CONVERGENCE ACROSS INDUSTRIES AND PROVINCES IN TURKEY

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Abstract

This paper investigates convergence across Turkish provinces between 1975 and 1995. The evidence shows that convergence across Turkish provinces is conditional unlike the absolute convergence pattern found for the regions within the developed nations. Using a fixed effects model it has been shown that estimated steady states differ significantly and the major determinant of the position of the steady states is the initial condition. The paper also investigates the sources of convergence by examining sectoral convergence pattern. It is found that productivity levels and productivity growth vary across sectors and across provinces. Changes in sectoral employment contribute significantly both to productivity growth and convergence at the aggregate level

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1. Introduction

During the last ten years there has been a vast literature on economic growth. The emphasis in these studies following the work by Barro (1991), Barro and Sala-i-Martin (1992) and Mankiw, Romer and Weil (1992) were more on forces that determine convergence across economic units. The lesson learned from this literature is that there is some regularity in economic growth. Using cross sectional analysis it is found that there is no evidence of convergence in absolute terms across broad sample of countries. One obtains convergence of two percent per year once differences in fundamentals across countries are controlled for. That is, poor countries are growing faster than the rich ones only conditionally. However, when the analysis is restricted to more advanced nations, such as OECD countries or countries in Maddison (1991) data set, there is also some evidence of unconditional convergence.

Empirical studies on economic convergence are also extended to convergence across regions of countries. While the neoclassical theory assumes closed economy, and if simply applied to open economies the speed of convergence becomes infinity, the existence of some sort of immobility ensures that even the regions will follow similar pattern as nations (Barro, Mankiw, Sala-i-Martin (1995)). The regional studies by Barro and Sala-i-Martin (1991,1992,1995) for states within U.S., Europe and Japan, by Shioji (1996) for Japan, by Coulombe and Lee (1995) for Canada and by Persson (1994) for Sweden conclude that there is indeed convergence across regions of the countries under investigation and, once again, the speed is around two percent. Yet, this time the nature of convergence is absolute, as regions within national boundaries are more likely to share similar economic and social characteristics.

Almost all of the regional studies are restricted to regions within developed nations because of the lack of data, except one by Cashin and Sahay (1996) on Indian states.[1] One purpose of this paper is to extend regional convergence literature to regions within developing countries by examining the case of Turkey[2] and ask the question whether the regularity observed for regions within advanced nations also holds for developing countries. The conclusion of this paper is that the answer is negative. Similar to Cashin and Sahay (1996) where they find that Indian states converge at a speed of one and an half percent per year only

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[1] Canova and Marcet (1995) also refer to a study by Rivera-Batiz (1993) on convergence across regions of China. I did not have any chance to get hold of that paper.

[2] Turkey is the poorest member of the OECD with significant differences in fundamentals relative to other countries in the group and, consequently, considered as a developing rather than a developed country.

if they control for sectoral shocks, Turkish provinces diverge in absolute terms, yet when regional dummies and human capital are introduced, the result is overturned and the estimated rate of convergence is very close to 'magical' two percent.

The neoclassical theory also predicts that migration may contribute to convergence. However, empirical studies for the U.S. states and Japanese prefectures show that migration does not account for a large part of convergence (Barro and Sala-i-Martin (1995)). Since 1950 there has been a massive movement of population in Turkey, mostly from eastern provinces to western provinces. The test for significance of migration in convergence process of Turkish provinces shows that the impact of migration is not important in Turkey as well.

The analysis is also extended to quantify the effects of public investment on growth. While theoretical models, such as Barro (1990), predict a positive impact of public investment on growth; there are not many studies at the regional level to investigate whether such public activities do really increase the speed of growth. Using aggregate and sectoral public investment data, this study finds no evidence of any significant effect of public investment on growth of Turkish provinces.

A second goal of this study is to investigate the distribution and determinants of the steady states of Turkish provinces. Recently, there have been some studies that intend to shift the focus from transitional dynamics to the distribution of income. For example, Quah (1993,1994) investigates explicitly the shapes of income distribution. Jones (1996,1997) following Solow (1956) attempts to characterize the steady state distribution as a function of both physical and human capital, population growth and technology. Hall and Jones (1996) conclude that governmental, cultural and natural infrastructure are the main determinants of the steady state distribution. Finally, Canova and Marcet (1995) argue that "the poor stay poor", that is, the long-run level of income is determined by the initial level of income.

By estimating steady states as fixed effects of a nonstructural model, this study shows that the distribution of steady states is flatter than the initial distribution and the distance between the poorest province and richest province increases further. These findings imply that the inequality persist even into the future. Furthermore, the regression of estimated steady states on initial income shows that 80 percent of the variation in steady states can be explained just by the initial conditions. The dispersion of steady states of countries can be explained by the differences in governmental and cultural institutions, but it is more difficult to rely on such reasoning when it comes to explain dispersion of steady states of provinces within the same country. Indeed, beyond initial level of income among all conditioning variables only fertility rate seems to have some impact on the steady state distribution.

In his 1996 article, de la Fuente suggests that the rate at which technology diffuses and changes in sectoral composition may generate great income disparities across regions.

Similarly Bernard and Jones (91996) document that convergence pattern varies across sectors and composition of sectoral output exhibits heterogeneity across states in the U.S. The lack of data, unfortunately, makes it impossible to investigate the contribution of technology and its diffusion as done by de la Fuente (1996) for Spanish regions. Nevertheless, the data contains information on sectoral outputs. Following de la Fuente (1996) and Bernard and Jones (1996), this paper also attempts to emphasize the importance of sectoral structure on convergence process.

Section 2 provides estimates of convergence using cross-sectional regressions. In Section 3 a non-structural fixed effects model is employed to estimate steady states. The section also discusses possible determinants of steady state distribution. Section 4 introduces changes in sectoral composition as a possible source of the observed dispersion. Section 5 concludes.

2. Cross-sectional Convergence

In this section cross sectional convergence equation for Turkish provinces is estimated. The data used in this paper are annual provincial gross domestic product for years 1975 to 1995. The values for 1987 to 1995 are from State Institute of Statistic of Turkey (SIS). Data for earlier years are obtained from Özötün (1980,1988). Sectoral composition of gross domestic product for every province is also provided. Provincial price deflators do not exist. Aggregate sectoral deflators (1987=100) are used to obtain real values for each sector within every province and then by adding all sectors total gross domestic product of each and every province is obtained. While not perfect, this construction captures, at least, some changes in terms of trade.

