Puzzles of convergence and catching up: Regional income growth in Norway*

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Abstract

Norway has a growth pattern with labor migration from the periphery and expanding economic activity and population in urban centers, like most other industrialized countries. The geographic concentration of investment and labor is associated with a large income gap between urban and rural areas. Given this development, it is puzzling that the growth in income per head has been higher in the periphery in our dataset covering municipalities during 1972 to 2004. We show evidence of overall convergence among the regions and catching up to the 'world frontier' measured by the US income level, and the catching up is stronger the lower the initial income level. But convergence primarily takes place during the 1985-91 economic downswing, when the growth in cities were held back more. And catching up is stronger the lower the education level, in contrast to the understanding that human capital is important for knowledge/technology adoption. The results indicate that investment flows and spillovers to the periphery have not been important to explain the convergence. Those left behind in regions with low initial income and education level and high out migration seem to gain from independence of business cycles and structural factors at the labor market.

JEL: O18, O33, R11; keywords: Regional growth, convergence, catching up, local growth empirics; Norway.

First draft, preliminary analysis
Pavia, October 15, 2008.

* I appreciate the assistance of Jo Jakobsen in the handling and analysis of the data and comments at the NTNU Economics winter seminar at Stugudal and University of Pavia Economics Department seminar, in particular from Carluccio Bianchi, Fredrik Carlsen, Torfinn Harding, and Hildegunn Stokke. The project is financed by the Norwegian Research Council.

1. Introduction

The growth pattern across Norway shows strengthening urban centers and weakening periphery. Economic activity and population have steadily been centralized to the capital Oslo and other large cities. The urbanization is characterized by investments concentrated to urban areas and flow of labor migrating from the periphery. The changing population density is combined with a shift of labor from agriculture and industry to services. The Norwegian experience of urbanization is common to most industrialized countries (see analyses by Rappaport (1999) for the US, ..).

The urban rural divide is described by a large gap in income per head in favor of the cities. We have collected data of income per head at the municipal level in Norway for the period 1972 to 2004 to investigate the growth pattern. Interestingly, the growth in income per head has been higher in the periphery. The observation is puzzling. On the one hand the growth experience is described by large income gap and steadily weakening periphery with large out migration. On the other hand the income per head in the periphery at least has kept pace with the urban centers over the last three decades.

Our simple preliminary analysis shows evidence of overall convergence among the regions and catching up to the 'world frontier' measured by the US income level, and the catching up is stronger the lower the initial income level. But convergence primarily takes place during the 1985-91 economic downswing, when the growth in cities were held back more. And catching up is stronger the lower the education level, in contrast to the understanding that human capital is important for knowledge/technology adoption. The results indicate that investment flows and spillovers to the periphery have not been important to explain the convergence. Those left behind in regions with low initial income and education level and high out migration seem to gain from independence of business cycles and structural factors at the labor market.

Standard neoclassical country level growth theory suggests convergence with low income countries expanding faster than high income countries due to shortage and high return of capital. At the regional level it follows that the high income growth in the periphery is explained by booming investment. But we do not observe a flow of capital investment from urban centers to periphery regions in Norway. The economic development is characterized by

investment and labor concentrating to urban centers. Closer examination shows that the convergence first and for all has happened during the recession 1985-1991 and as the result of lower growth in the urban centers. The overall business cycle has been more pronounced in the urban centers, and the continued growth in the periphery during the downswing explains the convergence. The stability of the income growth in the periphery even when income growth fell in the urban centers can be explained by differences in industrial structure. It is of interest to notice that the convergence observed first and for all is related to the stagnation in the urban centers. It is the economic activity of the urban centers that are important for convergence, not the higher income growth over time in the periphery.

The open economy growth model of catching up and international spillover proposes that countries far away from the world technology frontier will benefit from the large technology gap and grow faster. The model is particularly relevant for regions within a country with free geographic flow of technology and knowledge. Catching up is usually assumed to depend on the level of human capital. As mentioned above we find that catching up is weaker the higher the education level. Aghion et al. (2005) has applied the model for the study of US states. They show that skilled outmigration from poor regions will reduce the growth effect of the technology gap. When the periphery loses important human capital, low income regions may not be able to catch up. The migration pattern in Norway conforms to their view, the young from the periphery entering education end up in urban centers. However, our data show that catching up is stronger in regions with low education level. Spillovers of technology and knowledge may be important, but do not reflect variation in education levels.

The observed growth pattern is consistent with convergence and catching up, but with some important deviations that need to be explained. Rappaport (2004) extends the neoclassical model to the case of labor mobility and then more relevant for the regional context. He addresses the adjustments at the labor market and discusses how labor outmigration raises the marginal product of labor and reduces the marginal productivity of capital. He concludes that the investment effect of convergence is expected to dominate since the labor mobility effect is unclear. Our results indicate that labor market responses are important, but in a different way. The broad migration flows motivated by ‘quality of life’ have shifted labor market balance with possible excess labor in the urban centers. The rural areas have primarily reduced the income gap during economic downswing when their industries have been less affected than in the cities. The combination of counter-cyclical and regional policies with expansion of

government services in the periphery may have added a composition effect as people have moved from low wage private jobs to high wage government jobs. Future research must investigate the empirical importance of this channel.

The growth in income per head has been higher in the periphery than in urban centers during 1972-2004, but at the same time there has been a large income gap in the favor of the urban centers. It follows that the income gap must have been developed at an earlier stage. The industrialization with movement of labor out of agriculture to industry was strong during the 1950s and 1960s, and presumably the income gap developed then. Industry was concentrated to urban areas and raised the income level there. The periphery with stagnating agriculture was left behind with low income levels. During the period studied since the 1970s the labor use first and for all has expanded in services, and in particular in government services. The growth in services has been geographically more dispersed, and the central government has financed the expansion of municipal services with strong priority to the periphery. The periphery has held up income growth partly as a result of this regional policy.

Section 2 develops the links to the literature on economic growth and in particular in the context of regions with labor mobility. Section 3 presents the dataset and the broad pattern of income growth across regions. Section 4 presents the convergence analysis and section 5 offers an analysis of catching up assuming that the US income level serves as the world frontier. Concluding remarks regarding future research are given in section 6.

