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Labour productivity and competitiveness

by

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Labour productivity and competitiveness

Explorations for local level productivity measurement with an application to the four largest cities (G-4) in The Netherlands

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1. Introduction

Across the OECD, globalisation increasingly points to the ability of regional economies to adapt and exploit their competitive edge, as it offers new opportunities for regional development. This is why public authorities are rethinking their strategies. Moreover, as a result of decentralisation, central governments are no longer the sole provider of development policies. The objective of pursuing regional competitiveness is particularly relevant in metropolitan regions (OECD 2006, van Winden 2007, Rienstra and Hoekveld 2008).

The notion of competitiveness is one that informs every economic policy document at every level of government. The most prominent manifestation has been the declaration of the Lisbon Agenda by the European Commission (EC) in 2000. The objective of which is to make the EU "the most *competitive* and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" in 2010. Nevertheless, like the term 'globalisation', repetition of the term 'competitiveness' sheds much heat but little light (Budd and Hirmis, 2004). Competitiveness has become a generic term that is applied widely to a variety of business and economic circumstances. Consequently, it means different things to different people.

Common practice is that at the national level, competitiveness means the ability of a nation's citizens to achieve a high and rising standard of living, i.e. wealth. Analogously, at the local level it can be seen as the ability of a local entity (a city or region) to achieve a high and rising standard of living for its inhabitants. Besides money income also employment opportunities and the natural and cultural amenities determine the well-being of the inhabitants of a municipality. At the company level or sector level competitiveness usually refers to advantages obtained through superior productivity.

Competitiveness is thus linked to wealth and productivity. In general five underlying drivers of competitiveness can be distinguished:[1]

1. labour productivity
2. innovation
3. investment
4. labour quality and participation
5. business environment

These items pertain to both company and national/local levels.[2] In fact all of the items numbered 2-5 at the list, have an effect on labour productivity, as

[1] These are distinguished by the Conference Board, a non-profit organization that creates and disseminates knowledge about management and the marketplace to help businesses strengthen their performance and better serve society. See http://www.conference-board.org.

[2] The World Economic Forum independently (WEF) comes with a set of 12 pillars of competitiveness ranging from institutions to business sophistication. The WEF is an

was shown by numerous studies.[3] This led the EC to acknowledge productivity as the key factor to competitiveness.[4] This is corroborated for The Netherlands by van den Bergen (2008).

In this paper we will look at labour productivity and competitiveness at the local level and thereby assess the relation between local productivity and local wealth, the specifics of levels and growth of productivity and the most important factors that drive local productivity growth. Also attention will be paid on how labour productivity is related to employment opportunities. On the one hand the skill level of the labour force is a very important factor that may enhance labour productivity. On the other hand an important goal of local labour market policy is to increase the participation rates of those with limited access to regular jobs due to lack of skills or work rhythm or due to social or mental disorder. Often the productivity levels of these individuals are below average and when they become employed this may lead to lower levels of labour productivity. As an empirical application, we will consider the situation of the four largest cities (G-4) located in the Randstad, the economic core of The Netherlands. Section 2 is about the appropriate measures of output and labour in order the get an adequate expression of local labour productivity. Section 3 studies labour productivity and competitiveness, in terms of wealth, for the G-4 in relation to The Netherlands as a whole. Sections 4 discuss levels and growth of productivity and competitiveness. Sections 5 and 6 look into explanatory variables for productivity and competitiveness. Finally, section 7 concludes.

2. Measurement issues

Labour productivity is determined by two factors: (i) the realised production or output per unit of time, and (ii) the labour effort per unit of time. Both output and labour are not unequivocal.[5] Furthermore, labour productivity has a strong relation with labour costs, to which this section also pays attention.

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international not-for-profit foundation, striving towards a world-class corporate governance system where values are as important a basis as rules.

[3] Innovation, investment in high quality assets, like ICT, high skilled labour and an adequate innovation and business climate all have positive effects on productivity. This can easily be derived from a simple production function, where output is determined by labour (quality), capital (quality) and multifactor productivity (mfp): $y = \Omega \prod l_i^{\alpha_i} \prod k_j^{\beta_j}$, or $y/l = \Omega \prod (l_i/l)^{\alpha_i} \prod (k_j/l)^{\beta_j}$, given constant returns to scale and $l=\sum l_i$ and in which i denotes the quality (skill, education) of labour l, j denotes the quality of capital assets, k, (usually ICT vs. non-ICT) and Ω is mfp. Mfp-growth is associated with innovation, R&D and the like.

[4] http://europa.eu/legislation_summaries/enterprise/industry/n26027_en.htm

[5] This section is largely based on international standards reflected in the OECD Productivity Manual "OECD Productivity Manual: A Guide to the Measurement of Industry-Level and Aggregate Productivity Growth", Paris: OECD.

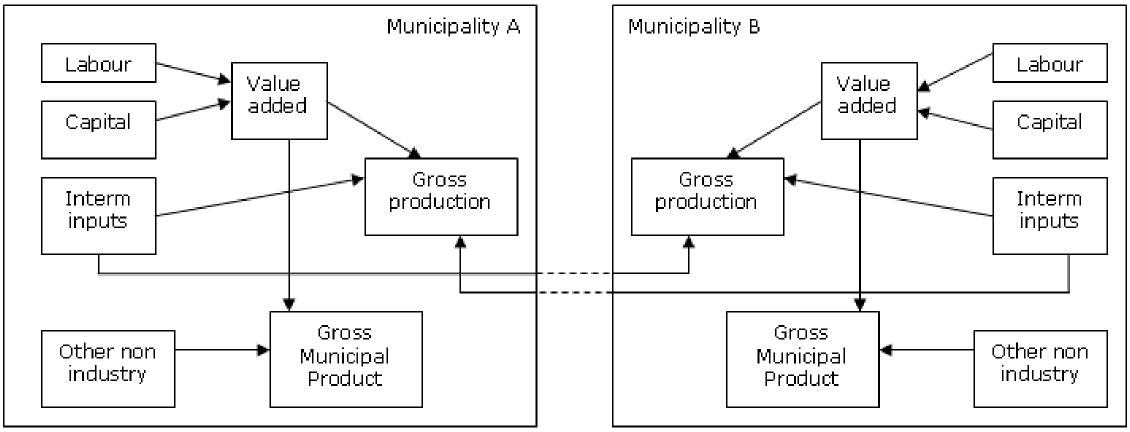
Local output
The common output measure in national productivity studies is Gross Domestic Product (GDP).[6] When focusing on productivity at the industry or company level, commonly used measures are gross production or value added of the company/ industry. The difference between gross production and value added lies in the role of intermediate inputs, like energy, materials and services. These inputs are used in the production process of the company/industry, but originate from other companies/industries and regions, unlike the primary inputs labour and capital, which are internal to the company/industry.[7] Intermediate inputs are included in gross production. Gross production minus intermediate inputs yields value added.