To calculate per capita terms population between ages 15 and 64 is used. Population figures are obtained from General Population Census (GPC) conducted by SIS every five years except 1995. In between years as well as for years after 1990 are author's own projections estimated using age-gender group specific survival rates. Education and fertility data are also obtained from GPC. Average years of education are calculated for population over 15. People who are literate but not have completed primary school are assumed to have completed one year of school. Fertility rate is 'crude child-woman ratio', that is, the ratio of children between ages 0 and 4 to the number of females between ages 15 and 49.

Starting from 1990 for political reasons number of provinces has increased from 67 in 1989 to 76 in 1995. To ensure consistency of the data some provinces that had split in later years are recombined. In one particular case two new provinces are created by taking land from three different provinces. In that case all five provinces are put together into a single province. Eventually, the number of provinces reduces to 65. A map that shows geographical position of each province is provided in the appendix.

2.1. β-convergence

The neoclassical growth theory with standard decreasing returns to reproducible factors assumption yields the following transitional dynamics of the output per capita around the steady state:

$$\ln(y_t) = e^{-\beta T} \ln(y_0) + (1 - e^{-\beta T}) \ln(y^*) \quad (1)$$

where y_t is the output per capita y_0 and y^* are the initial level and the steady state level of output, respectively. Equation (1) implies that the average growth rate of output per capita over an interval from time 0 to time T is

$$(1/T) [\ln(y_T) - \ln(y_0)] = x + [(1 - e^{-\beta T})/T] [\ln(y^*) - \ln(y_0)] \quad (2)$$

where x is the growth rate of steady state level of output. Holding steady state and convergence rate constant across time and economic units, Equation (2) shows that the growth rate of output is negatively related to initial level of output. As shown in Figure 1, this is not the case for Turkish provinces. Growth rate increases with the initial level of output, unlike what is observed for the regions within developed nations.

To quantify observed divergence the following equation is estimated:

$$(1/T) [\ln(y_T) - \ln(y_0)] = a - [(1 - e^{-\beta T})/T] \ln(y_0) + u_{i0,T} \quad (3)$$

where $a = x + [(1 - e^{-\beta T})/T] \ln(y^*)$ and $u_{i0,T}$ represents the average of the error terms between dates 0 and T.

Table 1 shows the estimates of convergence rate, β, in Equation (3) for various periods and specifications. The output series used in estimation is logarithm of per capita output measured in deviations from the sample mean in each period.

First column of Table 1 shows the estimates of convergence rate, β, in Equation (3) for various periods by holding steady state constant across 65 provinces in the data set. The sign of β coefficient is negative for the first two sub-periods as well as for the entire sample, and positive for the latter half of the sample, and insignificant in all cases except the last period. If β is jointly estimated for all four periods and is constrained to be same across periods, an estimate of –0.0054 (s.e. =0.0028) is obtained. The estimate is marginally significant at 5% level. The likelihood ratio statistic shows that the estimate of β is also stable across periods. The conclusion from this first regression is that Turkish provinces are diverging, though the rate of divergence is low.

The second column in Table 1 reports β coefficients obtained from the regression with regional dummies that are included to control for differences in steady states. The sign of the convergence rate is now positive except for early eighties, yet they are insignificant. Nevertheless the joint estimation yields stable, positive and significant convergence rate of

0.0096 (s.e. =0.0046). The inclusion of regional dummies changes the result substantially. Turkish provinces are converging, though to different steady states and at a lower speed compared to the regions of advanced nations (almost at half speed). With this speed Turkish provinces reach the halfway between initial period and long-run level of output in more than 70 years, as opposed to 35 years for regions within industrialized world.

In the literature one variable which is usually significant in convergence regressions is some indicator that controls for sectoral composition. Barro and Sala-i-Martin (1995) use this variable to control for aggregate shocks that affects groups of regions differentially, such as shifts in the relative prices of agricultural products or oil. The same indicator is constructed for Turkish provinces as described by these authors:

$$S_{it} = \Sigma\, w_{ij,t-T}\, [\ln(y_{jt}/y_{j,t-T})/T] \qquad (4)$$

Third column of Table 1 shows estimates of convergence rate after S_{it} is included in the regressor list. While qualitatively the results do not change, the magnitude of the estimates almost double. The β coefficient estimated jointly indicates, now, that the provinces are converging at a speed of 1.9% per year. One can, then, conclude that the Turkish provinces are converging at a speed of around two percent per year, very much like their counterparts in developed world, but unlike them convergence across Turkish provinces is just conditional.

2.2. Human Capital and Fertility

Absence of absolute convergence and slow conditional convergence in larger sample of countries has been already a concern in the literature. While the neoclassical growth theory is consistent with conditional convergence, with standard assumptions about the share of capital (around 1/3) and depreciation rate of 0.05, it implies a much higher convergence rate than estimated. Barro (1991) and Mankiw, Romer and Weil (1992) reinterpreting capital more broadly incorporated human capital into the neoclassical growth theory. From empirical point of view, extension of neoclassical model to include human capital requires a variable that controls for different levels of human capital in Equation (3).

To test if the above results are plagued with the omission of human capital, convergence regression is re-estimated by adding male and female education variables. First column of Table 2 reports estimated coefficients. Estimated convergence rate does not change significantly. The coefficient on male education variable, however, is puzzling. For all periods as well as in joint estimation the sign of this variable is negative. That implies that an increase in male human capital stock reduces growth rate, while an increase in female human capital increases growth. In the light of existing literature it is hard to explain the negative sign of the coefficient of male education variable[3].

The neoclassical model with exogenous population growth rate implies a negative correlation between steady state and fertility rate. The decrease in steady state implies, in return, a decrease in the convergence speed during transition. In the case where fertility is modeled endogenously, raising children becomes too costly as larger human capital stock implies higher wages. Therefore, families with higher capital stock lower their fertility and increase investment in human capital per child. This implies that while higher human capital increases the subsequent growth rate, higher fertility at given initial level of income and capital stock reduces growth rate. The theory predicts, then, a negative relationship between fertility and growth.

Second column of Table 2 adds fertility rate as an additional variable measured as averages over each period. Indeed, the coefficient on fertility rate in growth regression for Turkish provinces is negative and significant. An interesting finding is that the coefficient on female schooling variable is reduced to the half of the estimate without fertility rate. That is, a significant portion of the effect of female human capital on growth is coming through its effect on fertility. Inclusion of fertility also reduces the magnitude of the estimated coefficient on male schooling, but it is still negative.