2. Stable income distribution between regions, convergence or divergence?

The understanding of economic growth in the open economy has emphasized international flows of capital and international spillovers of knowledge and technology. Important historical origins are the catching up mechanism of Gerschenkron (1962) and the spillover mechanism of Nelson and Phelps (1966). Globalization with international spillovers have promoted similarities in growth rates and consequently stable income distribution across countries (Acemoglu and Ventura, 2002). Shifts in the world income distribution are associated with growth accelerations and decelerations that usually are temporary. The analysis of growth among regions within a country can help us understand globalization in the more extreme. While capital and technology/ knowledge flow easily within a country, also

mobility of labor is much higher than among countries. The importance of labor mobility for the growth process is an important new element introduced in regional growth studies.

The dominating theoretical framework of regional income gaps is the Rosen-Roback model (Rosen, 1979, Roback, 1982). The model interprets regional differences in wages and rents as compensating firms and residents for inter-regional differences in amenities. The spatial equilibrium of the model is characterized by identical levels of utility and profits across locations. Quality of life and productivity motivate location of households and firms respectively, and compensating wage and land price differentials establish equilibrium. In this static framework higher wage level in the periphery can be understood as the result of a positive quality of life shock in urban areas. The equilibrium response in the periphery is to have higher wage level (and lower price of land) to compensate the households for the relative shift in quality of life. The reduction in the price of land is necessary to defend the profit level in the periphery.

This stylized static model can explain both urban rural income divide and increasing income level in the periphery. The model predicts high population density in regions with high levels of productivity and quality of life. The shift in incomes will reflect compensating changes of factor prices and may imply periods of changes in relative wages to the advantage of the periphery.

Rappaport (1999, 2004, 2005) investigates the role of labor mobility in a neoclassical growth model to reach a better understanding of the dynamic processes involved. Adjustment costs of capital investment and population flows generate transition paths describing the responses to shocks in capital stock, productivity and utility (quality of life). Rappaport (1999, p. 8) analyzes a positive quality of life shock (in a model where firms are independent of the price of land). He concentrates on the urban side of our story and shows how the inflow of labor causes the marginal product of labor to decrease and wages to fall. The key intuition of the neoclassical growth model is that labor mobility out of poor regions will speed up wage equalization and thereby income convergence. But the labor outmigration also is expected to reduce the marginal productivity of capital and can lead to disinvestment. Rappaport (2005) concludes based on numerical simulations that labor mobility overall is expected to increase the speed of income convergence. Evans (1997) shows that speed of convergence is higher for U.S. states than for countries. The labor supply reductions in the periphery and the labor

supply increases in the urban centers, implicit in the Rappaport model version, contribute to the wage response underlying the convergence.

The Rosen-Roback and Rappaport models offer insight about the effects of labor mobility for regional income levels and growth. Both approaches concentrate on the interplay between capital and labor. The open economy growth literature has expanded the framework to include international spillovers of knowledge and technology. Catching up growth is based on the capacity to take benefit of the world technology frontier (Caselli and Coleman, 2006, Lucas, 2007, empirical support by Coe et al., 1997) through spillovers of technology and knowledge. Regions within a country are expected to have low barriers to such spillovers and the catching up mechanism is expected to be powerful. The evidence found in empirical analysis will depend on period studied and speed of spillovers. If all regions move together with close to perfect spillover the data will show little 'new' catching up.

The understanding of labor mobility for catching up can be based on the importance of human capital for the ability to adopt knowledge and technology, as studied by Benhabib and Spiegel (1994, 2005). The model has been applied in the regional context of the US states. Aghion et al. (2005) develop a version with mobility of skilled labor. Skilled labor is important for the capacity to adopt in the model. In the original understanding the economic growth increases with the size of the technology gap to the frontier. Aghion et al. show that skilled migration out of poor countries reduces the growth effect of the technology gap. The capacity to take benefit of the distance to the world frontier is reduced. They offer an interesting identification strategy to investigate the role of education in a dataset of the US states. They conclude that graduate education will be most growth enhancing for regions close to the technology frontier, while secondary education will be most growth enhancing for regions far from the frontier.

A different analytical model to the understanding of regional growth is based on new economic geography and the key concept agglomeration (see Baldwin and Martin, 2004, for overview). Agglomeration is usually linked to within and between industry externalities that raise productivity when firms are located together. Baldwin and Martin show how growth and agglomeration depends the mobility of human and physical capital between regions. In particular they show that spatial concentration of economic activities may be consistent with a

process of delocation of firms towards poor regions. Also the agglomeration models can be made consistent with growth in the periphery.

Given the different analytical approaches to regional growth theory, and with the added importance of labor mobility compared to country level studies, we can argue three alternative broad hypotheses of regional growth: Stable income distribution, convergence, and divergence.

Stable income distribution between regions results from the same, but even strengthened, mechanisms of stable world income distribution (Acemoglu and Ventura, 2002). The open flow of spillovers of knowledge and technology generate 'normal' growth rates everywhere. Regional deviations of normal growth rates are only temporary, but they can imply permanent shifts in the distribution. Convergence and catching up, the fundamental mechanisms of closed and open economy growth theory, point to the same growth pattern: Incomes in the periphery grows faster than in the urban areas. Capital flows to poor regions and/or poor regions gain by catching up on knowledge and technology compared to the frontier. Neoclassical trade theory of factor price equalization gives more support to this equalization of incomes. Interestingly, divergence can result from slight modifications of models predicting convergence. The most straightforward is the development traps identified in catching up models when human capital is important for the capacity to take benefit of spillover. Labor mobility also bring in possibilities of divergence in the neoclassical growth model when the productivity of capital is hurt by outmigration. More broadly divergence is associated with agglomeration and urbanization, but even in this setup the case for convergence can be argued. We need to analyze empirical regularities to separate between these different hypotheses and mechanisms.

This literature forms the background of our investigation into regional growth patterns in Norway. There exists a large literature of studies of regional growth of single countries, and of particular relevance for this study we mention Bianchi and Menegatti (2005) for Italy, Van Steel and Nieuwijnheusen (2004) for The Netherlands, and Serrano and Cabrer (2004) for Spain. Studies of the US states are mentioned above. Recent analyses addressing the growth of EU regions include Petrakos et al. (2005).

3. A first look at the data

Norway has experienced urbanization as other industrialized countries, even if regional policy has been ambitious and has attempted to hold back. Economic activity and population have been steadily more concentrated to the large cities, notably the capital Oslo. The analysis of total income or production by region consequently will show the standard pattern of centralization away from the periphery regions. The labor migration from the periphery to the center certainly has strengthened the concentration of economic activity.

The analysis is based on data about taxable income (before special deductions) in the municipalities. There are no data for gross product or similar at the local and regional level, but the tax statistics allow for an evaluation of the income level. Total taxable income is divided by the number of inhabitants in each municipality to measure income per head. The data cover the period from 1972 to 2004. The nominal income series is deflated by the consumer price index to define real income per head in 1998-NOK. This is the data series used in the analysis.

