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Title page

Road transport productivity in the sixteenth-century Low Countries. The case of Brabant, 1450-1650

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Road transport productivity in the sixteenth-century Low Countries. The case of Brabant, 1450-1650[1]

I.

While the grand narrative of the 'transport revolution' has long centred around transformations in the railways, canals and ocean shipping that fuelled productivity gains and revolutionary transport cost reductions in the nineteenth century, in earlier decades attention slightly shifted in favour of the 'traditional' road transport sector.[2] This renewed attention went hand in glove with a redirection of the chronological focus towards transport developments in the century prior to the industrial revolution. A variety of infrastructural and organisational improvements, in particular in the construction of roads such as the English turnpikes or the building of stone slab paved roads in 'Belgium', turned the waggon and stagecoach into vehicles of economic growth and development. In Brabant these

[1] The authors would like to thank the anonymous referees of this article, as well as their colleagues at the Centre for Urban History in Antwerp, Raymond Van Uytven in especially, and several colleagues at the N.W. Posthumus institute for their stimulating comments. This article also greatly benefited from a sabbatical leave at the University of California Los Angeles in 2015. Hans Blomme (Ghent University) was so kind to draw the map. Finally, the authors would like to thank John Eyck, Kate Elliot and Peace Gifty Sakyibea Ofei for carefully proofreading the text.

[2] Barker and Gerhold, *The rise and rise*; Gerhold, *Road transport*.

improvements occurred at least from about the late seventeenth century onwards.[3] The construction of modern, paved and well-drained roads in the eighteenth century facilitated the transport of heavier freights more quickly and/or over greater distances using fewer horses.[4] Due to infrastructural and organisational changes, such as the introduction of punctual, regular and reliable services, considerable gains in *transport(-related) costs* were achieved.[5] Even though the nature, timing and importance of the productivity gains through (a complex interplay of) good roads, sophisticated horse breeding, better vehicles, economies of scale, is still a subject of debate, there is consensus that land transport in the eighteenth century dynamically contributed to economic development.[6]

However, our knowledge of eighteenth-century transport changes stands in contrast to the period preceding the construction of turnpikes. Pre-turnpike roads and transport organisation were very often considered primitive, i.e. as both a consequence and a cause of a larger *histoire immobile*. Fernand Braudel labelled pre-industrial road transport expensive because it was essentially based on the use of horse power and needed to cope with inadequate technologies and infrastructure as well as with poor organisation.[7] English medieval roads and bridges were often characterised as primitive.[8] 'Pre-turnpike road

[3] Consult, for England, the bibliography in Gerhold, *Carriers and coachmasters*. The specific timing is an issue also raised by Bogart, 'Did the Glorious Revolution'.

[4] Blondé, 'At the cradle'.

[5] Blondé, 'Steenwegen'.

[6] For the most recent discussion, see Gerhold, 'The development'.

[7] Braudel, *Civilisation matérielle*, p. 365; Masschaele, 'Transport costs', p. 266.

[8] See Harrison, 'Bridges', p. 240.

transport' was presumed to be extremely expensive, and this was especially the case in comparison to inland river navigation and – a fortiori– to maritime trade.[9]

Expensive land transport did not prevent a significant share of long distance international trade in the sixteenth century being carried out by land, rather than by maritime means of transport. This also holds true for the sixteenth-century Low Countries, and particularly Brabant, a highly urbanised society in which major international trade routes, maritime as well as overland, converged. Around 1550, approximately fifty per cent of the Brabantine population lived in towns with more than 5,000 inhabitants.[10] The growth of the city of Antwerp, a major international commercial gateway, is of particular interest in this respect. With an estimated population of more than 100,000 in 1566, it was second in the hierarchy of the north European cities. Unsurprisingly, many transport routes converged on this city of commerce and wealth. Traditionally, Antwerp's rise has been explained by a remarkable combination of several factors, one of which was exactly the revival of the major transcontinental trade routes to Germany and Italy.[11] On these freeways of international commerce, historians argue, *economies of scale* gave rise to transport productivity gains. These would have been achieved especially through organisational progress. As a result, *'rich commodities'*, expensive luxury commodities of limited weight, could be shipped for favourable transport rates. However significant this transport progress may have been, for

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[9] Dyos and Aldcroft, *British Transport*, p. 85; Freeman, 'Introduction', p. 12; Génicot, 'Etudes sur la construction', p. 430; Dubois, 'Techniques et coûts', p. 81; Masschaele, 'Transport costs', p. 273.

[10] Klep, 'Urban decline', pp. 261-86.

[11] For a synthesis, see Blondé and Limberger, 'De gebroken welvaart', pp. 307-30. For the central importance of Antwerp in the middle of the sixteenth century for the provinces of the northern Netherlands see Lesger, *Handel in Amsterdam*, pp. 23-64.