The choice concerning which output measure to use in local productivity analysis depends on the question whether intermediate inputs are considered to be important. An increase in productivity in municipality A, based on gross production, has an effect on municipality B's productivity, when B uses part of municipal A's production as its intermediate inputs, even though the production process of B itself did not change. Use of gross production as output measures thus implies double counting in terms of measuring aggregate productivity. Hence, the local output measure to be used in productivity analyses should be the municipal equivalent for GDP, labelled Gross Municipal Product (GMP), or value added when available and not gross production.

Figure 1 illustrates the complexity of output measures at the local level by means of two municipalities. Labour input is one of the primary inputs in the local production process, next to capital. Intermediate inputs form the secondary input, which is part of gross production but not of GMP. GMP comprises local value added plus local transactions not attributable to local industries. Primary inputs make their contribution to production at the municipal work site; intermediate inputs may come from outside the municipality. Figure 1 shows how GMP can be measured at work sites located within the municipality in order to get a proper indicator for local value added.

[6] GDP comprises all productive activities of all domestic production units. It equals value added of all industries plus transactions not attributable to industries. Value added per industry equals gross production minus intermediate use. The non-attributable transactions comprise net product taxes and subsidies and net value added tax.
[7] A separate issue on the actual measurability of output is left aside here. Particularly in services output is notoriously difficult to measure. What to think of the output of for example a news paper journalist, an orchestra or a teacher?

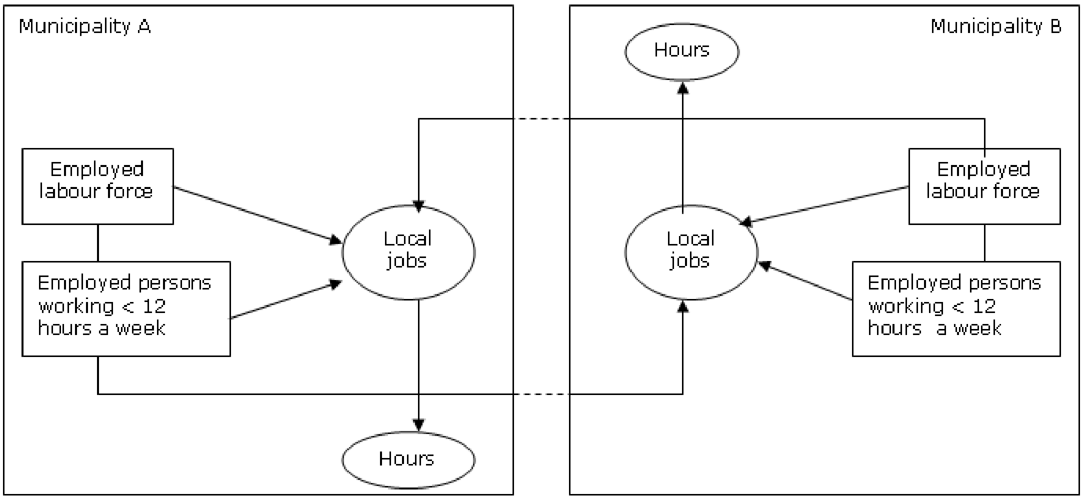
Figure 1. Measures of output at the local level



Local labour input
Labour input can also be measured by a large number of indicators, like employees, employed persons or total hours worked. At the local level, there is information on employment in terms of the number of jobs by industry and on the number of inhabitants in the employed labour force. The first indicator refers to employees *working* on a job located within the municipality. The latter refers to employed persons *living* in the municipality. Measuring employment in terms of local labour effort implies use has to be made of the jobs (by industry) in each municipality that generate municipal output. After all, employed persons who live in the municipality, but work elsewhere, do not contribute to municipal output.

Figure 2 illustrates the complexity of employment measures at the local level by means of two municipalities. There are employed persons living in municipality A who have a job of at least 12 hours a week within their place of residence. Another part of this group has a job in municipality B. In total this group is defined as the employed labour force (living in municipality A) and comprises both employees and self-employed. Next to that there are persons living in municipality A who have a small job of less than 12 hours a week, of whom some hold such a job in their own place of residence and others in municipality B. Together the employed labour force and the employed persons with a small job, build the total number of employed persons living in municipality A. Next, there is the number of jobs located in municipality A. Jobs are not distinguished by the number of working hours a week and all start from 1 hour a week. Jobs can either be filled by workers living in municipality A or by workers living in municipality B. Given the working hours for each of these jobs, it is possible to obtain the total number of hours work that is concerned with filling these jobs, i.e. hours work in municipality A which we need as a proper denominator to measure labour productivity.