Income differences between local governments and regions in Norway are large. The initial income per head in 1972 varies from about NOK 30.000 to NOK 80.000 (1998-kroner). The annual growth in income per head on average is about 2.9% during the 33 year period. Figure 1 shows the histogram of income growth rates. About 2/3 of the municipalities have average growth rates between 2.5 and 3.5%.

Figure 1 about here.

We start out by describing the extreme growth cases in Table 1. The upper panel shows the 10 municipalities with the lowest average growth rate. They have annual growth rate of about 2% and had 1972-income of about NOK 70.000. The lower panel shows the 10 local governments with highest annual growth rate of about 4% and with 1972-income of about NOK 40.000. Interestingly, among the 10 at the top and the bottom the high grower with highest income level in 1972 (Aremark, NOK 56.892) still was below the slow grower with lowest income (Fauske, NOK 59.892). Local governments with low income in 1972 have higher growth rates than those with high initial income.

Table 1 about here.

The stylized facts of Table 1 are consistent with income convergence. The municipalities with low initial income have high income growth rate. But the income convergence cannot be very powerful, since the income distribution across municipalities is quite stable. Figure 2 shows the scatterplot of income per head in the municipalities in 1972 versus income per head in 2004. The figure shows that the income level in 1972 is quite a good predictor for income in 2004. The bigger Oslo area to the top right (municipalities Oslo, Asker and Bærum) is at the top in both 1972 and 2004. At the bottom left we find the same small municipalities in the periphery in both 1972 and 2004.

Figure 2 about here.

The list of municipalities at the top and the bottom in Table 1 will come as a surprise for most observers grounded in the thinking that agglomeration and urbanization are key aspects of income growth. The high growers are basically all small municipalities in the periphery. The slow growers represent regional centers and small towns. The income growth pattern reflects the center-periphery dimension and to the advantage of the periphery. When we study local governments classified in this dimension we find that in particular the most peripheral municipalities stand out with an average growth rate of 3.1%. The other groups with population pattern and location more related to centers all have average growth of 2.7%. The main puzzle addressed is why the periphery municipalities have this higher growth.

In the analysis below the income growth is related to both the initial income level and education level. Initial income level is described by the income per head in 1972. To investigate the importance of initial income we apply the quartiles in a separation between four groups (‘low income’, ‘low medium income’, high medium income’, high income’). The education level has been focused in the recent growth literature on human capital and barriers to growth. Since secondary education is compulsory in Norway, we have measured variation at the college level and above. The education level is measured by the share of the population with education at the college/ university level in 1970. The municipalities are separated by quartiles to describe four groups with different initial education level (‘low education, low medium education’, ‘high medium education’, ‘high education’). The raw data show that the low education group has higher income growth than the rest. The differences in growth rates

reflect the differences according to initial income since the income level and the education level in 1972 are strongly correlated.

4. Convergence analysis

Convergence is the key implication of the neoclassical growth model. Regions with low initial income are predicted to grow faster than regions with higher initial income level. The income level is assumed to reflect the capital stock and the capital stock is assumed to have decreasing marginal return. In our regional context the model predicts a flow of capital from centers with high capital stock to the periphery with low capital stock. This investment flow raises the income growth rate of the periphery and the income level is increased towards the center.

The prediction of high growth in low income regions goes against the observed geographic concentration of economic activity. Urbanization is characterized by expansion of investment, employment and production in centers. It should be noticed that the mobility of labor between regions may strengthen the case for convergence, as discussed in section 2. Labor moves from the periphery to the centers, which is certainly well documented in Norway. The labor flow out of the periphery may create shortage of labor in the periphery and raise the income level for those left behind. More capital intensive production may contribute to this growth of income.

A first look at the growth pattern in Figure 3 offers a hint of what is to come. The Figure shows the development of income per head in 4 groups of local governments classified after initial income per head in 1972. The high income group has an average income per head of about NOK 70.000 in 1972, while the low income group is around NOK 40.000. Their growth paths are fairly parallel. But there seems to be a change of patterns about half way, around 1991/92. The income paths seem to convergence slightly before 1991/92 and diverge slightly thereafter.

Figure 3 about here.

We investigate the convergence by estimating the standard growth equation:

$$1/T \ln(yT_i / y72_i) = \alpha_0 + \alpha_1 \ln y72_i$$

The growth rate since 1972 is regressed with respect to the income level in 1972 for all N>400 local governments. The first column in Table 2 shows the estimates for the full period 1972-2004. Interestingly, the convergence result is fully consistent with the results reached in standard cross-country regressions. The β – convergence is calculated as -1/T ln (1 + α_1 T) which is equal to 0.0147 when α_1 = -0.014 and T = 32. The convergence is approximately 1.5% per year, small and still statistically significant.

Table 2 about here.

The convergence is confirmed when we draw the convergence diagram in Figure 4. In the scatterplot we can observe the extremes, the periphery island local government Frøya with low income in 1972 and the highest average growth rate above 4%, and the city of Tønsberg with high income in 1972 and the lowest average growth rate close to 2%.

Figure 4 about here.

Our first look at the data indicated a shift in the growth pattern during the period studied. In Table 2 columns 2 and 3 we have estimated the sub-periods 1972-1991 and 1992-2004 separately. The estimates show strong convergence in the first period and no convergence in the second period. The split in the early 1990s coincides with the shift from a period of stagnation and even negative growth after the OPEC I and II shocks in mid to late 1970s to a period of expansion starting in the early 1990s. It seems like convergence is associated with a period of stagnation, while the expansionary phase since 1991 eliminates the convergence. The estimated β convergence during 1972-1991 is quite fast, about 3-4% per year. In column 4 we concentrate the analysis to the recession years 1985 to 1991, and the results come out even stronger. The β convergence during 1985-1991 was about 10% per year. We have shown that Norwegian local governments had weak income convergence during the long period 1972 to 2004 and that the convergence basically took place during the short recession period 1985-91.

We think that the role of the business cycle for the convergence is an important insight to understand the background adjustment mechanisms. The convergence during recession years basically is associated with lower growth in the urban high income regions. The business cycle affects the urban economy, but the periphery continues to grow even during the recession. Presumably the industrial structure is different and the periphery is less dependent on economywide cycles. The income gap between the center and the periphery is reduced during downswings in the economy because the periphery is better insulated against the recession than the center. It follows that the convergence is a result of slow growth in the cities, not extraordinary high growth in the periphery. The neoclassical convergence model emphasizes the capital shortage and high growth in the periphery.

