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# Conditional Convergence and Future TFP Growth in Israel

**Shay Tsur* and Eyal Argov****

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* Bank of Israel, Research Department and Tel-Aviv University (shay.tsur@boi.org.il)
** Bank of Israel, Research Department (eyal.argov@boi.org.il)



חטיבת המחקר, בנק ישראל ת״ד 780 ירושלים 91007
Research Department, Bank of Israel, POB 780, Jerusalem, Israel 91007

# Conditional Convergence and Future TFP Growth in Israel

Eyal Argov and Shay Tsur *

**Abstract**

This study is part of a broad project of constructing a long-run growth model for Israel, and to evaluate how different exogenous developments, or policy steps, are expected to affect the long run growth rate. The current study describes the Total Factor Productivity (TFP) block of the project. We first estimate productivity determinants in regressions that are based on a cross section of countries with fundamental variables such as geography and culture, together with policy affected variables such as physical and human infrastructures, and institutions. We test the robustness of the policy estimates by running panel regressions with policy variables for which historical data are available. Using the estimates from the cross section regressions we calculate the gap of each country's productivity from its own predicted value, and forecast Israel's TFP growth by using this calculated gap as the potential to converge and therefore to grow faster than the average world growth rate. In this respect, this work is novel in integrating the deep roots of growth literature into a conditional convergence framework. We find that Israel's actual productivity level is slightly below the predicted one, suggesting that it has only a small potential to grow faster than the average global growth. The baseline TFP growth forecast for the years 2015–60 is 0.47, very similar to the historical growth rate of Israel's TFP over the last 15 years.

JEL classification:
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# התכנסות מותנית ועתיד הצמיחה בפריון הכולל בישראל

**שי צור ואיל ארגוב**

**תקציר**

עבודה זו היא חלק מפרויקט מקיף לבניית מודל לחיזוי הצמיחה במשק הישראלי בטווח הארוך, ולהערכת ההשפעה של התפתחויות אקסוגניות או צעדי מדיניות על קצב הצמיחה. העבודה הנוכחית מתארת את רכיב הפריון הכולל בפרויקט. אנו אומדים ראשית בנתוני חתך את התוצר לעובד במשוואה שבה המשתנים המסבירים הם משתנים יסודיים כגון גיאוגרפיה ותרבות ומשתנים שמושפעים ממדיניות כגון איכות ההון האנושי, רמת התשתיות ואיכות המוסדות. אנו בוחנים את עמידות מקדמי האמידה בעזרת אמידת פאנל שכוללת את משתני המדיניות שלהם זמינים נתונים לאורך זמן מספק. לאחר מכן אנו מחשבים מהו הפער בין התוצר לעובד בפועל בכל מדינה לבין התוצר לעובד החזוי על סמך ערכי המשתנים המסבירים בשנת 2010 ומקדמי הרגרסיה. פער זה משקף את הפוטנציאל של הפריון הכולל בישראל לצמוח מהר יותר מקצב הצמיחה הממוצע שלו בעולם. השימוש במשתנים יסודיים ובמשתני מדיניות יחד במסגרת של רגרסיות התכנסות מהווה חידוש בספרות הצמיחה הכלכלית. אנו מוצאים שהתוצר לעובד בישראל נמוך במעט בהשוואה לערך החזוי לכלכלה על סמך משתני היסוד ומשתני המדיניות האופייניים לה. מכך אנו מסיקים שהפוטנציאל של הפריון הכולל בישראל לצמוח מהר יותר מהצמיחה של הפריון הממוצע בעולם מוגבל מאד. הצמיחה של הפריון הכולל בתרחיש הבסיסי בין השנים 2015-2060 צפויה לעמוד על 0.47%, בדומה לקצב של צמיחת הפריון הכולל בשנים 2000-2015.

# 1 Introduction

There are large differences in the standard of living and in productivity across countries. models of production-factor accumulation predict that poor nations will eventually converge to the standard of living in rich areas (Solow, 1956). However, this phenomena is barely observed in cross country data. The lack of convergence between nations' wealth has led the literature to focus on "conditional convergence" rather then on "global convergence". Barro (1991) found in cross section regressions that the growth rate of real GDP per capita is negatively correlated with the initial level of real GDP per capita, though only after controlling for each country's human capital. Barro and Sala-i Martin (1992) emphasized that it is more informative to look at the distribution of wealth conditional on various characteristics of each economy, such as government expenditure and political stability. They found that the importance of the inclusion of these characteristics increases the more heterogeneous the sample of economic units is: The inclusion of background characteristics was not important at all in a sample of US states, it increased the degree of the convergence in a sample of OECD countries, and it was essential for finding convergence in a sample of 96 countries around the world.