2.3. Public Investment

It is common belief that government policies affect growth. Theoretical models however differ in their predictions. The neoclassical model assumes that the steady state growth is driven by exogenous factors, such as technology. Therefore, it is very unlikely for fiscal policies to have an effect on the rate of growth. Eaton (1981), however, using a stochastic growth model based on endogenous growth predicts that fiscal policy is one of the main determinants of the growth. Furthermore, Barro (1990) shows a positive effect of public investment on growth as this activity increases the productivity of the private sector. While there is conflicting conclusions of theoretical model there are not many empirical studies to test the predictions of different models because data to accomplish this task is not easily available. Only recently, Easterly and Rebelo (1993) provided an empirical investigation of the effects of fiscal policy on growth of nations. Their results indicate a robust correlation between public investment in transport and communications and growth, and budget surplus

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[3] In hope that the gender specific human capital variables may have non-linear effects, the model is estimated with male human capital and gender ratio in education instead of female human capital. The finding of negative coefficient on male education variable did not change even under this specification.

and growth. Beyond these facts, they conclude that the relations between most other fiscal variables and growth are fragile.

Following Easterly and Rebelo (1993), to estimate the effect of fiscal policy I collected data on public investment by sector. The data are from State Planning Organization (SPO) of Turkey for all years between 1975 and 1995, except 1976 and 1977. It has to be noted that the data may underestimate true public investment for two reasons. Several investment activities in Turkey are carried out by public enterprises and local administrations. The collected data, however, come from central government budget, not from consolidated budget and hence miss the contribution of both institutions. Second, a significant portion of aggregate public investment goes to 'miscellaneous provinces', that is, if a project extends over the borders of a province, that project is classified as an investment for 'miscellaneous provinces'. With these shortcomings in mind, period averages of total public investment by province are used in the growth regression. The result is shown in the last column of Table 2. The coefficient on public investment is positive and only significant at 10 percent level (p-value is 0.082). The direction of the impact is in accordance with Barro's (1990) prediction, nonetheless, the evidence is not strong enough to conclude that increasing public investment accelerates growth.

Public investment data also include sectoral composition of investments for the majority of years (sectoral details for years 1976,1977, 1980-1983 are missing). To test whether a particular type of public investment is more effective to speed up the growth process rather than the aggregate, growth equation is re-estimated, similar to Easterly and Rebelo (1993). The regressions include regional dummies, the structural variable, male and female education variables, fertility and one public investment variable at a time. Table 3 reports the coefficients of these regressions. Unlike the results obtained by Easterly and Rebelo (1993), non of the sectoral public investment variables come out significant.

In the light of these results one may conclude that the effects of public policy in Turkey on provincial growth seems to be either non-existent or negligible. This conclusion, of course, might be too strong, especially if the data on public investment is seriously distorted as mentioned above and if fiscal policy is endogenous. While it is obvious that further research is required on this aspect of growth, it is beyond the scope of this paper.

2.4. Migration

One other possible source of convergence is migration. People tend to migrate from regions with lower capital-labor ratio and low wages to regions where capital-labor ratio and wages are high. Consequently, migration causes poor regions to grow faster than rich regions.

Since early 1950s migration is economically, socially and politically a major issue in Turkey. A quick look at the numbers for Istanbul, the province with highest number of immigrants, is enough to show the significance of migration. Between 1975 and 1990 over 2 million people moved in Istanbul and net migration is around 1,250,000 people. The population of Istanbul increased from 3.9 million in 1975 to 7.3 million in 1990. This implies that net migration rate in Istanbul over 15 years is around 30%. Similar figures are also observed for other provinces in the western part of the country. To measure the contribution of migration to convergence process, this section considers the determinants of migration and its relation with convergence.

The data for migration comes from GPC. Unfortunately, SIS postponed population survey in 1995 to year 2000. Therefore migration figures for years after 1990 do not exist. Therefore the analysis in this section is restricted to years 1975 and 1990. Figure 2 shows the unconditional relation between migration rate and initial income. The positive association is evident. Richer provinces mainly of the west observe high levels of in-migration. The only initially rich province who experienced negative net migration is Zonguldak, a coal-mining province that lost its significance in 1980s.

Braun (1993) postulates a migration function where the decision to migrate comes from consumer's optimization problem and diminishing returns is achieved by assuming a natural resource congested by the population of that region. Table 4 shows regression results of net migration on initial level of income and density. The coefficient in front of income is positive and significant for all three sub-periods. The joint estimate is 0.0446 (s.e.=0.0007). This implies that a ten percent increase in income increases population in a province by 0.44 percent (holding mortality and fertility constant). The estimated effect of initial income on migration is very high compared to estimates obtained for the states of US by Barro and Sala-i-Martin (1995), 0.026, and for prefectures of Japan by Shioji (1996), 0.0225.

The theory predicts that the coefficient on density to be negative and the coefficient on square of density to be positive. For Turkish provinces I obtained opposite signs though very small effects, indicating that the theory does not hold for Turkey. Given the finding of net negative effect of density on migration for the advanced nations, such as the U.S. and Japan, the relation between migration and density probably should be thought more in non-linear terms. A further casual observation is that the migration decision in Turkey usually depends on the presence of some relatives of the immigrants in the destined town. Most of the ghettos in Istanbul, for example, are identified with the original village of their current residences.

Using the elasticity of net migration with respect to income, one can calculate the contribution of migration to convergence. Barro and Sala-i-Martin (1995) modify the neoclassical model by taking into account the effects of migration on growth. If there is indeed significant amount of migration, then estimated β from equation (3) captures both the true convergence and the impact of migration. The calculation of the impact of migration, however, requires some assumptions about the values of certain parameters. As there are no empirical studies about the magnitudes of these parameters for Turkey, I will use the parameter values suggested by Barro and Sala-i-Martin (1995). I assume that subjective discount rate is 0.02, that technology growth is 2 percent per annum and depreciation rate is 0.05. Average population growth rate in Turkey is 3 percent. I also assume that the share of capital in production is 0.75. Under these assumptions, if the immigrants cannot carry any capital (physical and human), then the convergence rate would have been 0.0486, instead of estimated 0.0189. If the assumption about the capital stock of immigrants is revised to be around 60 percent of the natives[4], then convergence coefficient reduces to 0.0337 but still significantly larger than the estimated value. This result suggests that migration contribute heavily to convergence across Turkish provinces.