To investigate the dynamic pattern further we have had a look at the coefficient of variation of the four income groups to check the σ convergence, the dispersion of income over time. The upper curve in Figure 5 shows that the total coefficient of variation is reduced considerably during the period 1972 to 1991/92 and is flat thereafter. The σ convergence coincided with the β convergence and happened during the first period. The reduction in the dispersion of income was exceptionally stark during the recession years of the late 1980s.

Figure 5 about here.

The robustness of the convergence result is investigated further including a set of control variables in Table 3. Four controls are added, the initial education level in 1972, the initial population size in 1972, the characterization of center versus periphery (dummy variable), and the separation out of the oil region Rogaland. The main convergence results hold. There is convergence for the full period and still about 1.5% per year. When the analysis is separated for two sub-periods, the convergence is stronger in the first period (although also the second period now is statistically significant). The effects of the control variables are all small in size, but they bring some further insights about the growth process. Higher initial educational level contributes to higher income growth rate. The center communities have a significantly lower growth rate during the stagnation period 1972-1991 and a significantly higher growth rate during the expansionary phase 1992-2004. The result confirms the importance of the changing growth experience of the center to explain the overall growth pattern.

Table 3 about here.

5. Catching up analysis

The convergence analysis above describes the growth pattern across regions. In this section we confront the data with the most common open economy hypothesis of how the growth pattern is generated. The key concept is the income gap to the 'world technology frontier', and the regional growth process is understood as the result of spillover of knowledge and technology. The economic growth is determined both by the income gap to the frontier and the capacity of the regions to take advantage of the frontier.

We start up by describing the income gap to Oslo, assuming that the capital Oslo works as an income frontier for all regions/ municipalities of Norway. Figure 6 shows the 4 groups of local governments classified according to initial income level in 1972. The diagram shows that the high income group on average has about 70% of the income level in Oslo in 1972, while the low income group has about 45%. In the terminology of the model, the high income group has a gap of 30%, while the low income group faces a gap of 55%.

Figure 6 shows how all 4 income groups are catching up to Oslo during the period 1972 to 1991/92. The high income group gradually reduces the income gap to below 20%, while the low income group reduces the income gap from 55% to 35%. During this period most local governments grow faster than Oslo. They are catching up on the frontier Oslo and income levels converge, as analyzed above. After 1992, however, the income gap is increasing again for all 4 income groups. Oslo grows faster and the rest is left behind. The income gap description obviously is consistent with the convergence analysis in section 3. The background understanding is that Oslo had relatively slow growth during stagnation, but then had higher growth when the national economy expanded.

Figure 6 about here.

Since Oslo is part of Norway, and in particular since the labor mobility in and out of Oslo is an important part of the economic adjustments during growth, we cannot use Oslo as the exogenous frontier in an econometric analysis of the income gap. We need a 'world frontier' outside the country that is exogenous to the growth process here. We have chosen to work with the per capita income level in the USA as world frontier, consistent with other

international studies of productivity growth (see Harding and Rattsø, 2008, and references therein).

The estimated model simply relates the income per head in each community to the income per head at the frontier:

$$y_{it} = \delta_0 + \delta_1 y^*_t + \delta_{2i}$$

Table 4 shows the estimated model with fixed effects and robust standard errors (since the frontier y* is common to all local governments). The coefficient of the frontier effect is statistically significant and the size is about 1.2. It follows that the growth rate of Norwegian regions is about 20% above the US frontier growth rate on average. In terms of the model this is interpreted as the ability of Norwegian regions to catch up to the frontier. When the two sub-periods are separated, catching up is shown for both periods, but significantly higher in the second expansionary period. It should be noticed that the understanding here is different from the analysis above looking at Norway alone. Catching up is strongest in the expansionary period of Norway since 1992. In the stagnating period up till 1992 the Norwegian regions were hardly catching up to the USA income level at all.

Table 4 about here.

The intersection of the convergence model and the catching up model suggests that the catching up will be stronger in low income regions. Table 5 separates the catching up between the 4 income groups classified according to initial income level in 1972. The estimates show that the catching up definitely is decreasing in the income level. The low income group has a frontier coefficient of 1.4, while the high income group has a coefficient of 1.0. The high income group just follows the U.S. frontier income path. The catching up model separating between municipalities according to initial income level is consistent with the convergence model. Catching up is stronger the lower the initial income level.

Table 5 about here.

The catching up hypothesis is linked to the understanding that human capital is important to take advantage of the world technology frontier. In terms of the model, human capital reduces the barriers to technology adoption. The catching up is investigated for 4 groups of local governments classified according to their initial education level in 1972. As shown in Table 6, all 4 groups show catching up to the frontier, but the size of the effect differs between the education groups. The differences in the degree of catching up are clearly related to the education level and the municipalities with the lowest initial education level have the strongest catching up. The differences in the catching up coefficients between the groups are statistically significant at the 1% level. Contrary to the catching up model catching up is stronger the lower the education level. We see this as evidence that the education level is not important for the spreading of technology and knowledge across the country in Norway. All regions have a high education level by international standards and the differences are not large enough to affect the economic growth. The possible effect of education is clearly dominated by our general finding that municipalities in poor regions have held up income growth during a period of serious outmigration.

Table 6 about here.

To investigate further the periphery – center dimension we also analyze catching up in 4 groups classified with respect to their location. As seen in Table 7, again all groups of local governments show catching up. The main difference in catching up is between the periphery group and the rest. The periphery group consists of the municipalities with the largest distance from urban centers, often also very small in population size and with large outmigration. This periphery clearly has the strongest catching up. The result is consistent with the differences observed regarding convergence. Given the lack of a positive education effect shown above, our interpretation is that the catching up does not reflect strong positive responses to spillovers of knowledge and technology.

Table 7 about here.

6. Concluding remarks

The standard neoclassical model of growth assumes that growth is a result of investment motivated by marginal capital productivity. Convergence between countries naturally follows

when the marginal return to capital is decreasing. Investment flows to capital poor countries and generates higher growth than in the capital rich countries. But the model may be less relevant for regions within a country. Broadly the investment flow does not run from the urban centers to the poor periphery in any country. Most countries have for a long time observed urbanization with geographic concentration of investments and growth. Rather there is a flow of labor from the low income periphery to the high income urban centers.

