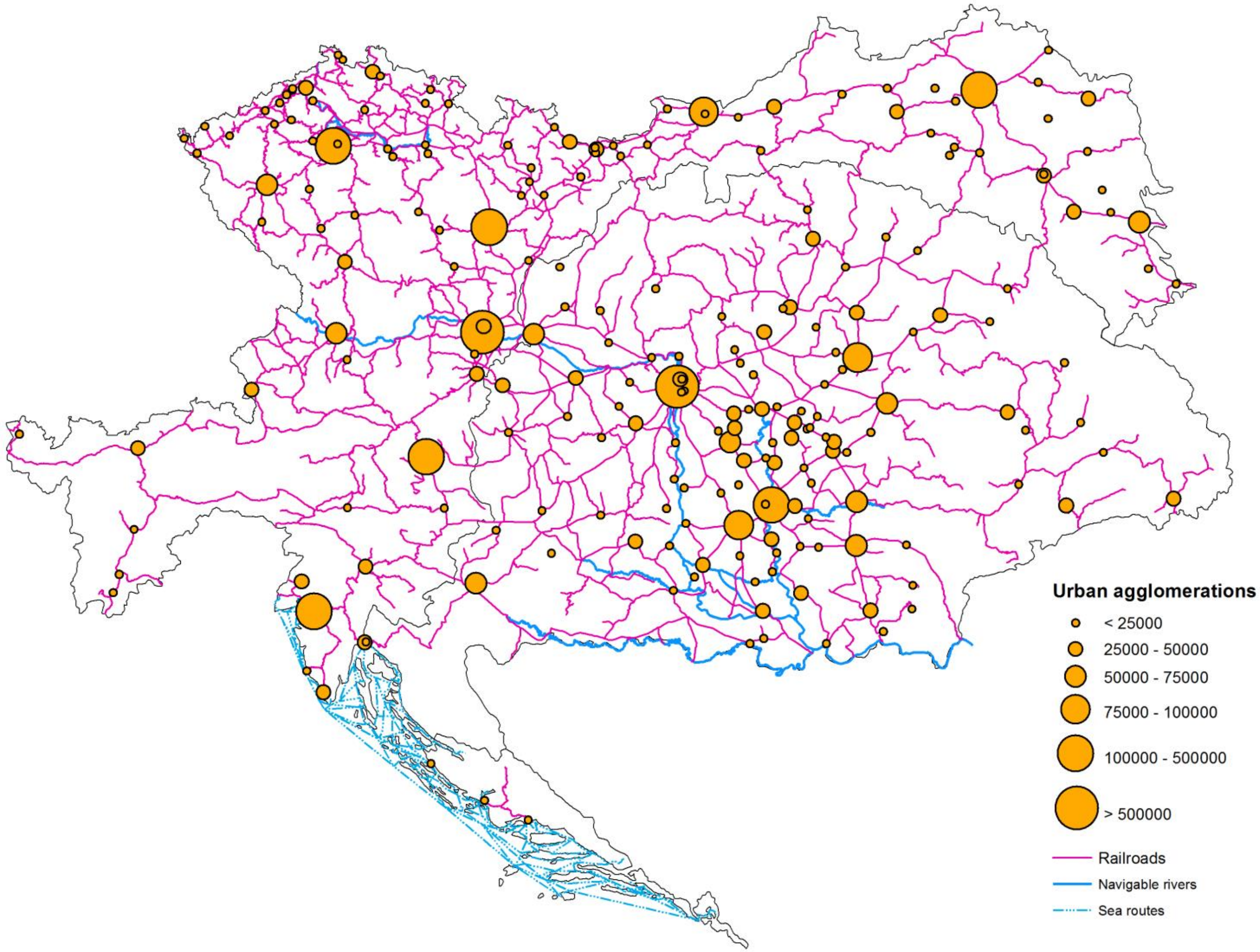

Table A3 Market Access to urban agglomerations measured by geographical distance