This is a strong conclusion and it might arouse suspicion about the validity of the assumptions made. In order to test the significance of migration I use a more direct test by introducing net migration rate as an additional variable in equation (3). Table 5 presents the estimates of this regression. Including net migration rate in growth equation increases the convergence rate, contrary to expectations. The result is most probably influenced by the endogeneity of net migration. Once net migration is instrumented with variables used to estimate net migration rate except initial income, the estimated β in regression with migration is lower than the estimate obtained without migration. The reduction in the estimates, however, is not very large, indicating that migration contributes to convergence, yet not as strongly as suggested in the previous paragraph. Shioji (1996) also finds a similar contradiction between the theoretical implication and empirical finding for Japan. He suggests compositional effects of migration as a source of the observed discrepancy, as well as effects of other factors, such as externalities associated with migration and changes in the age distribution.

2.5. σ-convergence

A different convergence concept relates more to the dispersion of per capita output across economic units. The so-called σ-convergence studies how the distribution of income evolves over time. In Figure 3 presents the cross sectional dispersion of per capita provincial output across time.

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[4] Barro and Sala-i-Martin (1995) assume that immigrants carry human capital and base their estimate of 60% on a study for young U.S. males by Borjas, Bronas and Trejo (1992).

As seen in the graph, the dispersion decreases during the seventies. The end of seventies in Turkey marked by high inflation and unstable political environment. In early 1980 a new economic program is accepted. According to this program, Turkey would move away from import substitution towards being an outward oriented economy. In late 1980 military seized power to implement this new policy. First three years of 1980s shows the military rule. During this period the status quo in income distribution is sustained. After 1983, the power is returned to civilians. Until 1989, civil governments pursued a policy supposedly aimed to increase capital accumulation, but evidently distorted income distribution across provinces severely. 1989 is another turning point in Turkish economy and politics. Since then governments are implementing popular policies. While a mild improvement is observed in distribution, the differences across provinces' income levels are still large.

To summarize, the dispersion of per capita output has increased since late seventies and since then there is not any strong tendency to come down. The analysis of dispersion of output levels supports earlier conclusion that provinces in Turkey are not converging towards each other.

3. Explaining Different Steady States

The results in the preceding section shows that Turkish provinces are converging to their own steady states at a speed of 1.9 percent per year. However, two questions, how different are the steady states provinces are approaching and what determines the steady states, remain. Naturally, using the estimated coefficients and assuming that the conditioning variables are good proxies for steady states one can derive the distribution of steady states. Yet, if conditioning variables are strongly correlated with initial income, that is, if there is a multicollinearity problem, the estimates will be inconsistent. Furthermore, if initial level of income is the main determinant of the steady state as argued by Canova and Marcet (1995), then it is not very likely to claim that one can accurately control for differences.

In this section a fixed effects model of convergence is estimated and by using fixed effects as estimates of the corresponding steady states the distribution of long-run level of productivity and their determinants are analyzed.

The evolution of relative per capita output is described as follows:

$$y_{it} = \alpha_i - \lambda\, y_{i,t-1} + \varepsilon_{it} \qquad (5)$$

where y_{it} is the relative per capita output for economy i at time t, $\beta=(1-\lambda)$ is the convergence coefficient and ε is a random disturbance term. The iterative solution of this equation is

$$(y_{it} - y_{i,t-\tau})/\tau = [(1-\lambda^{\tau})/\tau]\,(y_i^* - y_{i,t-\tau}) + \nu_{i,t,\tau} \qquad (6)$$

with $y_i^* = \alpha_i/\beta$ being the steady state of y and $\nu_{i,t,\tau}$ is weighted average of random disturbances.

This is a simplified version of the model suggested by Canova and Marcet (1995) except that it is assumed that each unit is converging towards its own steady state at the same speed as the others. To estimate equation (6) the following model with τ=1 is used:

$$(y_{it} - y_{i,t-\tau})/\tau = (\Sigma D_i) - [(1-\lambda^{\tau})/\tau]\, y_{i,t-\tau} + \nu_{i,t,\tau} \qquad (7)$$

The model is equivalent to cross sectional model if $y_i^* = 0$ for all i and τ=5. The use of relative per capita output instead of plain per capita output prevents the model to exhibit serial correlation and residual cross unit correlation because fluctuations at the business cycle level affect the economy as a whole. The main restriction is then that units are assumed not to respond more strongly to aggregate shocks than others[5]. The advantages of the model, on the other hand, is that it allows to use more information in time dimension and that it does not restrict the steady states to be the same across units.

Table 6 presents the estimation results of equation (7). Only 13 out of 65 fixed effects are insignificant (at 5 percent significance level), indicating a strong persistence in provincial disparities. The correlation coefficient between estimated fixed effects and 1995 output level is 0.95. Figure 4 shows the relative output level of each province and its estimated steady state level. It seems that Turkish provinces are very close to their steady states, while the dispersion of estimated steady states is marginally smaller than the dispersion of output in 1995, as well as the distance between the poorest and the richest.

Figures 5 and 6 provide more information on the evolution of provincial incomes. First, compared to initial distribution, the distribution of steady states are more flat and uniform. The number of provinces at the lower and upper ends of distribution increases. In Figure 6 provinces are sorted by ascending order of productivity for both initial period and estimated state states. This figure shows that distance between the poorest and the richest will increase in the future.

The fixed effect model helps one to describe the distribution of steady states but it does not tell anything about the determinants of the distribution. Hall and Jones (1996) and Jones (1996,1997) pursued this issue and concluded that the main determinants of high productivity are institutions that favor production over diversion, openness to trade, existence of private ownership, knowledge of international language by people and temperate latitude. Canova and Marcet (1995), on the other hand, claim that the main determinant of the long-run distribution of income levels is the initial conditions and other conditioning variables do not

[5] Proof of this statement is in Appendix 1 of Canova and Marcet (1995).

seem to be correlated with estimated steady states once the effect of initial income is taken into account.

The first three determinants suggested by Hall and Jones (1996) are, theoretically, more or less irrelevant for provinces within national boundaries. In Turkey, laws and regulations are same for everyone within the country and there is one central government that leaves almost no power to local administrations. If these institutions favor or disfavor production over diversion and/or honor or dishonor private ownership, they do so in all provinces. There are also no interior barriers for trade. However, it is not the written documents that show the existence of such institutions. It is very likely that these institutions may not be internalized (accepted) by the people in different regions of Turkey equally. If that is the case then the claims of Hall and Jones may still hold. Unfortunately, it is not possible to test such propositions given the existing data.

The only variables available are the ones used for conditioning the cross sectional regression. Following Canova and Marcet (1995) estimated steady states are plotted against initial level of income in Figure 7. There is indeed a positive and very strong relationship between initial level of output and steady states. The R^2 of the regression of estimated steady states on initial income is 0.807. This indicates a remarkably high explanatory power of initial conditions, even in comparison of Canova and Marcet's (1995) finding of 21% for regions within Europe[6].