We have shown income convergence among municipalities in Norway and that the business cycle influences the growth pattern in an interesting way. Convergence is shown to be mainly the result of the economic downswing 1985-91. Urban municipalities grow slower during the recession, while the income growth in the periphery is less affected. This is the main explanation for the convergence observed for the full period 1972-2004. It follows that it is primarily the changing economic activity in the urban regions that contributes to convergence, not the dynamism of the periphery. We suspect that the industrial structure and in particular the larger share of public sector jobs in the periphery contributes to the stability of the income growth there. Politicians may argue that their regional policy has been successful in terms of income growth, if not in terms of employment and migration.

The open economy understanding of convergence is based on spillover of technology and knowledge. Growth is understood as catching up to the 'world income frontier'. The analysis here, assuming that the US income level measures the world frontier, confirms that the Norwegian regions are catching up. Consistent with the convergence result above, the growth is increasing in the size of the gap. Catching up is faster in periphery regions with low initial income level.

But the role of the education level points to a different interpretation. The catching up model emphasizes the education level as an important factor in determining the capacity to take benefit of technology/ knowledge spillover. In our data the initial education level in fact contributes to reduced catching up growth. The lower the initial education level, the higher the growth in income per head. We conclude that other mechanisms than education influencing barriers to spillover have been dominating. The economic development does not reflect strong responses to spillover of knowledge and technology in the periphery. As argued above, the growth pattern more reflects the changing economic growth in the urban areas. Looking at the income level in the municipalities, there is certainly a strong correlation

between income level and education level, both at the beginning and the end of the period studied.

We have shown that regional income data in Norway are consistent with convergence and catching up. But at the same time our results question the background mechanisms of these growth theories. We do not observe flows of investment and knowledge/technology to the periphery with strong growth response. Convergence has taken place when urban growth has been held back by economic downswing, and catching up has not been related to the education level. The relative independence of the business cycle in the periphery seems to be important, and the expanding government services in the periphery have held up incomes even when outmigration has been high. The income level in the periphery has developed favorably for those left behind. Future research must look into labor and wage composition effects involved in explaining this income growth pattern.

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Table 1
Growth in income per head, highest growth and lowest growth

Low growth		
Local government	Average annual growth 1972-2004	Income per head 1972
Askim	1.96	72.436
Holmestrand	2.12	71.485
Narvik	2.17	62.270
Moss	2.20	73.103
Skedsmo	2.22	82.647
Odda	2.24	66.495
Ås	2.24	74.583
Fauske	2.26	59.892
Nesodden	2.27	75.716
Vaksdal	2.28	57.186

High growth		
Local government	Average annual growth 1972-2004	Income per head 1972
Austevoll	3.79	50.647
Øygarden	3.80	44.941
Roan	3.87	32.652
Lurøy	3.89	37.132
Ringebu	4.00	44.770
Hemsedal	4.14	48.191
Bykle	4.48	50.495
Frøya	4.52	35.775
Aremark	4.62	56.892
Leka	5.21	33.623

Table 2
Convergence
Local governments

	1972-2004	1972-1991	1992-2004	1985-1991
Ln y72	-0.014*** (0.0007)	-0.030*** (0.0008)	0.0046 (0.0008)	-0.065*** (0.0022)
Const	0.176*** (0.007)	0.358*** (0.009)	-0.018 (0.037)	0.752*** (0.026)
N	404	411	431	431
R-sq adj	0.504	0.767	0.002	0.651

Dependent variable: Dlogy (growth rate of income)

Table 3
Convergence with controls
Local governments

	1972-2004	1972-1991	1992-2004
Ln y72	-0.017*** (0.0011)	-0.031*** (0,0013)	-0.015*** (0.0040)
Const	0.213*** (0.011)	0.366*** (0.013)	0.183*** (0.044)
Education 1970	0.0007*** (0.0002)	0.0010*** (0.0002)	0.0003** (0.0001)
Population 1972 (ln)	0.00006 (0.0002)	-0.0003 (0.0002)	0.0016*** (0.0003)
Center-dummy	0.0004** (0.0003)	-0.0015*** (0.00034)	0.004*** (0.0006)
Oil region-Dummy	0.0013** (0.0005)	0.0024** (0.0006)	-0.0018*** (0.0012)
N	404	411	431
R-sq adj	0.518	0.789	0.251

Dependent variable: Dlogy (growth rate of income)

Table 4
Catching up, full period and separate periods
All local governments, 1972-2004

	1972-2004	1972-1991	1992-2004
Ln y*	1.205*** (0.0032)	1.143*** (0,0065)	1.567*** (0.0069)
Const	-0.940*** (0.033)	-0.317*** (0.066)	-4.701*** (0.719)
N	14.636	8.982	5.654
R-sq	0.702	0.424	0.533

Dependent variable Ln yt (log of income level, year t)
Fixed effects, no time dummies, robust standard errors

Table 5
Catching up dependent on initial income level 1972
All local governments, 1972-2004

	Low income 1972	Low mid income 1972	High mid income 1972	High income 1972
Ln y*	1.411*** (0,0065)	1.246*** (0.0060)	1.129*** (0.0059)	1.006*** (0.0061)
Const	-3.181*** (0.067)	-1.400*** (0.061)	-0.134* (0.060)	1.252*** (0.0621)
N	3.536	3.575	3.542	3.283
R-sq	0,887	0,892	0,869	0,745

Dependent variable Ln yt (log of income level, year t)
Fixed effects, no time dummies, robust standard errors

Table 6
Catching up dependent on initial educational level 1972
All local governments, 1972-2004

	Low education 1972	Low mid education 1972	High mid education 1972	High education 1972
Ln y*	1.349*** (0.0068)	1.238*** (0.0064)	1.159*** (0.0057)	1.049*** (0.0064)
Const	-2.510*** (0.070)	-1.312*** (0.067)	-0.457*** (0.058)	0.777*** (0.065)
N	3.621	3.553	3.553	3.150
R-sq	0.820	0.822	0.824	0.653

Dependent variable Ln yt (log of income level, year t)
Fixed effects, no time dummies, robust standard errors

Table 7
Catching up dependent on periphery versus center
All local governments, 1972-2004

	Periphery	Less periphery	Less center	Center
Ln y*	1.304*** (0.0048)	1.165*** (0.0093)	1.128*** (0.0075)	1.110*** (0.0067)
Const	-2.018*** (0.049)	-0.557*** (0.095)	-0.135* (0.076)	0.123** (0.062)
N	6.632	1.493	2.543	3.427
R-sq	0.801	0.795	0.795	0.659

Dependent variable Ln yt (log of income level, year t)
Fixed effects, no time dummies, robust standard errors