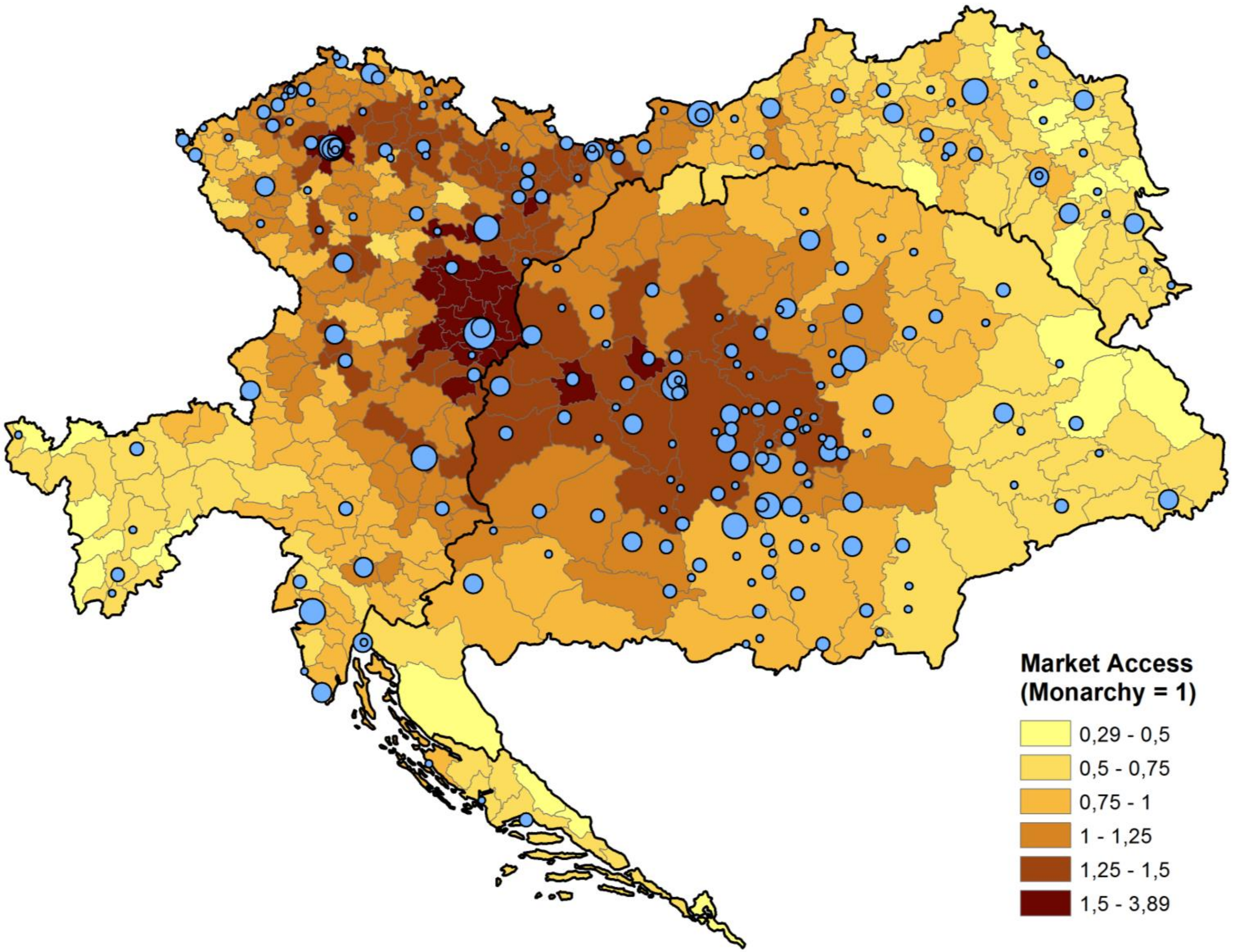

Table A4 Market Access to urban agglomerations measured by freights costs