'*rich commodities'* transport costs eventually formed only a small percentage of the final cost price of the products at their destination. Nor should we exaggerate the size of the actual volumes that were shipped via this overland route.[12]

However, the rapidly growing Brabantine urban population produced more than mere luxury products for the international markets. Cities and citizens also need to be provisioned with food, building materials, firewood, charcoal and other heavy goods. Unfortunately, research on the regional transport of such products with a poor price/weight ratio, the 'poor commodities', has thus far received little historiographical attention.[13] This is rather unfortunate, since there can be no doubt that transport costs added heavily to the end-user

[12] Brulez, *De firma Della Faille*; Van der Wee, *The growth*; Munro, 'The "New Institutional Economics"'; Munro, 'The Low Countries' export trade'; Van der Wee, *The growth*, 2, p. 328. In 1544 for example, 11,475.5 bales, approximately between 1,100 and 1,800 tons of goods were shipped to Italy, an estimate that can be inferred from the registers of the 100th penny on exports to Germany, the Iberian Peninsula and Italy for the period 1543-1545 (Algemeen Rijksarchief Brussel (hereafter ARA), Rekenkamer (hereafter RK), nos. 23357-23364, Accounts of Gaspar Ducci, collector of the 100th penny on exports abroad, 1543-1545). Figures represented here are a *guesstimate* as other units such as 'packs', 'sacks', and 'boxes' also appear in the registers. One pack contained an average of 3.75 bales. The bales of merchandise exported to Italy via Salzburg were not allowed to weigh more than 200 pounds. Brulez, *De firma Della Faille*, pp. 426-7 and Edler, 'The Van der Molen', p. 136. Municipal Archives Antwerp (hereafter MAA), Insolvente Boedelkamer (hereafter IB), 2898, Brievenkopij Pieter Van der Molen 1538-1544, fo. 145. We would like to thank Jeroen Puttevils for the references.

[13] Galloway, Keene and Murphy, 'Fuelling the city'.

prices of this type of commodity, hence fundamentally may have constrained the 'urbanisation potential'.[14]

Hitherto, the only author who has succeeded in constructing an appropriate series of grain transport prices is James Masschaele, though his data were limited to part of the fourteenth century. By comparing the latter with figures from the eighteenth century, when transport was already profiting from the presupposed benefits of infrastructural 'modernisation', Masschaele to his own surprise inferred that medieval road transport would have been comparatively cheap.[15] Some authors argue that the abundant and underemployed supply of rural transport capacity eventually would have turned pre-industrial land transport into a relatively cheap service, rather than an expensive one as has been argued above. Masschaele's hypothesis is not at odds with the fact that road transport sometimes proved surprisingly competitive compared to the much cheaper modes of water transport. In the fifteenth and sixteenth centuries, for instance, Mosel and Rhine wine reached the Low Countries both by road and by river.[16]

To summarise, when it comes to assessing pre-industrial road transport productivity, conflicting claims coexist. In this article we will try to verify whether or not land transport productivity changes contributed to economic development in sixteenth-century Brabant. Methodologically, productivity changes –which cannot unfortunately be measured directly– will be approached through an analysis of transport prices.[17] Hence the reconstruction of a reliable long term price series for regional land transport services is a primary prerequisite for

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[14] Van der Woude, De Vries en Hayami, 'Introduction', pp. 1-19.

[15] Masschaele, 'Transport costs' .

[16] Van Uytven, 'Die Bedeutung'.

[17] See the methodologies used by Van Zanden and Van Tielhof, 'Roots of growth', p. 394 and Gerhold, 'Productivity change', pp. 491-515.

answering the main question. Unfortunately, source constraints render any assessment of transport productivity gains very preliminary. However, by comparing the prices of the most important inputs (horse provender and wages) with the final prices of transport services a fair assessment will be made. We will argue that land transport in sixteenth-century Brabant was flexible enough to sustain the rapid urbanisation and growth of this region. Conversely, regional land transport did not contribute dynamically to economic growth or development.

II.

The absence of genuine transport price research undoubtedly can be connected to the strong focus of price historians on economic growth and the standard-of-living debate. For the calculation of purchasing power, wages and incomes need to be compared to prices on (urban) markets. Prices of intermediate commodities and services do not matter per sé.[18] Moreover, and more importantly, suitable sources for the composition of reliable series of transport prices are extremely rare to find.[19] Accounts generally contain only the final prices of products when sold on the market, comprising all intermediary costs, among others transport costs. And even if a transport price is registered in detail, it is rarely suitable for integration into a longer time series. As an enormous variety of factors affect the cost price of a transport service, it is almost impossible to find serial data on transports of comparable loads that were shipped under comparable circumstances. The type of product, its weight and volume, the weather conditions, the terrain, the availability and organisation of hauliers, the prospects for

[18] For Brabant in the sixteenth century the pioneering work by Etienne Scholliers and Herman Van der Wee is still valuable. Scholliers, *Loonarbeid en honger*; Van der Wee, *The growth*; Van der Wee, 'Prices and wages'.

[19] Masschaele, 'Transport costs', p. 266.

a return cargo, the obstacles to be encountered on the journey, and the tolls to be paid – all had an influence on the final price. Even when they are available, recorded transport prices are more likely to be incomparable than not. It renders them useless for integration into a long-term analysis.