Figure 2. Measures of labour effort at the local level



Relation with labour costs
So far we have discussed the formal definition of labour productivity as value added per hour worked. We now turn to the relation it has to labour costs. From the employer perspective, it is important to relate labour productivity of his employees to their (hourly) labour costs. As a stylised example, when employee A produces 10 products an hour and employee B produces 8 products an hour, then from the employers' point of view this is irrelevant when employee A costs € 10 an hour and employee B € 8. In that case the unit labour costs of both employees are equal. So a lower labour productivity can be compensated by lower labour costs. This implies that when a certain municipality has a lower than average labour productivity, this does not have to be a sign of low competitiveness, as long as labour costs are also lower.

This partly corresponds to the relation between labour costs and skills/education. Low skilled or low educated workers earn less than high skilled/high educated, because they are assumed to have a lower labour productivity. For an employer the level of education (or skills/work experience) of an employee is a signal for his or her expected labour productivity.

Data availability
The most detailed spatial level at which Gross Regional Product (GRP) and value added can be identified in The Netherlands is NUTS-3 (the so-called COROP-level), but not for municipalities.[8] Employment on the other hand is available at the municipal level in terms of jobs of employees by industry and in terms of the total employed labour force. At NUTS-3, employment is also available in terms of labour volume, i.e. full time jobs, by industry.

[8] The sole exception is Amsterdam.

Given these data, GMP will be approximated by the value added of industries according to the most detailed classification of the COROP-region the municipality is in, multiplied by the employment share of the same classification in the municipality. Employment share is in this case considered to be the job share by industry of jobs of employees and self-employed. This total number of jobs is determined by municipal jobs per employee raised by the fraction of total to employee labour volumes of the COROP-region the municipality is in. This way the total value added per municipality can be calculated. Distinction by industry is not possible.

As far labour cost is concerned, we know its level can differ between regions (and municipalities), also for similar professions, depending on e.g. sector structure and firm size.[9] As far as growth of labour costs is concerned, The Netherlands does not have region-specific wage negotiations. These negotiations are organised by sector (or for specific large companies). Hence, at the municipality level, the growth of labour costs will not show a wide variation. Reliable information of regional (or municipal) labour costs is however rare. There is only some information at the NUTS-3 level.

3. Local labour productivity and competitiveness

Labour productivity is usually measured as GDP per hour worked. The regional or local equivalent would be Gross Regional Product (GRP) per hour or Gross Municipal Product (GMP) per hour, respectively. However, GMP is not observed at the municipal level for The Netherlands. The closest approximation is municipal value added (see figure 1). Labour productivity for Dutch municipalities is thus measured by value added per hour worked.

Labour productivity is considered as a key factor to competitiveness. Competitiveness at the local level is the ability of a local entity to achieve a high standard of living for its inhabitants. Standard of living is usually defined in terms of per capita GDP. In regional or local terms this would become per capita GRP or per capita GMP, respectively. Note that per capita GRP is also the welfare indicator used by the EU to underpin its Regional Policy. Regions with a level of GDP per capita below a certain threshold qualify for financial assistance.

This makes it possible to represent the relation between labour productivity and competitiveness as follows.

$$\frac{Y}{H} = \frac{Y}{P} \cdot \frac{P}{P_{15-64}} \cdot \frac{P_{15-64}}{E_{lf}} \cdot \frac{E_{lf}}{E_p} \cdot \frac{E_p}{H}$$

or (1)

[9] Cf. STEC-Groep (2002).

$$\log\left(\frac{Y}{H}\right) = \log\left(\frac{Y}{P}\right) - \log\left(\frac{P_{15-64}}{P}\right) - \log\left(\frac{E_{lf}}{P_{15-64}}\right) - \log\left(\frac{E_p}{E_{lf}}\right) - \log\left(\frac{H}{E_p}\right)$$

where Y is value added, H is total hours worked, P is population living in the municipality, P_{15-64} is the population between 15 and 64 years of age living in the municipality, E_{lf} is the employed labour force living in the municipality.[10] E_p stands for the employed persons holding a job in the municipality. The difference between E_{lf} and E_p is related to differences in living and working locations or to net commuting.

Equation (1b) can be rewritten in words as: labour productivity (value added per hour worked) equals wealth (value added per capita) minus the effect of age composition of population, minus the effect of net labour participation, minus the effect of commuting, minus the effect of working hours.

Table 1 identifies each of these effects for the four largest municipalities in The Netherlands, relative to the national situation. It shows that labour productivity levels of all G-4 municipalities are higher than national, although for The Hague the difference with the national average is only marginal. Also wealth, in terms of per capita value added, of the four big cities is on average some 40% above the national average. This is also true for the individual cities, but there is also substantial variation with Utrecht being almost 70% above the national average.

Next we will discuss the factors that explain the difference between labour productivity and wealth. The effect of working hours contributes negatively in all cities. Because many people work part-time the hours worked per employed person in the G-4 is lower than the national average, particularly in Rotterdam and The Hague. This is likely related to the high shares of employment in services in large cities. Jobs in service industries are more often part-time than in manufacturing.

The effect of commuting on the difference between municipal labour productivity and municipal wealth is by far the largest. All four cities have substantial incoming net commuting flows, i.e. incoming commuting exceeds outgoing commuting. Incoming commuters have a positive effect on municipal labour productivity, because they hold a job in the municipality and thus contribute to the generation of municipal value added. Their effect on municipal wealth in terms of per capita value added is even larger, as they do contribute to municipal value added, but are not inhabitants of the city.

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[10] Note that the employed labour force for The Netherlands is defined as the number of persons between 15-64 living in the region and holding a job for at least 12 hours a week. This definition differs from the common international labour force definition, where there is no such working hours boundary. Statistics Netherlands has set this boundary at 12 hours a week, because that way employment can be considered the main activity of a respondent. Someone working less hours has another activity that he/she regards as main activity.