This paper uses deep roots of economic growth and policy variables in order to explain differences in GDP per worker (productivity) across countries and TFP (Total Factor Productivity) growth. We first estimate productivity determinants in a regression with geography, genetic diversity, culture and other common fundamental variables, together with policy affected variables such as physical and human infrastructure, and institutions indicators. Using the estimates from this regression we predict the "conditional productivity" of each country and the gap from this predicted level. Then, we estimate TFP growth using the initial gap from the predicted level as an explanatory variable.

The weakness of cross section convergence regressions is that the estimate of the convergence rate might be biased in the case of Omitted Variables (OVB) that are correlated with the initial level of GDP per capita. Islam (1995) employed a panel regression framework with country fixed effects in order to control for the basic unobserved characteristics of each country. That way he found a much more intensive degree of convergence, concluding that indeed, omitted variables were positively correlated with the initial level of GDP per capita. In a later study, Islam (2003) claimed that the OVB problem led the convergence literature to depart from the cross section framework. However, while the panel regression framework can more properly identify the speed of convergence, the country fixed effect predetermines the steady state level of the economy, unlike the cross section framework that defines the steady state of each country by the typical GDP per capita of countries with similar characteristics. Battisti, di Vaio, and Zeira (2018) use labor augmented TFP in a framework that avoids the use of endogenous explanatory variables. They claim that $\beta$-convergence should be interpreted as convergence of output per worker in each country to the productivity of that country, but not across countries.

In recent years, growth literature has abandoned the use of standard characteristics in convergence regressions Durlauf (2009), and it has focused on the deep roots of growth such as geography, culture, institutions, and policies. Our work exploits this growing literature to improve the cross section convergence regressions, in order to properly predict the typical potential path of each county, with a reduced risk of OVB. Using deep roots of growth has an advantage in that sense, since some of the variables that are used in the classic convergence regressions might be the result of the growth process rather than the cause of it.

In detail, there are two goals of our analysis: first, our study balances estimating the "clean" causal effect of policy variables on the level of productivity and achieving estimates with external validity. Estimating via cross section regressions the effect of policy variables on the level of productivity after controlling deep roots gets us closer to the causal effect of policy measures on long run standards of living. This way we measure the long run productivity of each country - as in Battisti, di Vaio, and Zeira (2018) - but based on a broad set of explanatory variables. We will verify the efficiency of our methodology by running a panel regression that includes those policy variables for which historical data is available. In the tradeoff between achieving a "clean" causal effect and achieving estimates with external validity, our estimates will have higher external validity compared to research that exploits a specific exogenous event in order to find a causal relationship between policy and growth, and higher internal validity compared to cross section regressions with policy variables alone. A second goal is to consider deep roots of economic growth and policy variables in a framework of conditional convergence, as it lets us predict future development of countries given a country's fundamental and current set of policies. This framework will also allow us ask questions about changes in the potential growth of a given country following a policy change.

This study is part of a broad project of constructing a long-run growth model to forecast Israel's GDP growth over a horizon of approximately 50 years given various assumptions, and to evaluate how different exogenous developments, or policy steps, are expected to affect the long run growth rate (Argov and Tsur, 2017). Previous projects in Israel were carried out by Geva (2013) and by Braude (2013), and global projects that focused on TFP forecast were carried out recently by Cette, Lecat, and Ly-Marin (2016) and Guillemette et al. (2017). Our long run growth model is built of several connected models. **The unifying model** combines, through an assumed production function, the forecasts for aggregate physical capital, human capital, and Total Factor Productivity (TFP) in order to forecast GDP. Physical capital evolves in accordance with the economy's investment which depends on three demographic variables (**demographic investment rate block**)—the fertility rate, life expectancy at birth and the old-age (65+) dependency ratio. A **general equilibrium model block** allows the Quantifying of how some structural changes affect the long run of the investment rate based on a static version of a general equilibrium micro-founded open economy model. The **effective human capital model block** aggregates the human capital of 84 population groups divided by gender, 5-year age group, and religion.

The effective human capital of each group is defined by its labor input as well as human capital from effective education years and from work experience. Labor input depends of the population size of the group, its labor force participation rate, its unemployment rate and its average hours per worker. The current study describes the **TFP model block** in detail.