However, the accounts of the domains of the Duchy of Brabant seem to offer a promising perspective in our search for reliable transport prices. The records include the costs of the purchase and transport of a great variety of building materials that were needed for the ducal domains.[20] In particular the ownership of dozens of windmills and watermills throughout the Duchy caught our attention. Millstones were replaced regularly and, since the purchase of these millstones was an extremely costly business, as was their transport, there were plenty of reasons for the receivers to keep records of very detailed entries of various separate cost components of any purchase. Thanks to the receivers' administrative accuracy, it is possible to follow every step of the millstone buying process, from purchase to delivery at the mill throughout the long sixteenth century. In 1490, for example, the following costs in the domain of Lier-Herentals-Antwerp were logged for the windmill at Mol. On June 15th 1490 a millstone was bought in Antwerp from Willem Oem of Dordrecht for the sum of 8£ 15s gr; the costs of miller Pauwelse of Hoelst and the receiver travelling to Antwerp to choose a millstone amounted to 10s gr and the transport of the millstone overland by Aerde Wouters to 40s gr.[21] Not only the transport but also the travelling expenses of the receiver or his deputy were often carefully accounted for.[22] In addition, the purchase of the stones was often

[20] For a general survey see Van Cauwenberghe, *Het vorstelijk domein*. For transport related observations, see Ballaux, *Transport*, pp. 235-8 and 262-4.

[21] ARA, RK, no. 4969 (Lier-Herentals-Antwerp, 1490/1), fos. 84-5. For another example including transport by water, see Limberger, 'De prijs', p. 217.

[22] Ballaux, *Transport*, pp. 240-7.

accompanied by specific rather costly rituals, such as the handsel or the toast to seal the agreement. Cranage and the hauliers' expenses put an even heavier burden on the final bill. In this contribution, we will exclude all these smaller cost components and focus on the real cost of the transport, i.e. the price of the on-road transport without the handling charges described above. The latter are much more product-specific. In this article the costs of the purchase of more than two thousand millstones, spread into often small entries over hundreds of accounts, were used to build a unique series of prices for regional road transport covering the long sixteenth century.[23]

Figure 1. Concentration of domain mills in the Duchy of Brabant, Mechelen and the domains of Ath and Halle (Hainaut), 1403-1656

The choice of the rather 'atypical' millstones may seem odd at first sight, but it is justified by more than the lack of a better alternative. Millstones, however expensive, may be considered as products that are exemplary for the transport of commodities with a poor value-weight ratio.[24] Though they are expensive and require delicate handling, their transport requires carters and waggons that are normally used for bulk transport. The choice of millstones was also prompted by their unparalleled 'superiority' –from a price-methodological perspective– for reconstructing a homogeneous time series.[25] To start with, it is essential to acknowledge that the majority of these transport prices are real 'market prices'. Although it still often happened in the first half of the fifteenth century that millstones were

[23] Ballaux, *Transport*, p. 230 and Ballaux and Blondé, 'Landtransportprijzen', p. 64.

[24] Farmer, 'Millstones', p. 103.

[25] Van der Wee, 'Prijzen en lonen.'

transported as part of the compulsory customary services (services owed by a tenant to his lord), in the course of the second half of the fifteenth century this practice gradually declined.[26] Most prices were achieved through merging supply and demand in a competitive setting. Sometimes, the prices were agreed by direct negotiation at the place of purchase. At other times, they were reached after a form of public tender. Unlike in the inland waterway sector, transport over land was hardly organised into guilds or any other institutionalised form.[27] As a result, the public tender of such costly transport projects attracted a varied array of transporters, from big farmers to professional carters competing side by side to win a transport contract.[28] On such occasions, transport contracts were awarded to the bidder with the lowest offer.[29] The accounts from the domain of Jodoigne contain explicit references to transport contracts being assigned *par marchié*. *Verdinging*, a method of haggling in which the costs of the services were agreed between the two parties, was regularly used when

[26] At present, the question is whether this is connected to the diminishing reliability of these sorts of service. The domain accounts certainly indicate a number of situations where the customary service waggon 'refused to serve.' The receiver at Nivelles was obliged to hire a carter in 1422/3 because no customary service waggons appeared to be available. ARA, RK, no. 4582 (Nivelles, 1422/3), '*...par faute de chars de corwees...*'. That the parallel transport market should not be underestimated is also evident from lease contracts stipulating in which urban centre the tenant was obliged to fulfil the duty of payment in kind. Limberger, *Sixteenth-century Antwerp*, pp. 283-4.

[27] Ballaux, *Transport*, pp. 133-4 and Stabel, 'Schippers', pp. 179-81.

[28] Ballaux and Blondé, 'In het spoor', pp. 61-4.

[29] ARA, RK, no. 4970 (Lier-Herentals-Antwerp, 1492/3), fo. 79: *'... heeft doen verdingen ten minsten coste ende ten meesten proffyte onser geneden heeren ...'*.

transport contracts were put out for tender.[30] Although professional hauliers featured prominently in the domain accounts, occasional carriers (big farmers especially) also frequently popped up. There was certainly no question of the formation of oligopolies, let alone monopolies.[31]

Most of the millstones used in Brabant came from the Eifel region, where they were hewn from the volcanic basalt stone of Mayen and Niedermendig.[32] Via Andernach, where they were loaded on the Rhine, and the compulsory staple market in Dordrecht the millstones reached Antwerp, from where they were further distributed to other Brabantine cities, such as Brussels. For the mills in Walloon Brabant, cheaper millstones from Liège, as well as the *'pierres blanches de France'* were often used. Despite the differences in finish, these millstones were relatively homogeneous products and their differences had practically no

[30] For example, ARA, RK, Acquittances, no. 1560 (Hoeilaart-Terhulpen-Overijse, accounts for the years 1519/20 and 1523/4); RK, no. 4768 (Vilvoorde, 1473/4), fo. 59vo; no. 4218 (Brussels, 1529/30), fo. 113. *Verdingen* is defined as 'assigning a particular task to someone by agreement, specifically invite tenders' and 'bargain or haggle over the price of something; also in the sense of offering something for sale for a determined or agreed (or to be agreed) price'. Verwijs and Verdam, *Middelnederlandsch woordenboek*, pp. 1601-2.