Table 1. Labour productivity and per capita income levels and the effects of working hours, labour utilisation and commuting, G-4 cities in The Netherlands, 1996-2006

	Value added per hour worked	Effects of:				Value added per capita		Disposable income per capita*
		Working hours	Commuting	Labour utilisation:				
				Net labour participation	Age structure			
	(labour productivity as % of Netherlands)	(hours worked per employed person - minus Netherlands)	(ratio empl. pers and empl. labour force - minus Netherlands)	(net labour participation - minus Netherlands)	(ratio popul 1564 and total popul - minus Netherlands)	(wealth as % of Netherlands)		(as % Netherlands)
Amsterdam	111.8	-2.8	31.3	0.2	5.3	145.9		104.4
Rotterdam	108.4	-6.5	41.0	-10.5	-1.2	131.2		95.0
The Hague	100.9	-4.2	21.1	1.7	-0.7	118.7		103.6
Utrecht	109.0	-1.8	48.3	2.1	9.3	166.9		101.2
G-4	108.4	-3.9	34.2	-2.1	2.6	139.2		101.2

* Only available for 2001-2006

Source: own calculation based on Statistics Netherlands

Labour utilisation, represented by labour participation and shares of inhabitants of working age, has a positive effect on competitiveness. The small negative participation effect of the G-4 is solely attributable to Rotterdam. Rotterdam has a far lower than average net labour participation rate, where the other three cities have rates above the national average. The age structure of the population does contribute positively to competitiveness in the G-4. This implies they have a relatively large population of a working age, i.e. 15-64. Again there are differences between the four cities. In Rotterdam and The Hague this effect contributes negatively. The share of the population of a working age is in these cities smaller than in Amsterdam and Utrecht.

All these effects result in far higher levels of competitiveness in the cities than their labour productivity. The main cause for this difference is the effect of commuting. The four largest cities in The Netherlands offer a host of job opportunities and hence attract many workers from outside the city. Commuters' employment effort raises the municipal level of competitiveness in terms of wealth more than it raises its productivity. This is because the effect of commuters' labour effort is part of the denominator of local labour productivity, but it is not in the denominator of local per capita value added. A lower denominator implies a higher wealth.

GDP per capita may be a good measure of competitiveness at the national level, but not necessarily at the municipality level, precisely because of this commuting-effect. At a national level, where there is no commuting, competitiveness and wealth (i.e. per capita GDP) coincide. Competitiveness at the local level, defined analogously as per capita municipal value added, does comprise the effects of commuting as we have seen.

In fact, value added has two sides of the same medal: a production-side, as has been discussed so far, and an income-side. Instead of production, value added also reflects the income that suppliers of labour (i.e. employees) and capital (e.g. owners) earn. In this setting, incoming commuting means that this income is transferred to the municipalities in which the commuters live and where they will spend it. In other words, in income-terms, commuters' value added moves to their place of residence, whereas in production-terms it is attributed to their place of work. In addition to that, part of the (gross) income from local value added straightforwardly moves to the central government in the form of taxes and social premiums. These are next redistributed locally to individuals in the form of social security payments and pensions. So at the local level value added and income do not necessarily coincide.

A better way to measure the municipal standard of living is to look only at the income generated by its inhabitants and not the value added generated at its work sites. Therefore, table 1 also shows the per capita disposable income in each of the four cities as percentage of the national average of per capita disposable income.[11] This income does not only include income from labour, but also from benefits, pensions, assets and the like. Drawback of the measure of local wealth is the fact that there now is no direct link to labour productivity.

In Amsterdam, The Hague and Utrecht, disposable per capita income is above the national average, but not as far above as per capita value added was. Of the G4, only Rotterdam has a disposable per capita income that is on average 5% below national. Part of this income may be earned in other municipalities. In that sense, (outward) commuting has an effect on the numerator, but these commuters are also in the denominator. This is contrary to per capita municipal value added, where the effect of commuting was present only in the numerator. Hence, the relatively low value of per capita disposable income for Rotterdam is primarily caused by two effects. First of all, it has a relatively low labour participation rate, implying that many (potential) workers are either unemployed or not involved on the labour market. Second, those who do have a job, work only relatively few hours.

4. Level or growth of competitiveness and productivity

In the current policy debate, however, it is not so much the level of competitiveness or labour productivity that sets the agenda, but their *growth rates*. The Lisbon Agenda denotes measures to enhance "…sustainable economic *growth*…". Productivity growth is driving economic growth. The motivation for the policy interest in productivity growth lies in the increasing gap between US and European productivity growth rates, which started to emerge from the second half of the 1990's. US productivity has an increasing growth path, while European growth rates were falling. Given the relation between productivity growth and growth of wealth, this widening productivity gap would then imply a widening lag in European standards of living.

Looking at productivity growth implies also to look at the growth rates of value added and growth rates of labour input. Value added is a financial quantity, which value (in money terms) consists of a volume and a price component. Regarding the production of some product, its price component is expressed in e.g. euro's per kg and the volume component in tons. In terms of output growth we are only interested in the volume component. After all value of production in money terms can also grow when prices have risen, without an increase in efficiency of production as a result of higher labour productivity. When considering growth rates of output over a time period, we therefore have to discard any effect of price changes, so only the volume component is taken into account. In order to do so, output is taken in constant prices, i.e. output in prices of some fixed (base)year. This so-called deflation method requires the availability of an output price index.

[11] Disposable implies net of taxes and social premiums.

At the national and regional level, output price indexes, like the GDP price index or the value added price index, are available. At the municipal level, there is no price information. Two approximations can be made. One is to straightforwardly assume that national, regional and municipal price inflation is the same and view all regional output relative to national. An empirical reassurance for this assumption is that regional differences in price inflation tend to be small for integrated, geographically small economies, such as The Netherlands. Second, when we do want to consider local output growth, the municipal price index is approximated by the price index of the smallest decomposition of the NUTS-3 region in which the municipality is located.[12]

The first methodology is used to compare the regional labour productivity levels and growth rates at the NUTS-3 level. Figure 3 shows the average level of regional minus national labour productivity for The Netherlands between 1990-2001. Figure 4 shows the average annual regional minus national labour productivity growth rate, in nominal terms, between 1991-2001.