Productivity in Israel was 13% lower compared to the average productivity among OECD countries in 2017. Since the OECD group of countries is very heterogeneous, Hazan and Tsur (2018) focused their comparison on six small and wealthy countries[1]. Using a development accounting framework, they showed that productivity in Israel is 30% lower compared to these countries due to a lower level of physical capital and a lower quality of human capital. In the current research, we forecast that productivity in Israel will get much closer to the OECD average, due to faster TFP growth. However, most of the gap compared to the average productivity among the six comparison countries will remain, as it has for the past 40 years, unless policy in Israel will be improved even faster than policy among the comparison countries.

The remainder of this paper is organized as follows: Section 2 discusses the deep determinants of income differences between nations. Section 3 describes the data used in this paper. Section 4 demonstrates the difference between global and conditional convergence based on the data and variables we use in the paper. Section 5 sets the empirical model for output per worker and TFP growth and shows the results. Section 6 illustrates future convergence patterns based on our results and focuses on the forecast for Israel, and section 7 concludes.

## 2 Deep Determinants of Income Differences

In the introduction (Section 1) we described the evolution of the literature from predicting global convergence following Solow (1956) to predicting "club" or a conditional convergence

[1] Austria, Denmark, Finland, Ireland, Netherlands and Sweden.

(Barro and Sala-i Martin, 1992). This evolution was accompanied by a literature that criticized growth theory for focusing solely on proximate causes rather than on fundamental causes of economic growth. As North and Thomas (1973) put it, "The factors we have listed (innovation, economies of scale, education, capital accumulation, etc.) are not causes of growth; they are growth" (p.2).

Acemoglu (2008) defines four groups of fundamental causes: geography; institutions; luck and multiple equilibria; and culture. Let us briefly survey a small sample of key papers regarding these fields.

The professional and popular book by Diamond (1997), *"Guns, Germs, and Steel"*, argues that differences in soil quality and fertility between Eurasia and other areas around the globe affected the ability of nations to build a complex organization and a hierarchy that positively influenced economic prosperity. Acemoglu, Johnson, and Robinson (2005) claimed that institutions, as broadly designed by European colonialism, have shaped economic differences between countries. Furthermore, they showed that there has been a reversal of fortune in income levels among former colonies. Jones and Olken (2005) found that leaders affect the economic growth of countries, and conclude that luck played a major role in cross country income differences. However, Acemoglu (2008) claims that the selection and the policy of leaders are part of the institutional explanations. Ashraf and Galor (2013) found that there is an optimum of genetic diversity within a country. They use the genetic diversity predicted by the prehistoric exodus of Homo sapiens out of Africa, and claim that there is a "tradeoff between the beneficial and the detrimental effects of diversity on productivity". Becker and Woessmann (2009) claim that Protestant economies prospered because the tradition of reading the Bible increased human capital. They found that Protestantism indeed led to higher economic prosperity and better education. A related study relevant for the Israeli context (Botticini and Eckstein, 2007) suggests that Judaism enforced a religious norm of studying that has influenced Jewish economic and demographic history. Our study uses variables from the groups of causes we briefly reviewed above, as deep explanatories of the level of productivity.