[31] We were unable to discover any systematic differences between the prices asked by the professional hauliers and the occasional carriers, often tenant farmers. See Ballaux, *Transport*, pp. 145-50 and Ballaux and Blondé, 'In het spoor'.

[32] Röder, 'Die Mühlsteinbrüche', pp. 35-46; Mangartz, 'Abbau und Produktion', pp. 160-8; Hörter, 'Gewinnung und Handel', pp. 169-74; Major, 'The manufacture', pp. 194-204.

effect on the price of the transport which was basically a price per millstone.[33] Although customary law decreed that a waggon should carry two millstones, in practice, this was not done. A waggon never carried more than one stone, probably as the risk of casualties was too high. As a result, the price data are in no way sensitive to *economies of scale*.[34]

Millstones were bought and sold throughout the year. But that did not mean that the need to buy them could not be scheduled in advance. Receivers, therefore, were seldom caught unawares. As a consequence, it was almost never necessary to transport the stones in adverse climatic conditions. A couple of exceptions proves this rule. In 1558/9, for example, bad winter weather did catch the miller and receiver of the mill at Lanskin unawares. They wisely decided to fetch an old millstone from Hannut *'que par l'incommodite du temps lon ne pouvoit bonnement aller a liege querir une pierre pour estre en temps diver'*.[35]

III.

Figure 2: Cost of transporting millstones to the Campine region, 1403-1656

Source: ARA, RK, nos. 4954-5053, 5179-5180, 5182-5228.

[33] During the long sixteenth century, the period for which sufficient sources are available, there appear to have been no incentives to use other millstones in the ducal mills. Ballaux, *Transport*, pp. 211-2.

[34] *Economies of scale* obviously applied to other costs relating to the purchase, such as the receiver's journey to the place of sale, but they were not explicitly included in this study. Ballaux, *Transport*, pp. 257-61.

[35] ARA, RK, no. 3722 (Jodoigne-Hannut, 1558/9). Blondé and Van Uytven, 'Langs land- en waterwegen', pp. 144-5.

Figure 3: Cost of transporting millstones to Jodoigne and surrounding area, 1403-1656

Source: ARA, RK, nos. 3584-3786/1.

Figure 4: Cost of transporting millstones to Hannut and surrounding area, 1403-1656

Source: ARA, RK, nos. 3584-3786/1.

The prices of overland transport in Brabant can best be explored with the help of the data gathered from the Campine area (Mol and Turnhout) and Walloon Brabant (Jodoigne and Hannut), two subregions that yielded rather consistent transport cost time series.

The data points raise an important question related to the development of the transport market in the first half of the fifteenth century. In this period customary services (*corvée)* were still invoked for the transport of millstones, and while the prices for transport to the mills in Turnhout and Mol look rather stabilised, they show slightly more volatility in Walloon Brabant (Hannut and Jodoigne). Further research will be needed to verify whether this indicates a transport market in Walloon Brabant that at that time was still not fully developed.[36] In spite of the limited number of observations for the fifteenth century the trend is quite clear. After a tendency to rise until the middle of the century transport prices fell until

[36] Van Uytven, *Het dagelijks leven*, pp. 93-5. In 1477/8, in the domain of Lier-Herentals-Antwerp, it was noted that all the customary service waggons had gone to the war (*'alle de corweywagenen waren ten oirloge waert inden dienst van mijnen geneden heere'*). ARA, RK, no. 4966 (1477/8), fo. 49vo. In 1422/3 Nemlien de Lijs of Nivelles worked as a carrier because of a lack of customary service waggons (*'par faulte de chars de corwees'*). ARA, RK, no. 4582 (1422/3), not in folio.

about 1475, after which a steady upward movement set in again. During the political, monetary and economic crisis period at the end of the fifteenth century transport prices reached a peak. It is certainly no coincidence that in the 1480s and 1490s transport in the domain of Turnhout was again undertaken by non-commercial carriers.[37] Prices for transport by land slightly fell again after the crisis of the late fifteenth century. By the middle of the second decade of the sixteenth century they began to climb again, both in the Campine area and in Walloon Brabant. They continued to rise steadily until the 1560s. After that, there was a steep increase which reached another peak at the end of the 1570s and during the 1580s. Clearly factors such as riots, wrecking, the permanent threat of war during the 'Dutch revolt', and gangs of thieves at that time were not conducive to safe and cheap transport. In 1579/80, the haulier Henry de Liggons received 25£ artois to collect a *'pierre blanche de france'* from Namur, a task that was considered as *'non sans grand perilz'*.[38] In 1577/8, in more peaceful circumstances, the same transport costed only 8£ artois. Galloping agricultural prices also drove transport prices to unheard-of heights. When the millstone was brought to the mill at Hannut in 1585/6 the receiver noted – to justify the exorbitant price he had agreed – that *'le long chemin'* was *'perilz et hazard'*, and also accounted for it by referring to *'la grande chierete du temps'*.[39] In fact overall transport costs were even higher than shown in the figure since a number of extra allowances for permits or escorts were not included in these data. The first half of the seventeenth century, finally, can be divided into two phases: a shorter period of falling transport prices lasting until about 1615, and a period of rising transport prices after that date. Unsurprisingly as it may seem, the first conclusion is worth recalling. The presence

[37] Ballaux, 'Molenstenen', p. 279.