The highest levels of labour productivity in the 1990's are found in peripheral harbour regions of the south-west and north-east of the country: Zeeuwsch-Vlaanderen and Delfzijl. This is a result of an overrepresentation of capital-intensive chemical industry in these regions, which is known to have a high labour productivity. The high level in Northern-Friesland is due to the winning of natural gas.[13] Relatively high levels are also found in the western part of the country. This is the area of the Randstad, a ring of the four largest cities (G-4: Amsterdam, Rotterdam, The Hague, Utrecht), as well as several medium-sized cites with a rural area in the centre. It is considered to be the economic heart of The Netherlands. The level of regional labour productivity is relatively low in regions at the eastern border, like Eastern-Groningen, Twente, Achterhoek and North-Limburg.

Figure 4 shows that the growth rates of labour productivity are relatively high in the regions in the middle of the country, like Veluwe and Flevoland, Utrecht and Greater Amsterdam; the latter three comprising the north rim of the Randstad. Some northern and southern regions also have above average labour productivity growth rates. Figure 4 also shows that productivity growth rates in the Western regions, where the Randstad and hence the G-4 are located, were lower than the national growth rates, apart from possibly Utrecht.[14]

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[12] After 1995, some NUTS-3 regions in The Netherlands were further refined into smaller spatial areas, of which the G-4 are a part.

[13] Extraction of natural gas was excluded from the region 'Other Groningen', as it comprises the exploration of the vast Slochteren gas field, which has a disturbingly large effect on the regional output and hence productivity.

[14] This was also found by Broersma and van Dijk (2008), Broersma and Oosterhaven (2009), OECD (2006), Van Winden (2007) and RPB (2007).

Figure 3. Average labour productivity 1990-2001 (region minus national)

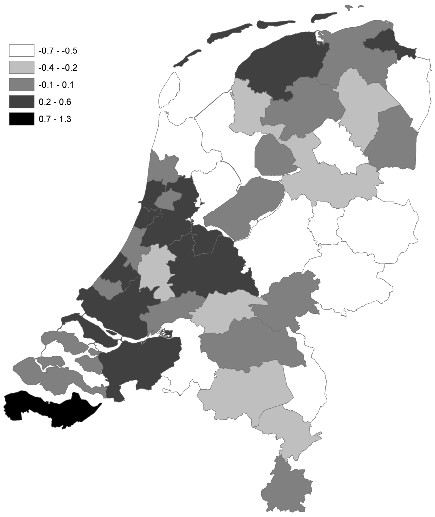
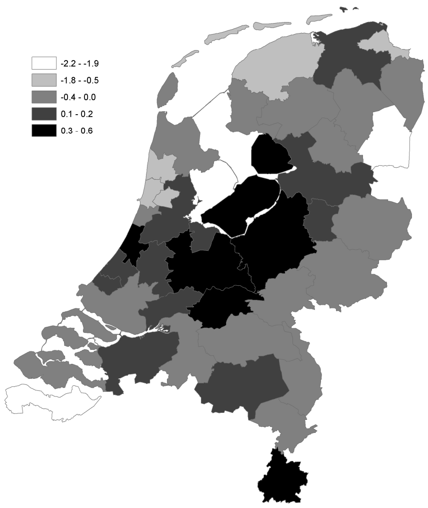
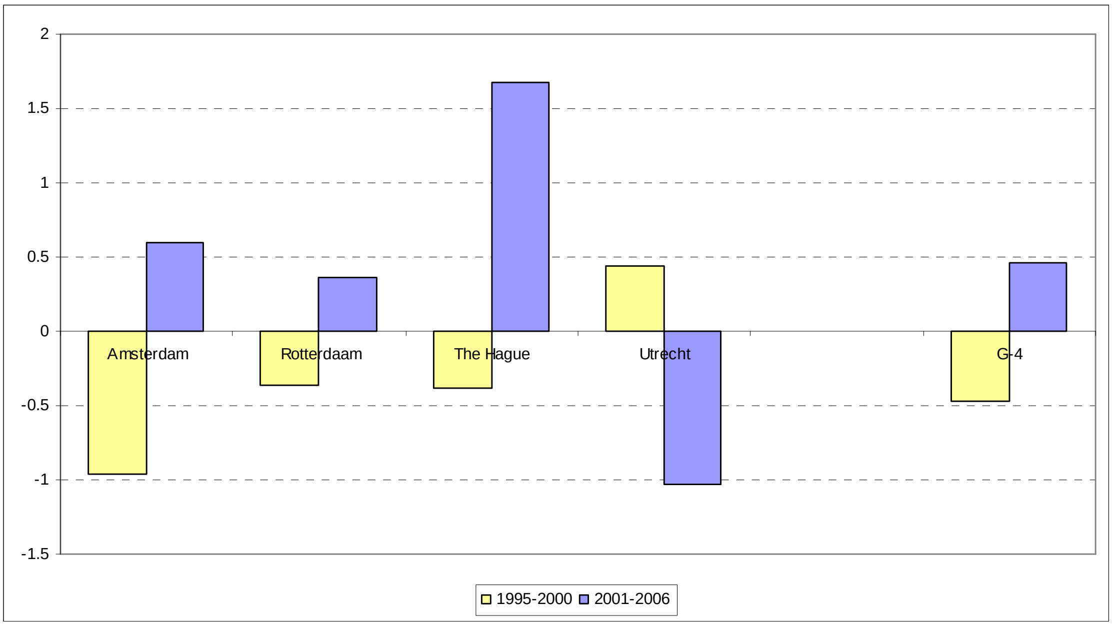


Figure 4. Average annual labour productivity growth 1991-2001 (region minus national)



This pattern is corroborated in figure 5, where the growth rates of the G-4 municipalities are shown for two periods. In the period 1995-2000, the G-4 growth rates are clearly below average, apart from Utrecht. Labour productivity growth of the G-4 was lagging behind the national growth rate almost 0.5 %-point each year during 1995-2000. However, these growth rates improved substantially in the period 2001-2006. This made productivity growth of the G-4 over the whole period 1995-2006 almost equal to national. A clear explanation for the differences between the two periods is not available. The strong increase in the number of jobs in the period 1995-2000 characterised by historically low unemployment rates may have caused that individuals with low levels of skills and labour productivity became employed which slowed down the increase in labour productivity.