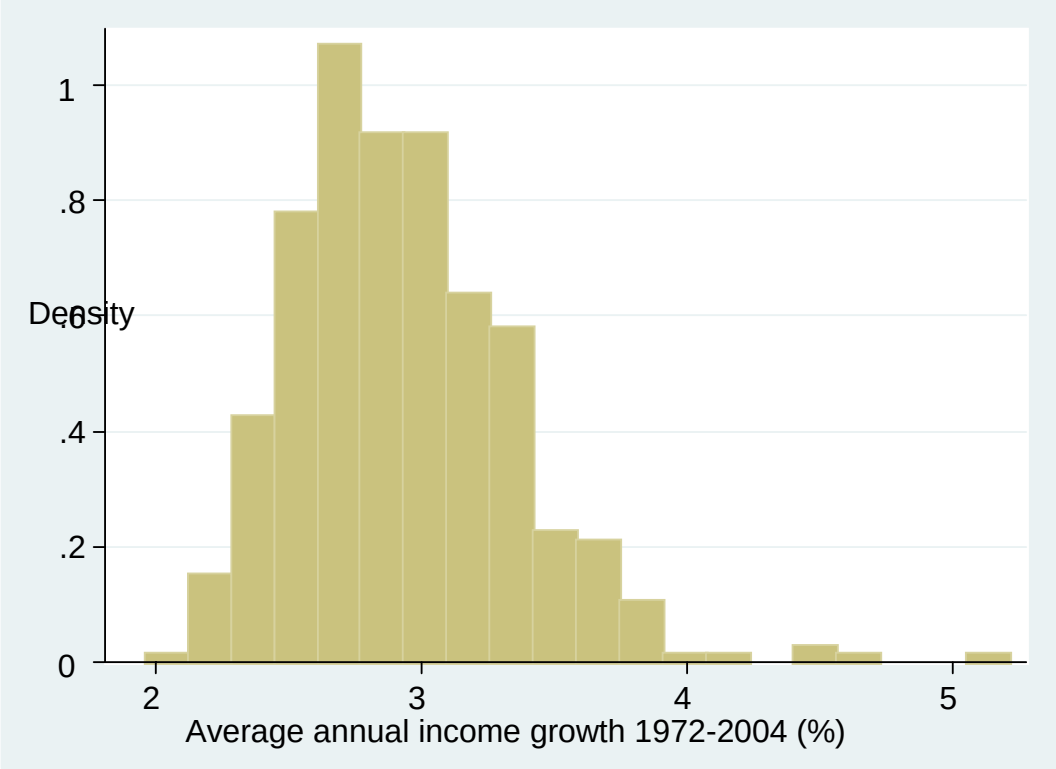

Figure 1
Histogram, average annual income growth 1972-2004

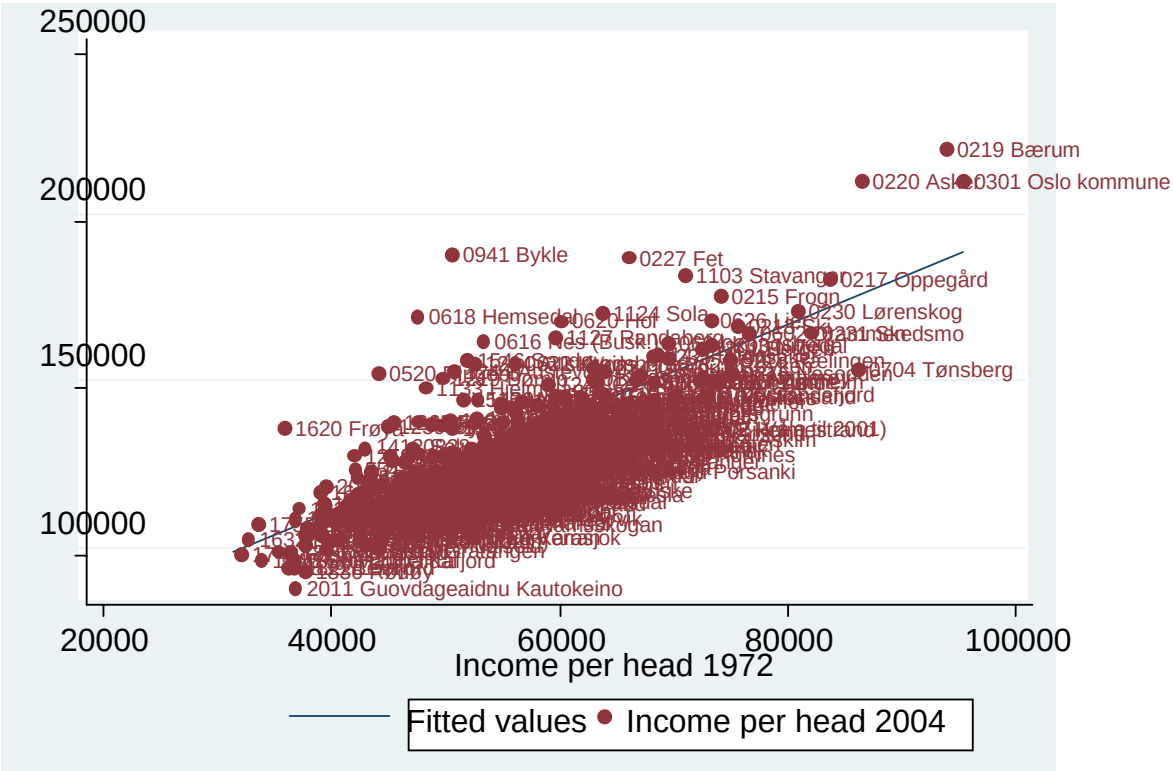

Figure 2
Scatterplot, income per head 1972 versus income per head 2004

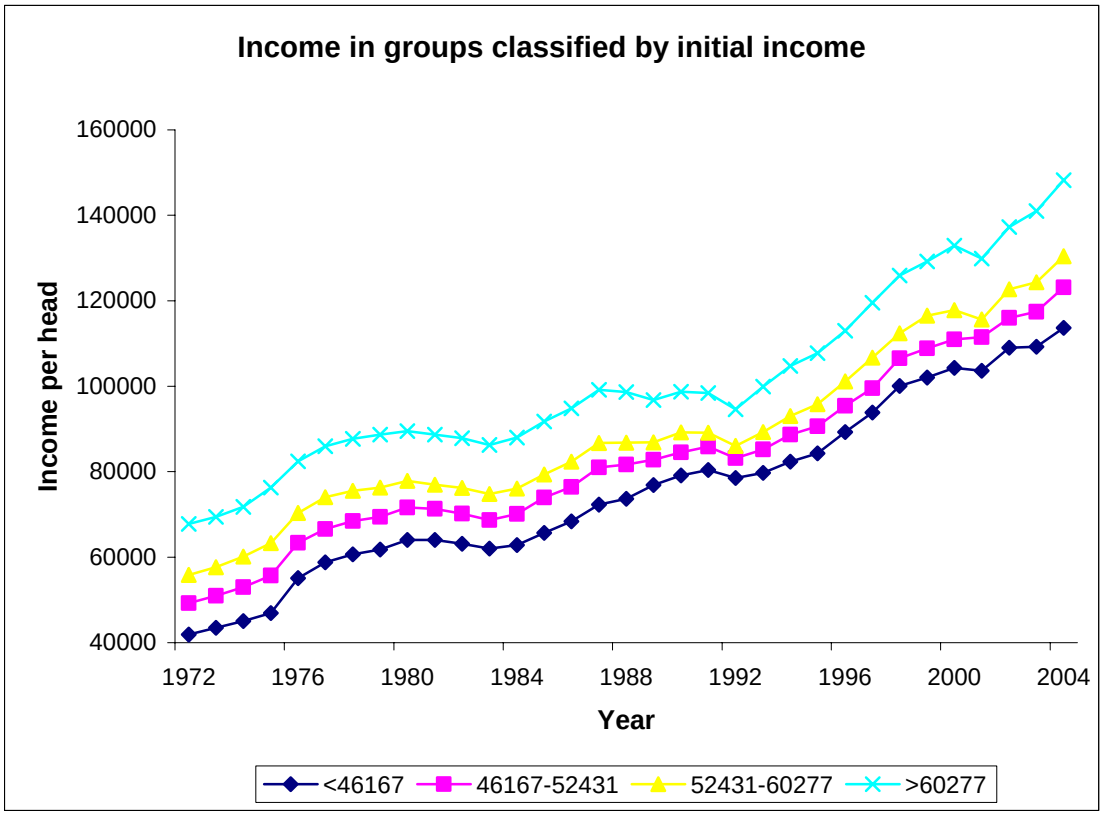