[38] Blondé and Van Uytven, 'Langs land- en waterwegen', p. 149.

[39] Ibidem.

or absence of peace is perhaps the most decisive explanatory variable in explaining pre-industrial transport price developments.

IV.

In order to reveal the underlying logics of the transport price formation process the scattered data from different regions and trajectories needed to be integrated into one transport cost index. Unfortunately, millstones are durable objects that were purchased at long and fairly irregular intervals, hence there are no annual observations. Moreover it happened that – despite the continuity of the supply routes – stones sometimes ended up at the same mill via a different route or place of sale, obviously rendering comparisons hazardous. Hence, unlike other studies of wages and prices, the basic series with which we had to work showed a considerable number of gaps as well as an uneven distribution of observations. To cope with these problems we designed an index that focused upon long-term movements in transport prices. In order to be able to link the different series, observations were somehow artificially grouped in cases by five-year period, and consecutively integrated into one chain index (see appendix). The necessity to index transport prices was partly prompted by the fact that the data series originated from different Brabantine domains and trajectories which renders any calculation of a price per ton-mile hazardous. Different routes and varying distances were involved, which makes it impossible to compare absolute cost prices per kilometre.[40] The choice of fixing the index in the years 1496-1500(=100) was determined by the rather favourable frequency of the transport costs data available for this period. It was in that period

[40] Ballaux, *Transport*, pp. 216 and 276-83.

that most independent time series data were found that facilitated the integration into a chain index (figure 5).[41]

However illuminating the compiled index of Brabant road transport prices may be, the reconstructed index does not automatically reveal anything about the underlying logics of price changes.

Figure 5: Compiled index of Brabant road transport prices, 1403-1650 (index 100: 1496-1500)

Source: ARA, RK, nos. 669, 3575-3583, 3584-3786/1, 3787-3864, 4013-4071, 4162-4250, 4457-4521, 4577-4646, 4749-4827, 4954-5053, 5179-5180, 5182-5228, 8282-8496, 9175, 9533-9732, 9742, 11610-11636, 31206-31222, 31225, 47148, Van der Wee, *The growth*, 1, 194-198 and Van der Wee, *Prices*, pp. 58-78.

One possible explanatory factor can in practice be discarded. The price evolution, spectacular though it may have been, was most certainly *not* driven by tensions between supply and demand. There was absolutely no question of *demand-led inflation*. The prices come from various domains in Brabant. Some of them were situated in a region that was

[41] The *International Scientific Committee on Price History* accepts that the period 1450-75 is a period of normal prices, and is thus a good period to use as an index point. Van der Wee, 'Prijzen en lonen', p. 36 and Idem, *The growth*, 1, p. 152. Because of the strong fluctuations in transport prices in the 1450-75 period and the practical problems involved in calibrating all the series for that period and integrating them in the index, the 1496-1500 period was chosen as index=100.

crossed by the busy major international trading routes, e.g. the Campine area.[42] Others, like the domains of Hannut and Jodoigne (Walloon Brabant), lay for the most part outside the sphere of influence of Antwerp and the great trading routes closer to the metropolis on the Scheldt.[43] It is no coincidence that, deprived of a good waterway connection to Antwerp, the supervisors of the mills in these domains usually went to Liège or Namur to purchase their millstones. Despite the fundamental differences and the varied transport economies of both regions, the price curves in the different domains generally followed the same patterns. Moreover, when in the seventeenth century transport volumes collapsed, prices were not corrected downwards.[44] This is an important conclusion: the spectacular growth of sixteenth-century international trade – and the urbanisation that came along with it – does not seem to have triggered a demand-led inflation on the land transport market.

Descriptions are not explanations, but the parallels between the developments in transport and agricultural prices are nonetheless particularly remarkable. Obviously, a large part of this parallel needs to be ascribed to monetary factors, such as the monetary stability in the reign of Philip the Good (1430-1467) fostering price stability. Conversely late fifteenth-century devaluations had an adverse effect, while the monetary appreciations under Maximilian I in the years 1494-1495 left traces in our figures as well. The extra influx first of European and later of American silver in the sixteenth century also did a good job in fostering the general price levels, and while population pressure accounts for part of the sixteenth-century price rises, the first half of the seventeenth century was marked by a considerable

[42] Frederix, *Het vrachtvervoer*; Lenders, 'Vrachtvoerders'; Peeters, 'Bijdrage aangaande het Kempisch'.

[43] Blondé and Van Uytven, 'De smalle steden'.

[44] Ballaux, *Transport*, pp. 153-203 and pp. 270-1.

monetary effect again.[45] Methodologically, it remains impossible to separate monetary effects from cost and income components in explaining the long-term trend in transport costs. Monetary effects offer only a partial explanation, since prices for building materials, textiles, etc. strongly diverged from the agricultural price development.