Figure 5. Average annual productivity growth rates of G-4 relative to national productivity growth, 1995-2000 and 2001-2006



Source: own calculation based on Statistics Netherlands

Instead of looking at differences in municipal relative to national productivity like in Figure 5, we now consider the actual real growth rates of municipal labour productivity over time.[15] Like table 1 showed the contribution of the various factors determining the difference between local labour productivity and local per capita income levels, figure 6 shows the contribution of the growth of these factors to the difference of real productivity growth and real welfare growth over the time period 1996-2006 for the G-4. It reveals that contrary to the fact that labour productivity growth is the most important determinant of welfare growth at the national level since the 1950's, this is not the case at the local level over the past decade.[16]

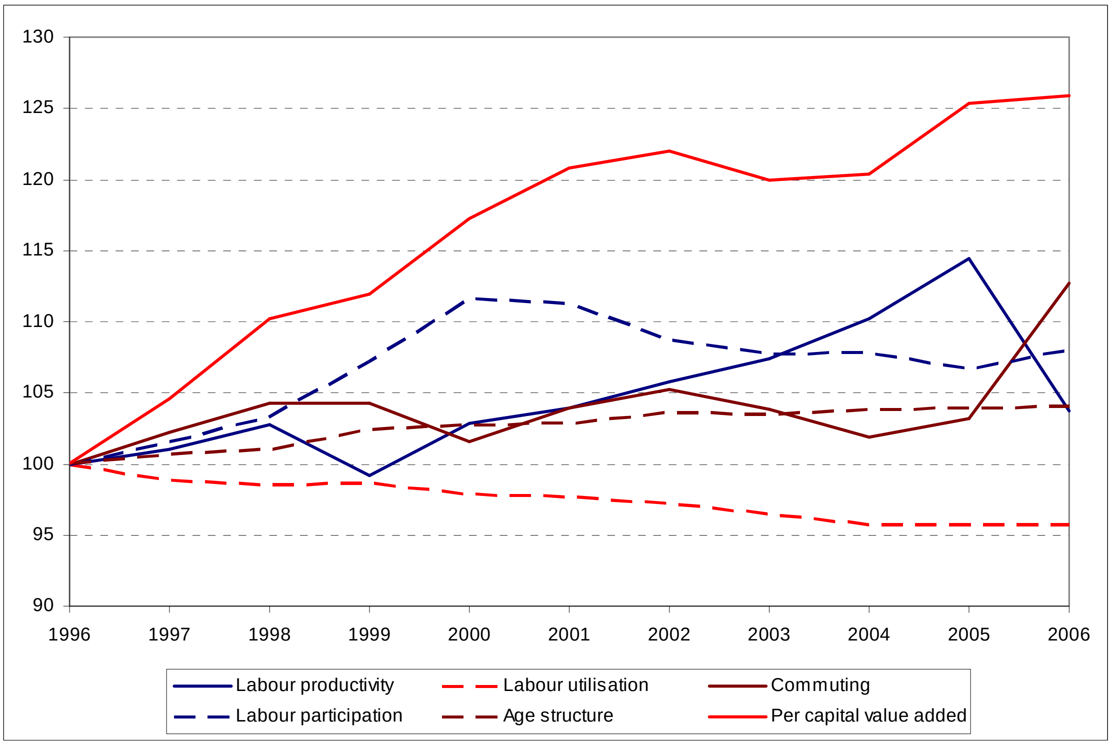
Figure 6 shows that per capita real income growth in the G-4 of the late 1990's was particularly caused by strong growth in labour participation, whereas labour productivity hardly changed during this period. This is the period of the 'Dutch Miracle', where The Netherlands experienced a period of exceptionally strong employment growth. In fact the labour market was so tight that many low skilled workers found a job, thereby dampening real labour productivity growth. After 2000 until 2005, on the other hand, it was real labour productivity growth that contributed most to per real capita income growth and labour participation growth came to a halt. This has to do

[15] This requires that we have to correct for price effects by means of the calculation of municipal price indexes based on the second method.
[16] See Van den Bergen (2008) who shows the national developments from 1948.

with the drop in economic growth in 2001 and subsequent recession of 2002/3. The drop in the contribution of labour productivity after 2005 is most likely caused the economic recovery where like in the period at the end of the previous century again less skilled workers were hired given the tight labour market situation leading to a fall in labour productivity.

The contribution of both commuting and age composition to real per capita income growth in the G-4 is limited to less than a total of 5% between 1996 and 2005. Notice that this does not imply that commuting did not change, because it did in the period under consideration, but merely that its contribution to welfare growth was only minor. The rationale behind this finding lies in the existence of agglomeration externalities. Dense economic activities, which are present in the G-4, have a positive effect on the level of labour productivity and thus per capita income, but at the same time impede further growth of it. This is a consequence of the high land prices and heavy congestion that outweigh the positive agglomeration externalities. (Broersma and van Dijk 2008; Broersma and Oosterhaven 2009).