Figure 3: Development of income per head, 4 groups dependent on 1972 level, quartiles

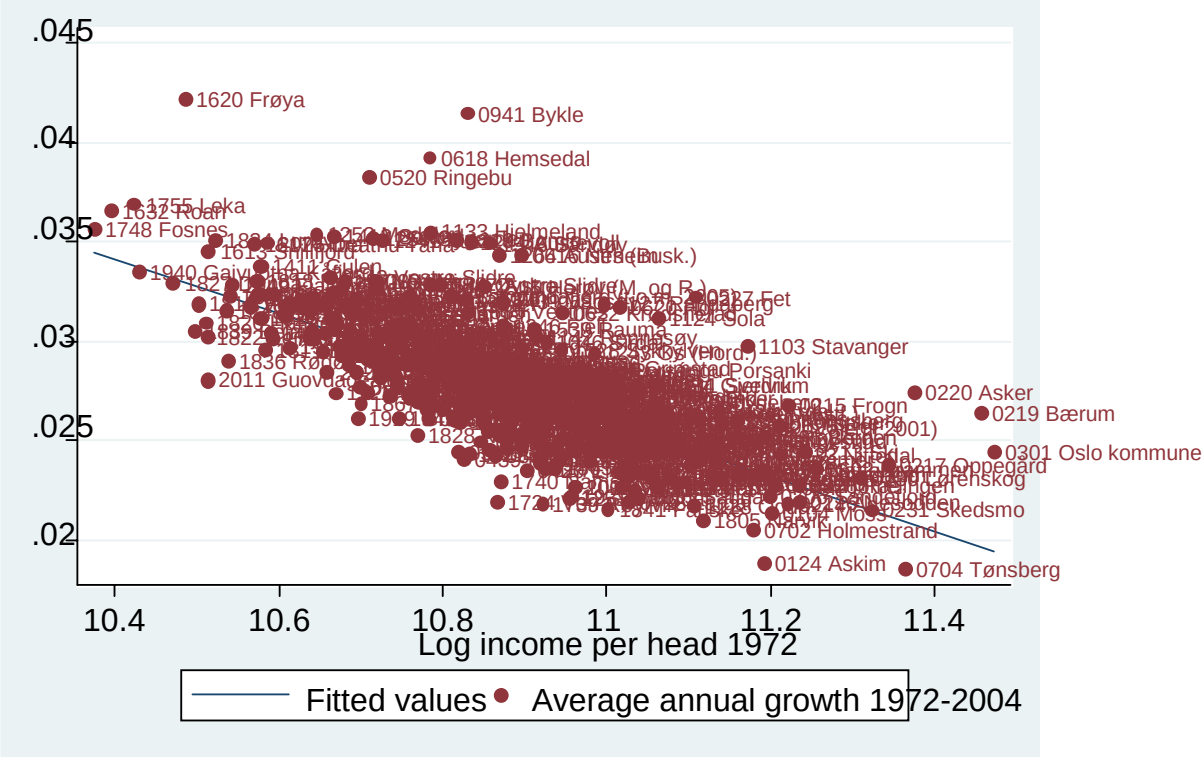

Figure 4
β convergence diagram.
The relationship between income growth rate 1972-2004 and initial income level 1972.