In the case of road transport the connection between transport costs and agricultural prices is also real, since agricultural prices played a key role in transport cost price formation. Even in sophisticated eighteenth-century stagecoach traffic, the cost of fodder for the horses always accounted for more than half of the operational costs of transport.[46] In the middle of the sixteenth century, the fixed daily allowance for a horse exceeded the wages of the waggon-hand by about 50 per cent.[47] Since a millstone was easily transported with four to six horses, in this particular kind of transport services labour costs shrank to barely a fraction of the whole, perhaps somewhere between 10 to 15 per cent. All indicators show that the cost of fodder also represented the lion's share of the total cost of the horse, rendering the sector extremely vulnerable to changes in horse-fodder prices.[48] For the time being the conclusion is that the cost price of pre-industrial regional road transport more or less seems to have followed the agricultural price rhythm.

However, agricultural and transport prices did not match completely. Most importantly, the sixteenth century was marked by a relative price shift (figure 6). The

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[45] Munro, 'The Price Revolution', pp. 631-4; Munro, 'The Central European', pp. 136-53.

[46] Gerhold, *Road transport*; Barker and Gerhold, *The rise*, p. 6; Van der Jonckheyd, *Diligencediensten*, pp. 72-5.

[47] Ballaux and Blondé, 'In het spoor', p. 57; ARA, RK, no. 4986 (Lier-Herentals-Antwerp, 1550/1), fo. 68vo.

[48] Gerhold, *Carriers*, pp. 46-8 and pp. 116-8 reaches similar findings and relations for hauliers and stagecoach services in seventeenth-century England.

sixteenth-century pressure on food prices, in itself the result of both monetary and Malthusian forces, undoubtedly caused a significant relative drop in the prices of road transport. In periods of demographic growth the cost of transport –either by professionals or occasional farmers– fell in relation to agricultural prices.[49] But is this relative price shift the mere consequence of Malthusian dynamics, or do land transport productivity gains also account for this relative fall in the cost of transport?

Figure 6: Relationship between land transport prices and grain prices, 1403-1655

Source: see graph 5.

V.

If productivity gains, stemming from various 'sources' (such as organisational progress, infrastructural improvements, horse breeding, economies of scale, centralised provender purchases, etc.) marked the sixteenth-century land transport scene, then their impact cannot readily be inferred from the series presented above. In order to more adequately assess the incidence of productivity gains on the basis of relative price shifts we need to be informed in greater detail about all costs involved in the process of providing a transport service. In the absence of this detailed information, we were obliged to use relative prices as the method for considering productivity changes.[50] By comparing the prices of road transport to the prices of

[49] According to Van der Wee, *The growth*, 1, pp. 23-4, navigable rivers allowed the emergence of an integrated grain market in West Brabant.

[50] Van Zanden and Van Tielhof, 'Roots of growth', pp. 394-403; Gerhold, 'Productivity change', pp. 491-515, especially p. 493 where Gerhold was informed about horse provender

the inputs, we will try to assess productivity changes. Even for such a calculation some strategic information is unavailable. Information on the prices of horses, the depreciation of these animals, shoeing, harnessing, the ropes and beam to safely bind and carry the stones, etc. is scanty and extremely difficult to process in a consistent manner.[51] Equally unbalanced is our knowledge about the prices of other capital inputs such as waggons. Based on the available information, it is safe to conclude that the depreciation costs of both waggons and horses do not impact fundamentally upon the operational costs of transporters. The underlying methodological assumption is that the market is not distorted by asymmetrical power structures as well and that profit margins are more or less constant. The first condition certainly seems to be fulfilled after the gradual abolition of feudal transport services and the firm establishment of a competitive transport market in the course of the fifteenth century.

However incomplete and approximate, we will assume that the most important costs can be reduced to (or at least assessed by) two major cost components: horse fodder and wage labour. Typically, the transport of a millstone would require the use of about four to six horses (we settled on 5 for this calculation), and the cost of a horse can be assessed at about 150% of the daily cost of the waggoner, to which also the daily cost of his assistant needs to be added.[52] The series of prices of oats running until the start of the seventeenth century and collected by Herman Van der Wee, was used to get a grip on the fodder costs.[53] In the following figure, horse fodder costs were assumed to make up approximately 76 per cent of the final cost of moving millstones. Conversely, labour accounted for 24 per cent only, and

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costs (68%), harness and shoeing (7.1%), depreciation of horses (2.8%), horsekeeping (3.4%), drivers (6.1%), bookkeepers and porters (3.7%), waggons (7.5%) and rents (1.2%).

[51] Ballaux, *Transport*, pp. 60-5 and pp. 253-6.

[52] Ballaux and Blondé, 'In het spoor', p. 57.

[53] Van der Wee, *The growth*, 1, pp. 194-8.

for the assessment of the waggoners' wages, masons' servant wages from Antwerp were used.[54] Even though these specific choices can be criticised, the possible distortions in the calculations are limited. It is not the absolute level of the prices (oats) and wages that mattered, but their evolution through time.[55] Finally, the carriers' rates index was divided by the total costs index in order to discover possible productivity changes.