Table 7 shows the result when conditioning variables are added to the regression. Only fertility rate is significant and as expected has a negative sign. All other variables come out insignificant. Overall, these variables do not add much to the explanatory power of the regression.

It should be noted that the estimated speed of convergence in the fixed effects model is 33 percent. It is already a known fact in the literature that the inclusion of fixed effects also changes the estimates of the rate of convergence. It has been argued that without knowing the position of steady states the rate of convergence will be underestimated. Indeed, Canova and Marcet (1995) using a Bayesian model estimate the speed of convergence as 11 percent for OECD countries and 23 percent for European regions on average. Islam (1995) obtains estimates of convergence rate ranging from 4.3 percent to 9.3 percent depending on the countries included in the estimation. The speed for Turkish provinces is well above the average of estimates reported by above mentioned studies, yet it is noteworthy to mention that Canova and Marcet's individual convergence rate estimate for Turkey is also 33 percent (p. 17).

Nevertheless, this estimate is far above the estimate obtained in cross sectional analysis and if interpreted structurally, it implies negative coefficient for capital in production function[7,8]. de la Fuente (1996) claims that this finding indicates that forces other than decreasing returns must be contributing to convergence. He suggests two possible explanations, technological diffusion and sectoral composition of output. While data are not available for Turkey to analyze technological diffusion, the data contain information on sectoral output levels and next section discusses sectoral convergence in Turkey.

4. Sectoral Convergence

Most of the studies on convergence have concentrated on aggregate output level. There are very few studies investigating convergence pattern across sectors of regions. The first attempt has been made by Barro and Sala-i-Martin (1991) where they look at the sectoral convergence across the states of the U.S. They conclude that β-convergence applies within sectors similar to the ones for aggregates and that an important part of overall convergence across states can be explained by adjustment process of convergence across sectors. Bernard and Jones (1996) examine sectoral convergence across U.S. states more thoroughly and conclude that there exist large heterogeneity in productivity levels across sectors and states and while productivity growth in manufacturing provides the main source of convergence across states. They also find that changes in the composition of sectors also affect the process significantly and inversely as employment shifts from more productive sectors to less productive ones. Similarly, de la Fuente (1996) investigates convergence across sectors and regions of Spain. He also concludes that changes in sectoral composition affects convergence process, but unlike Bernard and Jones (1996), he reports that the flow of labor in Spain is more from low productive sectors, specifically from agriculture, to more productive ones.

It is already a well-known fact in regional economics literature that sectoral composition plays an important role to explain differences in productivity across regions. Indeed, to the extent the average productivities exhibit significant variation across sectors, sectoral composition can be thought as a determinant of dispersion across regions. In Turkey changes

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[6] They report that the initial conditions explain about 85% of the cross sectional dispersion in estimated steady states of 17 West European countries including Turkey.

[7] It should be noted that this coefficient in fixed effects model can be interpreted structurally. In the standard neoclassical growth model the rate of convergence can be expressed as

$$\beta = (1-\alpha)(\delta+g+n)$$

where α is the coefficient of capital in production function, δ is the depreciation rate, g is the rate of technological progress and n is the population growth rate.

[8] Assuming commonly used assumptions about depreciation rate and the rate of technological progress and using average population growth rate in Turkey.

in sectoral composition occurs in a faster way compared to most of the developed nations, especially people are moving from rural to urban areas and consequently from agriculture to other sectors. This section deals with the assessment of the effects of sectoral composition and convergence on the overall convergence process across Turkish provinces.

4.1. Sectoral Productivity Levels and Growth Rates

The sectors analyzed here are agriculture, manufacturing defined as the sum of mining and manufacturing[9], construction, domestic trade, transportation/public utilities, financial institutions and services. Unfortunately sectoral employment data exist only between 1975 and 1990 and at five-year intervals. This leaves only four observations per unit. In this section I also define aggregate productivity as the sum of output by sectors mentioned above and output per employee instead of output per adult population.

Figure 8 presents the evolution of sectoral productivities over time. The variables are defined as deviations of logarithm of sectoral productivity from the logarithm of aggregate productivity level in each period. The difference between productivity levels across sectors is remarkable. The productivity levels in agriculture and service sectors have been consistently below of the productivity levels of other sectors. Productivity in financial sector was highest at the beginning of the sample but shows a steep decline over the last fifteen years. The productivity levels of other sectors do not exhibit any significant trend but they exhibit some decline in late seventies and a recovery in early eighties.

Table 8 completes the figure by presenting sectoral productivity levels, measured in 1987 TL and averages of provinces. Finance sector had the highest productivity level at the beginning and service sector the lowest. In three sectors average productivity declined over the fifteen years, finance sector observed a major decline which is followed by services and construction. As of 1990 the most productive sector is transportation and public utilities; a natural consequence of continuing efforts of successive Turkish governments in last forty years to build major dams and electricity plants.

Table 8 also provides coefficient of variation. The variation across sectors is matched by variation across provinces. The standard deviation of aggregate productivity level is over fifty percent of the average in both 1975 and 1990. The coefficient of variation in all sectors increased throughout the sample period. The variation in manufacturing is remarkably high. It was 71.7 percent at the beginning of the sample and increased to 81.2 percent in 1990. The dispersion observed in Turkey is incomparably higher than the ones observed for the U.S. by Bernard and Jones (1996).

Table 9 provides sectoral growth rates. The average province grew at an annual rate of 1.5 percent in fifteen years whereas the growth of aggregate productivity in Turkey overall is 2.2 percent. Yet, variation across provinces observed in levels is also found in the growth rates. Sectors in an average province grew at wildly different rates. The finance and service sectors exhibit large decline whereas transportation/public utilities sector exhibits relatively high growth. Both tables indicate that there is significant heterogeneity both across sectors and across provinces.

Table 10 focuses on the composition of sectors within average province over time. Both employment and output shares of agriculture decline whereas shares of all other sectors increase, indicating a shift from agriculture to other sectors. The growth rate of employment is highest in finance sector. It is followed by trade and construction sectors. However, more than one third of labor moved away from agriculture ended up in services. In terms of output shares, transportation/public utilities exhibits the highest growth, followed by trade and manufacturing sectors. Yet only in transportation/public utilities and manufacturing the growth rates of output shares are higher than the growth rates of employment shares.