Figure 6. Developments in the determining factors of real growth of per capita value added, G-4, 1996-2006



Source: own calculation based on Statistics Netherlands

5. Explaining local labour productivity (growth)

We have so far established that the interest of labour productivity lies in the effect it has on the standard of living. In its turn, this section addresses the variables that explain labour productivity. Labour productivity can be derived from a simple production function (footnote 3), which shows the explanatory variables. This labour productivity equation can be augmented with a variable reflecting agglomeration effects. See Broersma and Oosterhaven (2009) for a formal derivation. We confine ourselves here to simply add this term to the equation of footnote 3.

$$y/l = \Omega \prod (l_i/l)^{\alpha_i} \prod (k_j/l)^{\beta_j} (l/a)^{\gamma} . \qquad (2)$$

where *a* stands for acreage (surface) of the municipality, so *l/a* is municipal job density. Further, $l=\sum l_i$ and in which *i* denotes the quality (skill, education) of labour *l*, *j* denotes the quality of capital assets, *k*, (usually ICT vs. non-ICT) and *Ω* is mfp. When $\gamma>1$ the (positive) agglomeration dominates and when $\gamma>1$ the (negative) congestion effect dominates productivity.

Multifactor productivity (mfp) *Ω* is that part of labour productivity that cannot be attributed to the primary inputs labour and capital. It represents the efficiency with which these primary inputs are used in the production process and basically represents the state of technological progress in combination with an efficient organization of production. How state of technology is made operational is still an issue. Usually, mfp-growth is associated with innovation, R&D and the like. These can all be considered as (investment) flows. In order to get the stocks of innovation and R&D, we would need the associated rates depreciation and life span. Next, (2) shows that the education/skill level of the local jobs is important, just as the capital-labour ratio, by different types of capital assets. Usually distinction is made in ICT and non-ICT capital.[17]

Equations like (2) have been estimated for Dutch regions by Broersma and Oosterhaven (2009) and for European regions by Ciccone (2002) and Caragliu and Nijkamp (2009). In general agglomeration is found to have a positive effect on the level of labour productivity. A doubling of job density raises labour productivity with 3-5%. These studies also show that human capital (skill/education) has a positive effect on productivity, just as the capital-intensity (capital-labour ratio) and knowledge stock. In addition to the explanatory variables of (2) also the industry structure and in company size are also important to explain differences in levels of local labour productivity.

[17] When allowing capital-labour ratio's by different assets (for capital) and different education/skill levels (for labour), the equation can also reflect the possibility of a skill bias of new technological capital. Determining capital stocks at the local level is however very difficult.

Looking at productivity growth instead of levels is also the subject of a whole strand of research. There are generally two main empirical methodologies to analyse (regional) labour productivity growth. One is the growth accounting method which decomposes labour productivity growth into its building blocks, essentially: mfp-growth, capital deepening (growth of capital-labour ratio) and labour quality (human capital growth). Broersma and van Dijk (2008) employ this method to unravel differences in provincial labour productivity growth rates in The Netherlands. Their analysis confirms that labour productivity growth appears to be higher in the peripheral provinces of the north and south than in the economic core provinces. They find that the main reason for this lagging growth performance is the slow mfp-growth in the core provinces. Labour productivity growth in the core regions is to a larger extent caused by a slightly higher effect of labour quality and of IT and non-IT capital deepening, but by far a lower contribution of mfp-growth. Especially the rise in congestion has affected mfp-growth negatively in the Randstad provinces. This congestion effect exceeds the agglomeration effect. Hence, these results confirm the hypothesis that the negative congestion effect dominates the positive agglomeration effect. Given the weight of the core regions in the Dutch economy, the slowdown in mfp-growth of the core has also had consequences for the national slowdown in mfp-growth.

Further research is necessary to find out to what extend agglomeration effects continue to contribute to labour productivity growth in a linear relation or that a quadratic or other functional form is more appropriate. If the latter is the case it is interesting to find out in what range of city sizes agglomeration effects are positive and at what stage the negative congestions effect are starting to dominate. In this respect a more detailed operationalization of agglomeration and congestion effects are also relevant. Do agglomeration effects mainly affect productivity growth because economies of scale can be realized or are, for instance, knowledge spill-overs the main driving force. Different types of congestion may also affect labour productivity in different ways and this can also be related to the spatial structure of a city and the way in which public and private transport facilities are organized.

The second method is to reformulate (2) in terms of growth and estimate the effects of the explanatory variables. This was conducted by Broersma and Oosterhaven (2009). They also find evidence of congestion effects exceeding agglomeration in the Randstad area. Equation (2), its counterpart in terms of growth, and growth accounting are all theoretically well-founded. Many other studies have related productivity growth to level variables. In that way labour productivity growth is explained by the level of agglomeration (like city size), the level of human capital, the firm size and so on. Cf. Carlino (1985), Moomaw (1985, 1986), Cingano and Schivardi (2004).[18] It is not straightforwardly clear why it should be the *level* of agglomeration or the

[18] In one of their model specifications Caragliu and Nijkamp (2009) even relate the level of labour productivity to population growth and growth of capital (investment).

level of human capital or the firm size that has an effect on *growth*. This calls for a sounder theoretical underpinning of these models (cf. Storper and Scott 2009).

Considering labour productivity growth by extending equation (2) immediately yields its main explanatory variables. Setting aside which method of deflation is used, either taking regional variables relative to national ones, or using a local price index, the explanatory variables of local labour productivity growth can be identified as

- local innovation intensity
- change in education intensity of the municipal jobs
- change in capital intensity of municipal establishments
- change in agglomeration or congestion effects
- growth of municipal establishments (in terms of employment)

6. Explaining local (growth of) competitiveness

Since labour productivity is the main driver of competitiveness, the explanatory variables from the previous section all explain (growth of) local competitiveness as well. Section 4 showed that in addition a number of other local indicators have effects on local competitiveness. So apart from the variables that determine labour productivity, local competitiveness is also determined by the inhabitants'

- working hours
- commuting
- labour utilisation, comprising
  - labour participation
  - age composition

In addition, as mentioned in the introduction, the local business climate has an effect on competitiveness. This factor is actually at the municipal's discretion. Kresl and Singh (1999) mention qualitative determinants of competitiveness comprising municipal policy institutions and social climate. Rienstra and Hoekveld (2008) conclude that the effect of this municipal component on competitiveness of the 31 largest Dutch municipalities has in fact increased after 2000, compared to the decade before.