## 3 The Data

The initial level of country specific productivity gap, as well as the parameters that determine the marginal effect of different variables on productivity, are derived from a cross country regression of the (log) level of actual GDP per worker in 2010 on a set of fundamental and policy variables. Country level macro data, such as GDP per worker and TFP, are taken from Penn World Tables. The fundamental (deep root) variables are taken from a variety of studies that explored the deep roots of growth, as organized in Ashraf and Galor (2013): (1) **Neolithic transition** is the number of years (in thousands) that elapsed since agriculture became the primary mode of subsistence; (2) **Arable land** is the fraction of total land area that is arable, as reported by the World Bank's World Development Indicators; (3) **Population in tropical** is the percentage of a country's 1995 population that lives in tropical areas; (4) **Distance to waterway** is the average across the grid cells of a country, in thousands of kilometers, from an ice-free coastline or sea-navigable river; (5) **OPEC dummy** equals 1 for countries that are members in the Organization of the Petroleum Exporting Countries; (6) **Genetic diversity** is the expected heterozygosity (genetic diversity) as predicted by migratory distance from East Africa (Ashraf and Galor, 2013);(7) **Ethnic fractionalization** is the probability that two randomly selected individuals will belong to different ethnic groups; (8) **Religion controls** include variables that represent the share of Muslims, the share of Catholics and the share of Protestants in the country. As for the policy variables: (1) **Doing Business** is the country's "Distance to Frontier" in the World Bank's indicator which measures the ease of doing business in several areas; (2) **Economic Freedom** is an index that covers 12 areas, such as property rights and financial freedom, in 186 countries since 1970; (3) Data on **the quality of roads**—a principal component of indicators for the quality of roads, based on indices taken from the "International Road Federation"; (4) Data on **communication infrastructures**—main telephone lines and mobile phones per 1,000 workers, as published by the World Bank, based on the International Telecommunications Union; (5) Data on the quality of education: **Test scores** for the years 1995–2010, standardized over time, across subjects (Math, Reading and Science), schooling levels, and various international and regional assessments. These data were obtained from the World Bank, based on a study by Angrist, Patrinos, and Schlotter (2013). (6) **Inequality in education** is represented by Gini coefficients of education provided by Ziesemer (2016) for 146 Countries for the years 1950-2010, based on data from Barro and Lee (2013). These Gini coefficients were calculated based on a methodology that was first developed by Thomas, Wang, and Fan (2001) and Castelló and Doménech (2002). The regression will include approximately 70 developing and advanced economies, among them Israel[2].

Figures 6-8 present the order of the countries over the policy oriented variables that were described above. Israel's transportation infrastructures are at the middle of the distribution of OECD countries, whereas its communication infrastructures are at the top of the distribution. Regarding the quality of institutions, Israel is at the middle of the distribution of countries with GDP per capita above 5000$, but it is at the bottom of the OECD countries distribution. Israel is at the bottom of the distribution of the grades in national tests, and within OECD countries, its grades are only better than Mexico and Turkey. Israel is in a better place when looking at the inequality of years of schooling, but indicators for inequality in the quality of education, which are not presented and not analyzed in this study, show that educational opportunities in Israel are low.

# 4 Past Convergence Patterns

We begin the empirical analysis with basic cross section convergence regressions using the deep root variables we employed for our study (described in Section 3). These variables are organized in Ashraf and Galor (2013) as part of a larger set of controls, and we reduced the

[2]The precise number depends on data availability for each specification

list by omitting variables with negative R squared adjusted in a partial regressions analysis. The variables that survived this analysis will be used in the rest of the regressions as well.

Table 1 presents the results of regressions that are formally represented by:

$$\Delta prod_{i(1980-2010)} = \alpha + \beta prod_{i1980} + \gamma Fundamentals_i \tag{1}$$

Where:

$prod_{i1980}$ is GDP per worker in country $i$ in 1980, and $\Delta prod_{i(1980-2010)}$ is the average annual growth rate in the period 1980-2010.

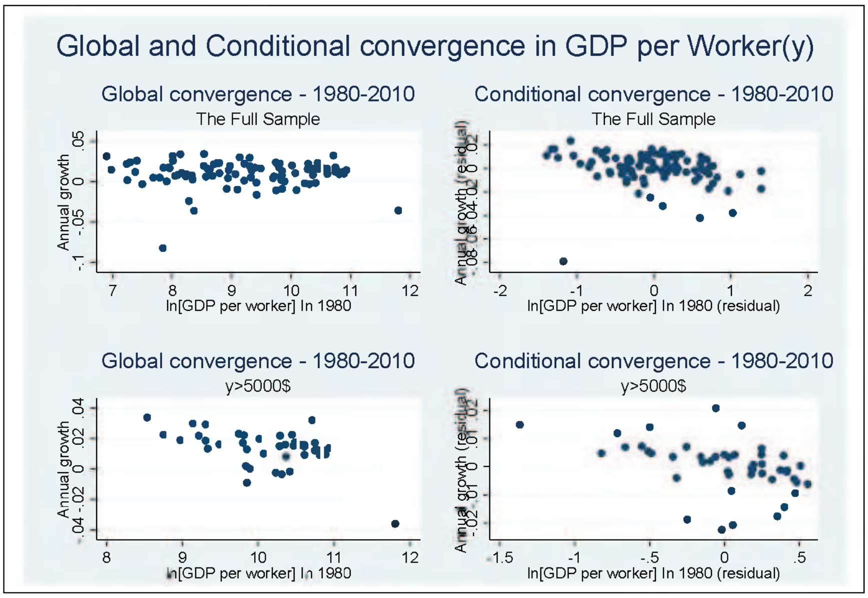
$Fundamentals_i$ is the country level set of fundamental variables.