To assess the relative importance of changes in productivity within a sector and changes in sectoral composition within a province, I employ the decomposition technique described by Bernard and Jones (1996). Let $y_{it}=Y_{it}/L_{it}$ denote aggregate productivity level for state i at time t. It is then the sum of weighted sectoral productivities over j sectors where weights are sectoral employment shares:

$$y_{it} = \sum_j \frac{Y_{ijt}}{L_{ijt}} \frac{L_{ijt}}{L_{it}} \equiv \sum_j y_{ijt} w_{ijt}$$

Productivity growth in every state, then, can be decomposed into a productivity growth effect and a share effect:

$$\Delta y_{it} = \sum_j \Delta y_{ijt} \overline{w}_{ijt} + \sum_j \Delta w_{ijt} \overline{y}_{ijt}$$

where the first summation is the within sector effect, or productivity growth effect, and the second one is the between sector effect, or share effect. The bars on variables indicate that the average value of that variable across two periods for which growth rate is calculated is used. It is also possible to reformulate the effects in terms of percentages:

$$\%\Delta y_{it} = \sum_j \%\Delta y_{ijt} \left(\frac{y_{ij0}}{y_{i0}} \right) \overline{w}_{ijt} + \sum_j \Delta w_{ijt} \left(\frac{\overline{y}_{ijt}}{y_{i0}} \right)$$

[9] Mining is relatively not an important sector in Turkey. In some provinces in certain years there is not any mining activity, hence it would mislead the analysis if mining were treated as a separate sector.

Table 11 reports the average productivity growth effects and share effect for the provinces. The average annual percentage change in productivity is 0.42 percent, the contribution of improvement in within sector productivity is 0.53 percent per year and the contribution of changes in sectoral composition is –0.11 percent per year. That is, if the sectoral composition had not change, the aggregate productivity would grow 0.53 per cent per year, instead of 0.42 percent. The major contribution to growth comes from the productivity increases in agriculture sector which is partly offset by the decline in productivity of financial and other services. In addition, the inverse effect of sectoral composition is due to the fact that people mostly moved from agriculture to service sector which has a lower productivity level than agriculture. In terms of total effect industry seems to be more important. It accounts 88 percent of total gains in productivity. In other words, people are moving away from a low productive sector, agriculture, causing productivity in this particular sector to increase. However, the excess labor from this movement engages in services, a much less productive sector. If they were to be employed in manufacturing instead, the productivity would have grown much faster.

To summarize, productivity levels and growth rates vary across sectors and across provinces considerably. It is not only changes in aggregate productivity level that matters but also the productivity levels of various sectors and the composition of aggregate output. In the following section I turn to investigating sectoral convergence across Turkish provinces.

4.2. Sectoral Convergence

To analyze sectoral convergence I use the same tools as before. Figure 9 shows the pattern of sigma convergence at the aggregate and sectoral levels. The dispersion in aggregate productivity increases until 1985 and shows a mild decline afterwards[10]. The same pattern is also observed for agriculture, manufacturing and services which together account 84 percent of total employment in 1990. For the remaining sectors the dispersion fluctuates around a slight downward trend.

Table 12 presents the results of beta convergence. The sectoral productivity variables are measured in logarithms of sectoral output per employee and expressed as deviations from the interprovincial average of logarithm of aggregate output per employee. As before, I find no evidence of convergence at the aggregate level. However, convergence rates vary across sectors significantly. While there is no evidence of convergence in agriculture and service

[10] The difference between this figure and the one for output per adult indicates that the age distribution and labor participation rate may play significant role in convergence process in Turkey. Some studies discussed the effects of age distribution to convergence (e.g. Lindh and Malmberg (1996)). But I prefer to leave it to subsequent research.

sector, all other sectors converge at a high speed, ranging from 4.8 per year in industry to 24.7 per year in construction. Estimates of long-run sectoral productivities also vary significantly across sectors. The estimated steady state of agriculture and services are far below than the average.

Table 13 reports the results of fixed effects models for each sector. Aggregate productivity converges at a speed of 15.1 percent per year once the steady states are allowed to vary across provinces. The estimated speeds of convergence across sectors vary in this specification as well. Especially in trade and transportation/public utilities sectors the rate of convergence is dubiously high. The slowest sector is services again.

Table 13 also reports the standard deviations in 1990 and estimated steady states across provinces. For all sectors the dispersion of steady states is lower than the dispersion in 1990, but it is just the opposite for the aggregate measure. This is only possible if sectoral composition plays an important role. That is, if provinces specialize in certain sectors and specialization do not improve productivity as fast as the rate of specialization.

To quantify the contribution of changing sectoral composition to convergence, I will imitate Bernard and Jones (1996) once again. The productivity difference between a province and a benchmark to which all provinces are converging is defined as

$$\%\Delta y_{leader} - \%\Delta y_{follower} = \Sigma[PGE_{leader}-PGE_{follower}] + \Sigma[SE_{leader}-SE_{follower}]$$

As discussed in Bernard and Jones (1996), the choice of the benchmark (leader) is quite difficult. Choosing the state with the highest productivity level would allow idiosyncrasies of that particular province to derive the results. As suggested by them, I use productivity level of Turkey as the benchmark. If the productivity level of a particular province is below the productivity level of Turkey, than Turkey is the “leader” relative to that province, if otherwise, Turkey is the “follower”.

The results for the sectoral decomposition of convergence are given in Table 14. The emerging picture is somewhat different than the sectoral contributions to productivity growth. For an average province, three quarters of observed convergence is due to convergence within sector productivity levels. Significant within sector productivity convergence, however, occurs only in two low productivity sectors, services and agriculture. For the rest of the sectors, within sector productivity levels are diverging. On the other hand, changes in sectoral shares explain one quarter of aggregate convergence. The fact that labor is moving away from agriculture contributes significantly to convergence. The evidence suggests that convergence occurs mostly when employment shifts from low productive sectors to high productive ones and not because initially less productive provinces are catching up with the rest. There is also some indication that productivity catch-up occurs only in low productive sectors.

It should be noted that figures in this table are for average province and they mask the heterogeneity across provinces. It should also be noted that massive migration from agricultural provinces to industrial provinces in Turkey is a major part of the employment shift which is not covered in this paper due to the lack of detailed data on migration. Nevertheless, the analysis strongly suggests the importance of sectoral movements in convergence process.

5. Conclusion

In this paper I investigated convergence across Turkish provinces. Unlike their counterparts in developed world, provinces in Turkey are converging only conditionally. Increasing education of females contribute to the convergence process, but male education seems to have a surprising negative effect. It has been also found that fertility plays an important role in explaining growth of provinces while migration and public investment have positive effects as expected though very small. It is also found that estimated steady states differ significantly across provinces and the major determinant of the position of the steady state is the initial condition.