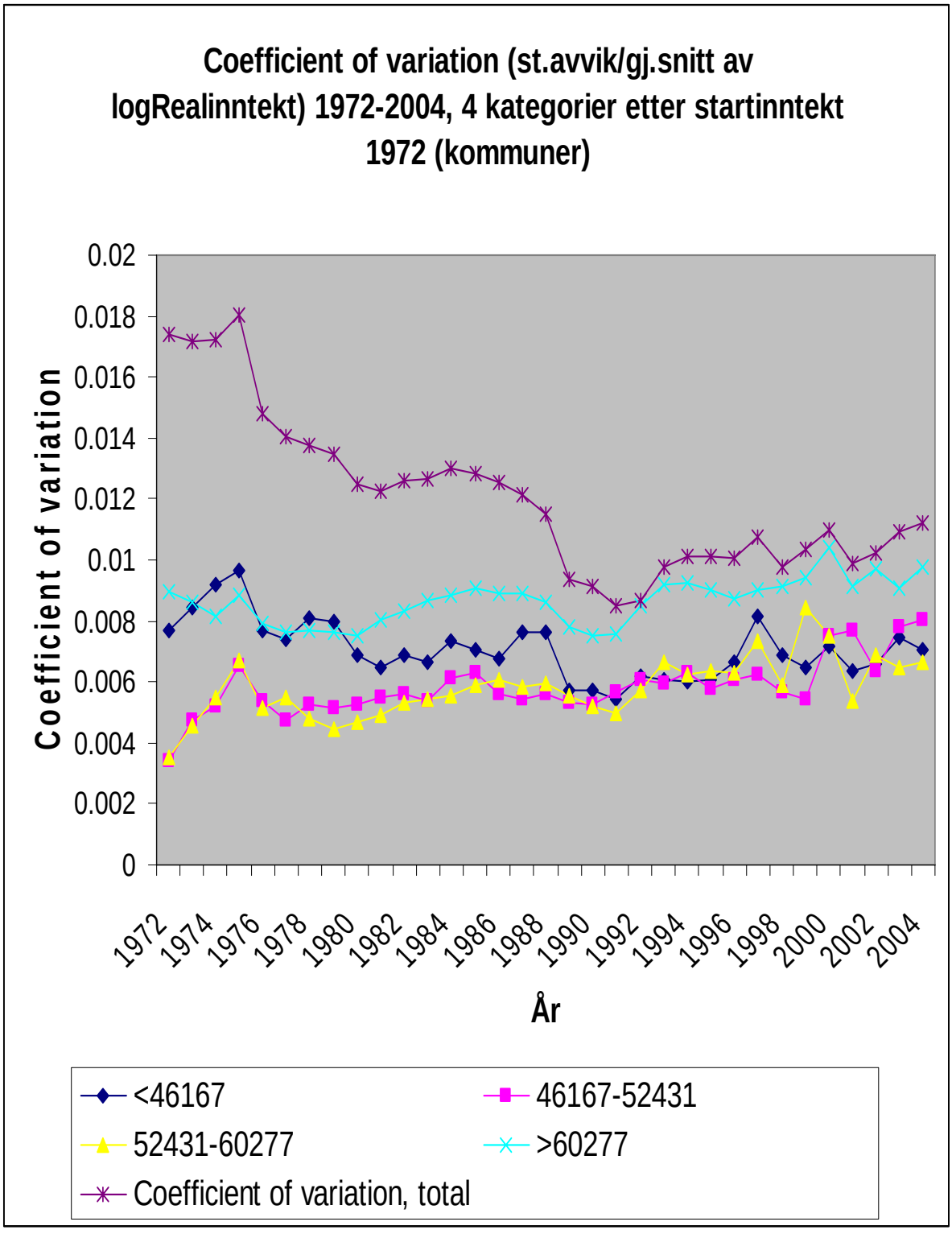

Figure 5.
σ convergence diagram.
Coefficient of variation, 4 income groups classified according to income per head in 1972 and total.

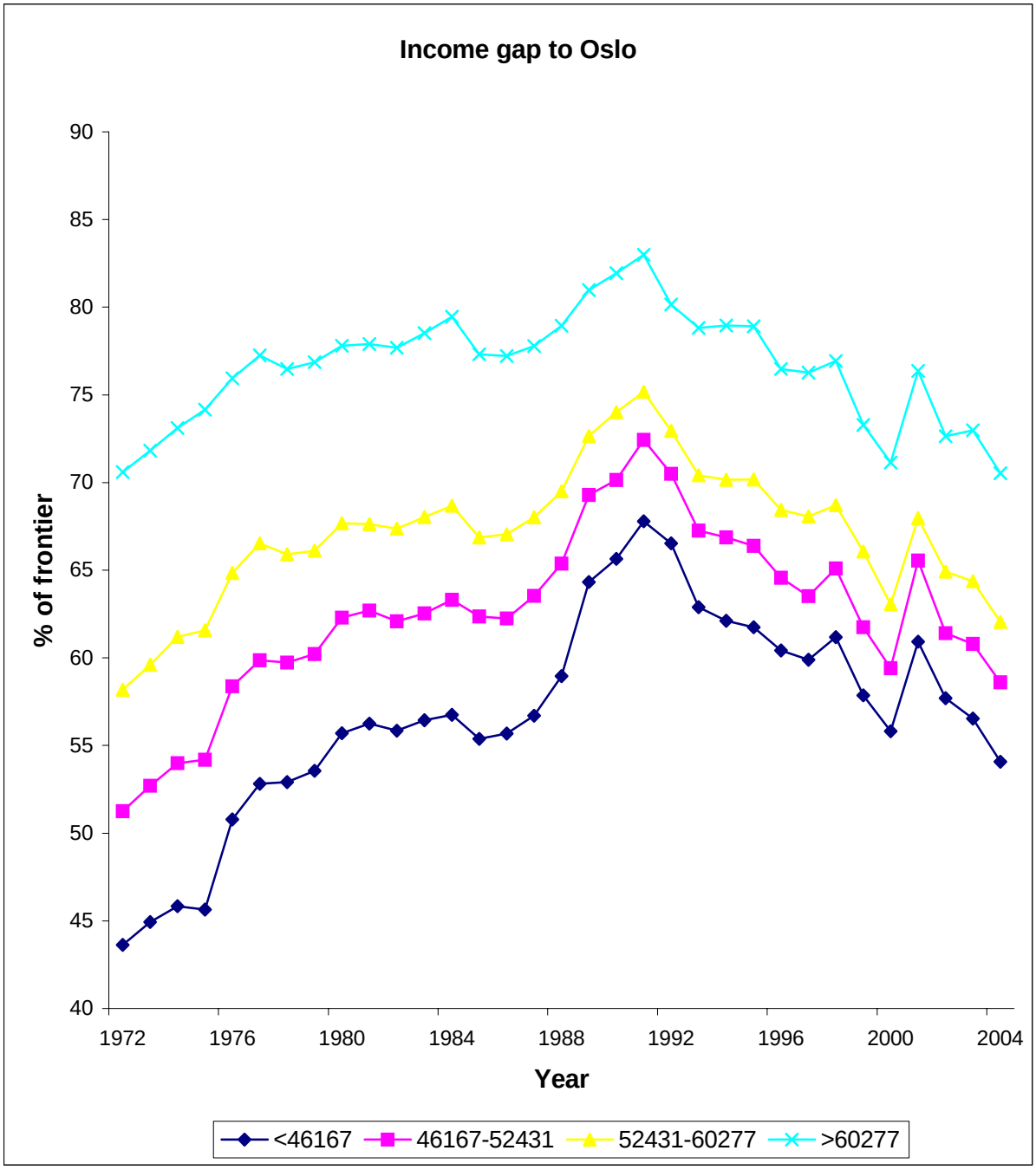

Figure 6.
Income gap to Oslo, 4 groups classified by income per head in 1972.