$\beta$ is the convergence parameter.

The results show that "global convergence" - the value of $\widehat{\beta}$ without conditioning on $Fundamentals_i$ is not significant among the full sample of countries. Controlling for the set of $Fundamentals_i$ yields a significant negative estimate for "$\beta$ convergence": the growth rate of a country is lower as its initial productivity in 1980 is higher. These findings can also be seen graphically in Figure 1: without controlling for fundamentals no link between the growth rate and the initial level of income can be found, whereas after controlling for fundamentals, we observe a clear negative slope.

As for the sample of countries with annual GDP per capita above 5000$, "$\beta$ convergence" is also found without controls, but $\widehat{\beta}$ is slightly stronger after adding controls. Our findings are consistent with those of Barro et al. (1991), but as already explained, using deep roots of growth in our regression is more useful, since some of the variables that are used in the classic convergence regressions might be the result of the growth process rather than the cause of it.

Figure 1:




# 5 Empirical Model for TFP Growth

## 5.1 Empirical Model Description

The empirical model set here is built to retrieve a few basic parameters: the marginal effect of fundamental and policy variables on the frontier path of GDP per worker and the distance of each country from its own frontier. These will be estimated from the first stage regression. The global TFP growth rate and the speed of convergence will be estimated from the second stage growth rate regression.

**First stage regression** In the first stage we estimate level regressions for each $t = 1965, 1970, ..., 2010$ of GDP per worker on a large set of fundamental and policy variables:

$$prod_{i,t} = \alpha + \beta_{t,1}\overline{Fundamentals_i} + \beta_{t,2}\overline{Policy}_{it} + \epsilon_{i,t} \qquad (2)$$

Where:

$\text{prod}_{i,t}$ is GDP per worker in country $i$ in period $t$,

$\overline{Fundamentals_i}$ is a country level set of fundamental variables such as geography, culture, luck and other determinants (described in Section 2).

$\overline{Policy_{i,t}}$ is a set of policy oriented variables such as institutions and growth enhancing policies in country $i$ at period $t$,

and $\epsilon_{i,t}$ is the error term.

Using the estimated coefficients from equation 2 we are able to fit a predicted value for GDP per worker for each country $i$ in period $t$ conditioned on its fundamentals and policy variables:

$$\widehat{prod_{it}} = \alpha + \widehat{\beta_{t,1}} \times \overline{Fundamentals_i} + \widehat{\beta_{t,2}} \times \overline{Policy_{i,t}} \tag{3}$$

The difference between the fitted GDP per worker and the actual GDP per worker represents the gap of each country from its own frontier path in period $t$ given its fundamentals and policy variables:

$$Gap_{it} = -\widehat{\epsilon}_{it} = \widehat{prod_{it}} - prod_{it} \tag{4}$$

**Second stage regression** In order to estimate the speed of convergence to the frontier path and the basic global growth rate of TFP, we will specify TFP growth in period $t$ as a function of the $Gap$ in period $t-1$ for each country $i$:

$$\Delta TFP_{i,t} = \delta_{g,t} + \rho Gap_{i,t-1} + \lambda_{i,t} \tag{5}$$

Where:

$\delta_{g,t}$ is the basic world growth rate that can get a differential value depending on the specific period $t$, using dummies for periods,

$Gap$ in equation 5 is calculated from a formula that is similar to equation 4, except that the variables that determine $\widehat{prod}_{it}$ in each period are the fundamental variables and only policy variables with sufficient historical data: the Economic Freedom Index, the quality of roads and the inequality in education.[3] The estimate $\rho$ represents a factor that determines the speed of convergence. In this we assume that the convergence in labor productivity is achieved through TFP. We will show the empirical basis of that assumption in the next section.

$\lambda_{i,t}$ is the error term that represents a stochastic shock to TFP growth of each country $i$ on period $t$.