The paper also reports large heterogeneity of productivity across sectors and across provinces in Turkey. There is evidence of convergence in most of the sectors except agriculture and services, the two low productivity sectors which seem to drive the results for the aggregate productivity measure. Some evidence is also provided that changes in sectoral composition of output has significant effects on growth and therefore on convergence.

The results in this paper call for further research on convergence across regions of developing and less developed countries. The convergence pattern found for Turkey indicates that there might exist some differences between the two sets of countries. The paper also attempted to underline the importance of sectoral composition. The results suggest that there are lessons to be learned by examining changes in sectoral productivity and sectoral shifts in employment.

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Table 1: Cross-sectional Convergence Regressions 1975 - 1995

	Basic equation		Equations with regional dummies		Equations with structural variables & regional dummies	
Period	***β***	***R^2 [σ]***	***β***	***R^2 [σ]***	***β***	***R^2 [σ]***
1975 – 1990	-0.0066 (0.0042)	0.0406 [0.0113]	0.0062 (0.0065)	0.2550 [0.0104]	0.0104 (0.0097)	0.2597 [0.0105]
1975 – 1980	-0.0064 (0.0127)	0.0043 [0.0326]	0.0344 (0.0165)	0.3268 [0.0281]	0.0405 (0.0237)	0.3288 [0.0283]
1980 – 1985	-0.0145 (0.0071)	0.0583 [0.0228]	-0.0034 (0.0094)	0.1950 [0.0221]	-0.0013 (0.0108)	0.2000 [0.0223]
1985 – 1990	0.0051 (0.0106)	0.0030 [0.0386]	0.0135 (0.0148)	0.0692 [0.0392]	0.0078 (0.0148)	0.0939 [0.0390]
1990 – 1995	0.0156 (0.0064)	0.0685 [0.0251]	0.0294 (0.0185)	0.1754 [0.0248]	0.0301 (0.0169)	0.2601 [0.0237]
Joint, 4 periods	-0.0073 (0.0029)		0.0035 (0.0051)		0.0028 (0.0057)	
LR statistics (p-value)	4.5145 (0.2110)		6.3737 (0.0948)		5.3325 (0.1490)	

Non-linear least squares estimation. Standard errors of estimates are in parentheses.
The estimated coefficients for regional dummies and structural variables are not reported.
The likelihood ratio statistics refers to a test of the equality of the β coefficient over four periods.
The p-value comes from a χ^2 distribution with three degrees of freedom.
Regional dummies are for Marmara, Aegean, Black Sea, Mediterranean, Central Anatolia, East and Southeastern Anatolia regions. See Table in the appendix for a list of provinces contained in each region.

Table 2: Cross-sectional Convergence Regressions with Additional Variables

Variable		
Initial Output	0.0071 (0.0056)	0.0086 (0.0062)
Logarithm of Male Education	-0.0354 (0.0194)	-0.0326 (0.0183)
Logarithm of Female Education	0.0273 (0.0087)	0.0165 (0.0091)
Logarithm of Fertility		-0.0204 (0.0131)
LR statistics (p-value)	9.5293 (0.3899)	16.2534 (0.1799)

Non-linear least squares system estimation. Standard errors of estimates are in parentheses. Each equation contains regional dummies and structural variables for each of the four sub-periods defined in the previous table. The estimated coefficients for regional dummies and structural variables are not reported.

The likelihood ratio statistics refers to a test of the equality of the reported coefficients over four periods. The p-value comes from a χ^2 distribution with 9, and 12 degrees of freedom in column one and two, respectively.

Table 4: Regressions for Net Migration into Turkish Provinces 1975 – 1990

Period	Initial Income	Density	Square of Density	R^2 [σ]
1975 – 1980	0.0552 (0.0009)	4.5E-04 (1.0E-04)	-5.5E-07 (1.3E-07)	0.8011 [0.0187]
1980 – 1985	0.0245 (0.0009)	2.2E-04 (8.3E-05)	-2.1E-07 (9.2E-08)	0.7649 [0.0162]
1985 – 1990	0.0505 (0.0101)	2.2E-04 (1.0E-04)	-1.4E-07 (9.6E-08)	0.8096 [0.0261]
Joint, 3 sub-periods	0.0446 (0.0007)	Individual Coefficients	Individual Coefficients	

Equations are estimated using SUR. Standard errors of estimates are in parentheses.
The regression includes regional dummies and structural variables for each period for which the estimates are not reported.

Table 5: Regressions for Growth with Net Migration 1975 – 1990

	Migration Excluded	Migration Included		Migration Included (Instrumental Variables)	
Period	β	β	Migration	β	Migration
1975 – 1980	0.0310 (0.0179)	0.1005 (0.0374)	0.6039 (0.1939)	0.0307 (0.0209)	-0.0071 (0.2085)
1980 – 1985	-0.0009 (0.0235)	0.0215 (0.0293)	0.5373 (0.3079)	-0.0018 (0.0231)	0.6175 (1.0113)
1985 – 1990	0.0061 (0.0127)	0.0054 (0.0138)	-0.0083 (0.0964)	0.0050 (0.0121)	-0.2058 (0.2421)
Joint, 3 sub-periods	0.0204 (0.0071)	0.0451 (0.0106)	0.2358 (0.0939)	0.0183 (0.0067)	-0.0789 (0.1436)

Non-linear least squares estimation. Standard errors are in parentheses.
In joint estimations the coefficients on initial income and migration are held constant across periods.
Instruments in the last column are the variables used in Table 4.

Table 6: Panel Estimation

Province	Estimated Fixed Effects	Province	Estimated Fixed Effects	Province	Estimated Fixed Effects
ADA	0.3319	ELA	0.1515	MRS	-0.0107
ADI	-0.2166	EZC	-0.2812	MUG	0.4422
AFY	-0.2208	ERZ	-0.4289	MUS	-0.7446
AGR	-0.8713	ESK	0.3205	NEV	0.2700
AMA	-0.1349	GAZ	0.0639	NIG	-0.0996
ANK	0.4269	GIR	-0.3509	ORD	-0.4635
ANT	0.2553	GUM	-0.6140	RIZ	0.0854
ART	0.1065	HAT	0.1486	SAK	0.1079
AYD	0.2428	ISP	-0.1127	SAM	0.0534
BAL	0.2256	ICE	0.5174	SIN	-0.1632
BIL	0.5010	IST	0.7212	SIV	-0.3447
BIN	-0.7859	IZM	0.6690	TEK	0.4376
BIT	-0.7330	KAR	-0.7208	TOK	-0.2005
BOL	0.2416	KAS	-0.0421	TRA	-0.0940
BRD	0.1339	KAY	-0.0159	TUN	-0.5777
BRS	0.5059	KKL	0.4840	URF	-0.3518
CKK	0.3925	KIR	-0.0571	USA	-0.0437
CAN	-0.3510	KOC	1.2674	VAN	-0.5671
COR	-0.0047	KON	0.0866	YOZ	-0.3757
DEN	0.2371	KUT	0.2625	ZON	0.2699
DIY	-0.0584	MAL	-0.1067	SMH	-0.3499
EDI	0.2061	MAN	0.3276		
Std. Dev. Est. SS.	0.4101				
Std. Dev 1995 Output	0.4389				
Convergence Coefficient	0.2399 (0.0210)				

* Insignificant.