Unsurprisingly, the ratio calculated fluctuated wildly. Overall relative prices dropped considerably at the start of the fifteenth century. It can be questioned whether or not this suggests the gradual maturing of a more transparent transport market at that time. Thereafter, transport productivity hardly improved. At the end of the sixteenth century, when very high tariffs were charged, the relative price dropped considerably as well. Clearly, the assumption

[54] In the eighteenth century, hired waggons driving (largely over unpaved roads) from Antwerp to Breda with 2 horses were charged 16 styvers. The bill was raised to 28 styvers when 4 horses were needed. Via substitution and elimination, the price of a horse can be set at 6 styvers, the waggoner at 4 styvers. This is a very rough way to approach the problem, of course, but one that, coincidentally or not, perfectly corresponds to our evidence for the sixteenth century. The labour cost of coach drivers was obviously somewhat higher, and showed a tendency to rise in the eighteenth century. Van der Jonckheyd, *Diligencediensten*, p. 76.

[55] The choice for the Antwerp wage evolution was inspired not only by the central role of the city in the Brabantine transport system but especially by the evolution of its nominal wages. Nowhere else in sixteenth-century Brabant did nominal wages grow so strongly. Scholliers, 'Le pouvoir d'achat', pp. 312-4. As we used the Antwerp wages, most probably the wage component growth in our total factor costs calculation has been overestimated, hence also the productivity gains. Given the apparent absence of significant productivity gains in the sixteenth century, this choice thus is a rather cautious one.

behind the calculation (that profit margins are more or less constant) is an absurd one in a period of full military and economic crisis.[56] Strikingly, in these years the purchase of millstones was, whenever possible, postponed due to high transport costs and insecurity; often older millstones were recycled.[57] With demand for transport almost drying up, waggoners who were still operating seem to have offered transport services with strongly reduced profit margins. Warfare, as we have already mentioned, always had a devastating effect on the transport sector.

As a result, the slight downward 'trend' line of the sixteenth-century output/input ratio needs to be ascribed to the exceptional decade of the 1580s. Overall, the productivity calculation does not reveal any clear pattern or trend at all. Under the assumption of more or less stable profit margins for most of the period and a more or less efficient and transparent market, it can be concluded that regional road transport productivity changes did not fundamentally contribute to economic growth in this core area of the sixteenth-century European economy.[58] Nor did economic growth seem to have affected road transport productivity through, for example, mechanisms of economies of scale and professionalisation.

Figure 7. Productivity change of land transport in sixteenth-century Brabant

Source: see figure 5. This figure shows the land transport cost index/((0,76*oats price index)+(0,24*daily wage index mason servant in Antwerp))

[56] Masschaele, 'Transport costs', p. 274 made a similar observation.

[57] ARA, RK, no. 3739 (1582/3).

[58] Effects of productivity gains, if present, were probably offset by changes in the prices of the inputs not included in our calculation. Masschaele, 'Transport costs', p. 276 reached a similar conclusion.

VII.

Paradoxically, the 'exceptional nature' of the purchase of millstones and the accompanying transport costs in this contribution offered major possibilities for reconstructing the first reliable long-term road transport price series available for the preindustrial era. Receivers of the ducal domains had to turn to the broader transport market to find competent hauliers among professional carriers and farmers to transport millstones to the mills of the ducal domains. In this market they were *price-takers* and the prices they paid are the ones we used for the rather laborious reconstruction of the long-term movements of road transport prices.

The mechanisms – apart from the monetary factors – which dominated price-forming in the overland transport sector could be isolated with a great degree of certainty. The price development in sixteenth-century Brabant was not determined by tensions between supply and demand. Cost and opportunity cost effects were the overriding determinants. Moreover, this price study suggests that after the start of the fifteenth century perhaps no considerable productivity gains in the local and regional land transport sector were achieved. Technology, infrastructure and organisation did not sufficiently evolve to exert any significant pressure on the relative cost of transport.[59] Agriculture's tight grip on the road traffic sector and the absence of productivity gains confirm the position of land transport as a major pre-industrial bottleneck. It fundamentally limited the radius of action of the international, transcontinental trade to a modest product range of goods with a favourable value-weight ratio. This helps to explain why even the eighteenth-century transport improvements, albeit very important for rich commodities, did not spectacularly contribute to the integration of the commodity goods

[59] Ballaux and Blondé, 'Landtransportprijzen', pp. 80-1.

market.[60] At the risk of being provocative, it could be suggested that the much-applauded paved roads were significant only for expensive products and rich people. The subsequent nineteenth-century reductions in transport costs played a more important role in the urbanisation of Europe than did their pre-industrial forerunners.[61]

For supplying the urban centres with 'poor commodities' the friction of overland distance imposed limits. As a result, robust urban networks could develop only in regions where cheaper river traffic enabled the provisioning of urban markets.[62] Undoubtedly, the impressive sixteenth-century urbanisation of the Low Countries relied heavily upon water transport, as the famous Italian Low Countries watcher Ludovico Guicciardini, among others, ascertained.[63] It is on the water that the few improvements to transport and infrastructure that really mattered took place. Two major waterway improvements occurred in Brabant in the sixteenth century: in 1561, a new canal was inaugurated between Brussels and Willebroek. It greatly improved the accessibility and the centrality of Brussels. Moreover, in the eastern part of the Duchy the Grote Gete was canalised as well. As a result, the importance of Brussels' harbour increased considerably, and for a while Tienen (on the Grote Gete) manifested itself as a valid alternative to Zoutleeuw as an inland port in the Hageland.[64] Unsurprisingly,

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[60] Buyst, Dercon and Van Campenhout argued that the impact of the construction of eighteenth-century paved roads on the market integration of the Brabant grain markets is at least dubious. Buyst, Dercon and Van Campenhout, 'Market integration'.