7. Concluding remarks and suggestions for further research

This position paper has looked into the possibilities of identifying and analysing local labour productivity as a main driver of local competitiveness, with an application to the G-4 in The Netherlands. Competitiveness is the ability to raise the standard of living, which can be measured as per capita GDP but also employment opportunities and the natural and cultural amenities determine well-being. From our analysis it is clear that labour productivity in terms of value added per hour worked is in a complex way related to welfare measured as value added per capita due to municipal differences in commuting, labour force participation rates and number of working hours.

Where at the national level, competitiveness is clearly driven by productivity, at the lower spatial level of municipalities, this is not necessarily the case. First of all, there is a major effect of commuting. Particularly large cities (as the G-4) have huge commuter inflows that contribute to the value added of the municipality where the commuters work but not live. This means they raise urban competitiveness measured as per capita value added. Second, the growth of competitiveness of the G-4 is mainly driven by both productivity growth and changes in participation. The effect of growth of commuting on growth of urban competitiveness is only minor.

Focussing on productivity (growth) as driver of competitiveness (growth), we have shown that productivity growth itself is determined primarily by innovation, changes in education, changes in capital intensity and agglomeration/ congestion. Many empirical studies point to the importance of agglomeration and congestion of local productivity (growth). Others have stressed the role of education. Education is also an important explanatory factor of participation. Next to productivity growth, growth of participation was also an important factor to determine growth of competitiveness. Participation (and hence its growth) is also driven by education. Higher educated persons have higher rates of labour participation than low educated.

The analysis shows that during the economic boom period 1995-2000 labour productivity growth of the G4 was substantially lagging behind the national level, whereas in the period 2001-2006 it was above the national level. A clear explanation for the differences between the two periods is not available. The strong increase in the number of jobs in the period 1995-2000 characterised by historically low unemployment rates may have caused that individuals with low levels of skills and labour productivity became employed which might have slowed down the increase in labour productivity. There is also evidence that the growth rates of labour productivity are lower in the Randstad area then in the rest of the country. This raises the question whether or not investments in the Randstad will yield higher returns than in other parts of the country. When growth rates continue to be higher outside the Randstad this may cause that investments outside the Randstad are becoming more profitable. It also implies that average levels and growth rates of labour productivity should be interpreted very carefully before appropriate policy conclusions can be derived. A high level of labour productivity may increase the number of jobs because the goods are produced very efficiently leading to a larger share of the world market. It may also cause that new firms enter the region because it is well known for its efficient production. However, when this leads to a very tight labour market it implies that also workers with lower productivity need to be hired which may cause the level and growth of labour productivity to go down. Also local labour market policy measures aiming to increase the participation rates of those with limited access to regular jobs due to lack of skills or work rhythm or due to social or mental disorder may lead to lower growth of productivity. It implies that there is a kind of trade-off between high levels of productivity and high levels of employment.

To get insight in these trade-offs it is necessary to have detailed insight into the way labour productivity and employment levels are determined by local innovation intensity, quality of the labour force in terms of education, capital intensity and ICT use, and agglomeration and congestion effects. Further research is necessary to find out to what extend agglomeration effects continue to contribute to labour productivity growth in a linear relation or that a quadratic or other functional form is more appropriate. If the latter is the case it is interesting to find out in what range of city sizes agglomeration effects are most positive and at what stage the negative congestions effect start to dominate. In this respect a more detailed operationalization of agglomeration and congestion effects are also relevant. Do agglomeration effects mainly affect productivity growth because economies of scale can be realized or are, for instance, knowledge spill-overs the main driving force. Different types of congestion may also affect labour productivity in different ways. Different types of congestion may also affect labour productivity in different ways and this can also be related to the spatial structure of a city and the way in which public and private transport facilities are organized.

In a recent article Storper and Scott (2009) express serious doubts about the value of currently fashionable general notions of 'creativity' for the explanation of urban economic growth and as underpinning of urban economic policy. They argue that a more effective line of explanation must relate urban growth directly to the economic geography of production and must explicitly deal with the complex recursive interactions between the location of firms and the movements of labour. It is well known that even within the same branch productivity levels between firms differ widely due to completely different ways in which production is organized. Therefore, it seems relevant to analyse the effects of agglomeration and congestion not only at the regional and municipal level, but also to study these effects at the firm level. In interesting question is how the way of organising production and the composition of the workforce within a firm is related to firm performance taking also into account the regional economic and labour market situation. In a municipality where a lot of high skilled and technological knowledge are available this may make a firm choose to apply a very capital and knowledge intensive way of production. As a result the labour productivity of a firm will be very high, but if they have to pay the high skilled a very high salary the cost may also be quite high. Another firm in the same branch might be located in a municipality where a lot of low skilled cheap labour is available. This firm may choose for a complete different organisation of production using low skilled cheap labour. Although this firm will not achieve a high level of labour productivity the product they make is not by definition more expensive because the low level of productivity might be compensated for by the low cost of this type of labour. Instead of substituting high skilled labour by low skilled labour or vice versa; there is also evidence that the mix of low and high skilled workers within a firm affects productivity (see Canton, 2009, and Schlitte, 2009). Similar effects can be due to the composition of the workforce within a firm in terms of diversity with regard to gender and ethnicity and how this composition is related to the local economic and labour market situation and to the specific location of firms in for instance the inner city, suburbs or at new, old or revitalized industrial sites.

Of course there a only a limited number of ways in which production can be organized, but until know not much is known about how production in the Netherlands is influenced by the local economic and labour market conditions and the location of the firm. Also the role of distance in these processes is important. Some effects may only occur at very short distances within the same plant location while other effects may occur at a greater spatial scale of a region or even at a spatial level like the total Randstad area. More insight in these determinants and effects is necessary for developing the right mix of policy measures for influencing innovation, education, employment and participation rates by local and/or regional or national government.

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