** Significant at 10% significance level.

Table 7: Explaining Cross Sectional Distribution of Steady States

Variable		
Constant		-0.0978
		(0.3028)
Initial Condition	1.1026	0.8905
	(0.0674)	(0.0818)
Male Education		-0.1443
		(0.2521)
Female Education		0.0626
		(0.1315)
Fertility		-0.5131
		(0.1474)
Public Inv. – Output Ratio		0.5086
		(0.4407)
R^2	0.8070	0.8694

Table 8: Productivity Levels and Variation Across Provinces

	1975		1990	
	Average	Coef. Of Variation	Average	Coef. Of Variation
Agriculture	978,847	28.40	1,113,224	47.01
Manufacturing	4,675,426	71.65	5,781,761	81.17
Construction	5,563,940	59.36	4,081,622	63.51
Domestic Trade	6,877,793	33.27	7,325,122	43.05
Transp./Pub. Util.	9,954,282	26.09	13,740,519	49.49
Financial Inst.	12,623,857	39.68	4,458,580	58.44
Services	498,384	49.53	312,298	81.84
Total	1,841,223	52.03	2,451,059	59.19

Averages are across provinces and expressed in 1987 TL.

Table 9: Average Growth Rates

	Turkey	Average	Std. Dev.
Agriculture	0.88	0.43	2.30
Manufacturing	1.01	0.73	3.95
Construction	-1.32	-1.90	5.83
Domestic Trade	0.05	0.15	2.40
Transp./Pub. Util.	2.17	1.72	2.62
Financial Inst.	-2.42	-7.01	3.44
Services	-0.02	-4.38	3.49
Total	2.20	1.52	2.13

Table 10: Employment and Output Shares for Average Province

	Employment Share		Output Share	
	1975	1990	1975	1990
Agriculture	75.80	63.66	56.15	34.68
Manufacturing	6.60	8.93	12.28	18.81
Construction	2.66	4.31	5.88	7.15
Domestic Trade	3.32	5.75	10.77	17.22
Transp./Pub. Util.	2.36	2.94	10.48	16.97
Financial Inst.	0.68	1.37	2.04	2.68
Services	8.58	13.04	2.40	2.49

Table 11: Sources of Productivity Growth

	PGE	%	SE	%	Total	%
Agriculture	0.49	116	-0.89	-209	-0.39	-92
Manufacturing	0.18	43	0.19	46	0.38	88
Construction	0.03	7	0.11	25	0.14	32
Domestic Trade	0.03	8	0.17	40	0.20	48
Transp./Pub. Util.	0.08	18	0.05	11	0.12	29
Financial Inst.	-0.03	-7	0.03	8	0.01	1
Services	-0.25	-59	0.22	53	-0.03	-7
Total	0.53	126	-0.11	-26	0.42	100

Table 12: Unconditional Sectoral Convergence

	Convergence Rate	Sectoral Steady State	R^2	SEE
Agriculture	0.0132 (0.0091)	-0.0183 (0.0061)	0.0088	0.0524
Manufacturing	0.0483 (0.0143)	0.0243 (0.0126)	0.0765	0.0985
Construction	0.2474 (0.0915)	0.0915 (0.0141)	0.4012	0.1091
Domestic Trade	0.0890 (0.0172)	0.0721 (0.0162)	0.1758	0.0849
Transp./Pub. Util.	0.0612 (0.0151)	0.0988 (0.0233)	0.0982	0.0738
Financial Inst.	0.0739 (0.0104)	0.0086 (0.0107)	0.2189	0.0670
Services	-0.0035 (0.0067)	-0.0531 (0.0110)	0.0016	0.0643
Total	-0.0052 (0.0053)	-	0.0049	0.0374

Non-linear least squares estimation. Standard errors are in parentheses. The last column reports standard errors of the regression.
The sectoral productivity variables are measured in logarithms of sectoral output per employee and expressed as deviations from the interprovincial average of logarithm of aggregate output per employee

Table 13: Sectoral Fixed Effects Model

	Convergence Rate	R^2	SEE	Std. Dev. Of 1990 Productivity	Std. Dev. Of Steady State Productivity
Agriculture	0.3814 (0.0927)	0.6284	0.0347	0.4667	0.4140
Manufacturing	0.3885 (0.1494)	0.5760	0.0717	0.7350	0.6423
Construction	0.5901 (0.5444)	0.6619	0.0846	0.5633	0.4096
Domestic Trade	1.7155 (0.0544)	0.6956	0.0517	0.4806	0.4722
Transp./Pub. Util.	1.7241 (0.0593)	0.7131	0.0489	0.4438	0.4316
Financial Inst.	0.2948 (0.0778)	0.5726	0.0555	0.3496	0.2719
Services	0.2579 (0.0485)	0.6440	0.0274	0.8839	0.5587
Total	0.1509 (0.0259)	0.5801	0.0448	0.5680	0.8751

Non-linear least squares estimation. Standard errors are in parentheses. The last column reports standard errors of the regression.
The sectoral productivity variables are measured in logarithms of sectoral output per employee and expressed as deviations from the interprovincial average of logarithm of sectoral output per employee

Table 14: Sources of Convergence

	PGE	%	SE	%	Total	%
Agriculture	0.08	39	-0.13	-62	-0.05	-23
Manufacturing	-0.06	-31	0.05	25	-0.01	-6
Construction	-0.08	-38	0.01	6	-0.06	-32
Domestic Trade	-0.03	-14	0.05	25	0.02	11
Transp./Pub. Util.	0.00	1	0.01	5	0.01	6
Financial Inst.	-0.01	-4	0.02	12	0.02	8
Services	0.25	123	0.02	12	0.27	135
Total	0.15	76	0.05	24	0.20	100