[61] Bairoch, 'The impact', pp. 148-9.

[62] Van Uytven, 'Brabantse', pp. 29-79.

[63] Van Der Wee, *The growth*, 1, p. 23.

[64] Ballaux, *Transport*, pp. 44-6, Ballaux and Blondé, 'Molenstenen', p. 242 and Rombouts, 'Dynamiek van markten', pp. 257-8.

millstones were moved as far as possible via these inland waterways, before being transported over land to their final destination.

Apart from the fifteenth-century price convergences and the gradual abolition of customary transport services, the spectacular growth of the Brabantine economy in the sixteenth century did not cause any significant transport productivity gains. Conversely, the overland transport sector did not impede economic growth either. The most important transport revolutions took place in the twelfth and thirteenth centuries, when horses replaced oxen on the one hand,[65] and in the nineteenth century on the other. As far as land transport of commodity goods was concerned the centuries in between were deprived from substantial productivity gains.[66]

[65] Langdon, *Horse, oxen*.

[66] Gerhold, *Carriers*, p. 172; Malanima, *Pre-modern European*, pp. 183-185.

Appendix: Price index for land transport (1496-1500: index=100)

The indices were drawn up on the basis of aggregated data. First, an unweighted average of the land transport prices available for every route over a period of five years was calculated. These averages were used as a basis for compiling the indices for every route. The years 1496-1500 were selected as the reference period (index=100). For those routes where there were no data in the reference period the index was set at the value in another five-yearly period, closer in time. The overall index is an unweighted average of all constituting route-indices.

The absolute price for each route can be inferred from the price in *Brabant groats* that is given between () in the reference index period (1496-1500).

Source: The prices were drawn from entries in the domanial accounts of Brabant (ARA, RK, nos. 669, 3575-3583, 3584-3786/1, 3787-3864, 4013-4071, 4162-4250, 4457-4521, 4577-4646, 4749-4827, 4954-5053, 5179-5180, 5182-5228, 8282-8496, 9175, 9533-9732, 9742, 11610-11636, 31206-31222, 31225, 47148).

Period	Liège-Hannut (35km)	Huy-Hannut (21km)	Namur-Hannut (28km)	Liège-Jodoigne (51km)	Huy-Jodoigne (35km)	Namur-Jodoigne (29km)	Antwerp-Turnhout (40km)	Antwerp-Mol (51km)	Brussels-Halle (21km)	Namur-Ath (80km)	Brussels-Hoeilaart (12km)	Brussels-Terhulpen (16km)	final index road transport
1403-1405			57			57	57						**57**
1406-1410						80			70				**75**
1411-1415	56		56	50		63							**57**
1416-1420	33			90		56							**60**
1421-1425		98,03		83	105		86						**93**
1426-1430		65,59					95	44	60				**66**
1431-1435	60			124			100	73	71				**86**
1436-1440	83	87,1		83			105		56				**83**
1441-1445					95		116		55				**89**
1446-		50,81					126	88	104				**92**

1450													
1451-1455							105	47	44	124,04			**80**
1456-1460				56			105	79	63	173,08			**95**
1461-1465							76	61	55	86,54			**69**
1466-1470				75	105			72	50				**76**
1471-1475		72,58			79						30	50	**58**
1476-1480	75			75	79		116	60	63	103,85			**82**
1481-1485	90	143,55		60	158		105	72	94		150		**109**
1486-1490			150					105	100		152,5	185	**139**
1491-1495	100		120			127	100	99	100				**108**
1496-1500	**100 (240)**	**100 (186)**		**100 (240)**	**100 (171)**		**100 (280)**	**100 (456)**	**100 (384)**	**100 (297,6)**	**100 (240)**	**100 (240)**	**100**
1501-1505		87,1	**105 (150)**		95	**105 (150)**	95	141	100	115,38			**105**
1506-	75			75		114	96			115,3	59,38		**89**

1510									8			
1511-1515	92		139	90			111		66	140,63	75	68,75	**98**
1516-1520	101		127	106			110		40	111,06	75	50	**90**
1521-1525	109			113			137	107	45	126,2	65,63	56,25	**95**
1526-1530	104			117			150	94	67	170,19	67,5		**110**
1531-1535	115			115			140	106	113	173,08	81,25		**120**
1536-1540	121		118	111		160	105	113	97	182,69		93,75	**124**
1541-1545	150			163		274	189	124	106	167,31	106,25		**160**
1546-1550	139			150				115	112	182,69	100		**133**
1551-1555	150			171				141			106,25		**142**
1556-1560	153		190	181				192			187,5	150	**176**
1561-1565	150		179	150									**160**
1566-1570	194		169	181		227		200					**194**

1571-1575			213			267	250					**244**
1576-1580			264			566		385			250	**366**
1581-1585	394				702							**548**
1586-1590	375			458								**417**
1591-1595						422						**422**
1596-1600			543			619	758					**640**
1601-1605			464			554				450		**489**
1606-1610			401			422						**411**
1611-1615			492			422						**457**
1616-1620			464			520						**493**
1621-1625			591			591						**591**
1626-1630			675			675			300			**550**
1631-			675			675			300			**550**

1635													
1636-1640									750				**750**
1641-1645			928			928			450				**769**
1646-1650													
1651-1655													

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