After estimating equation 2, calculating $\widehat{prod}_{it}$ and $Gap_{it}$ as described in equations 3 and 4, and then estimating equation 5 we can predict $\Delta TFP$ for country $i$ in period $t+1$:

$$\Delta TFP_{i,t+1} = \delta_{g,\tilde{t}} + \rho \times Gap_{i,t} + \lambda_{i,t+1} \tag{6}$$

where:

$\tilde{t}$ is an average of a selected period dummies.

$$\text{and } \lambda_{i,t+1} = \begin{cases} > 0 & \text{predicting an exogenous positive shock} \\ < 0 & \text{predicting an exogenous negative shock} \\ = 0 & otherwise \end{cases}$$

## 5.2 Regression Results

Table 2 presents the results of regressions that include only the fundamental variables we control. The first four columns report specifications in which three groups of variables are gradually included in the regressions: Geography variables, Genetic Diversity variables and Culture. The time that has passed since the Neolithic transition is positively correlated with GDP per worker ($prod$), and after controlling for it, two other variables that are associated with strong agriculture are negatively correlated with $prod$: the share of arable land and proximity to waterway. The genetic diversity variables, as explored by Ashraf and Galor

[3] A full panel of the policy variables is not available.

(2013), affect *prod* positively at low enough values and negatively at high values. Most of the variables remain significant and with the same sign in the specification that includes the full set of fundamentals, except for Ethnic fractionalization which loses significance.

In Section 3 we described 6 policy variables. Along with 11 fundamental variables (grouped in 8 categories, of which three variables belong to the religion shares category and two to the genetic diversity category) we have a total of 17 controls. Including all of them in a single regression naturally yields some nonsignificant variables. Table 3 presents the estimates of the policy variables without controlling for the fundamentals, and the estimate for each policy variable separately, when controlling for the fundamentals. The estimates for the policy variables are significant in most cases with the expected direction. Since the degrees of freedom are very limited in our cross section of countries, including all variables together is not possible. Alternatively, there is a huge number of subsets of variable combinations, and choosing between them might be arbitrary and simplistic. Therefore, we decided to focus on specifications that include the full set of fundamentals, one institutions variable, one infrastructure variable, and one education variable. This strategy is somewhat similar to the one adopted by Sala-i Martin (1997), who ran around 2 million regressions in order to test which variables are the most correlated with prosperity. Sala-i Martin (1997) decided to include three fixed variables and three variables that changed from one specification to the other.

The 8 equations in Table 4 are the 8 combinations that our rule created. Tables 5–7 repeat the above analysis, that is presented in Tables 2–4, for a sample of countries with GDP per capita above 5000$.

The significance of the fundamental variables changes between the specifications, but most of them stay with the same sign and with a reasonable explanatory power. Regarding the policy variables, the doing business variable as well as the communication and the transportation infrastructures variables appear to be the most stable variables. The economic freedom variable is not significant together with other policy categories. Both educational variables seem to be strongly correlated with productivity only in the full sample. The positive and significant estimates based on the full sample are more consistent with recent studies, such as Hanushek and Woessmann (2012) that found a close relationship between educational achievement and GDP growth that is stable across country samples, and based on various specifications that address causality. They conclude that school policy can be an important instrument for intensifying growth.

In order to test the robustness of the estimates to basic differences between the economies in our sample that were not captured by the fundamentals variables—we also estimated panel regressions with policy variables and country fixed effects. Table 8 presents the results of these regressions with several combinations of the policy variables for which we have sufficient historical data. The estimate of the economic freedom variable is between 0.03 and 0.07 and is significant in the specification that includes the other two policy variables and conducted on the sample of countries with GDP per capita above 5000$. The estimates of the road quality variable are higher in the sample of countries with GDP per capita above 5000$, whereas the estimates of the educational inequality are higher in the full sample. All in all, the sizes of the estimates of the three policy variables are very similar to the sizes of these estimates in the cross section regressions that control for fundamental variables. Importantly, the relative effect of each policy area—infrastructure, Institutions, and educational quality—is kept. This similarity suggests that controlling for the fundamentals improved the validity of the estimates for the policy variables, including those policy variables that are only available for use in the cross section regressions.

Table 9 presents the estimate for the speed of convergence of productivity through TFP for the period 1980–2010. The estimate of the lagged gap represents $\rho$ from equation 5, and the constant represents $\delta$. The excluded period is 1985, so $\delta$ is the average growth in 1985–90, and the period dummies should be added according to the assumptions on the similarity between the patterns of growth over the world in the past and the patterns in the future. The estimate $\widehat{\rho}$ is lower when using only countries with GDP per capita>5000$

compared to the case in which we use the full sample. The estimate $\widehat{\rho}$ is similarly lower when limiting the sample only to OECD countries (not presented). The estimate $\widehat{\rho}$ is higher when we include policy variables in the regression. In interpreting the speed of convergence estimates, $\widehat{\rho} = 0.043$ (from equation 4) means that the annual estimate for $\rho$ is 0.009 (since the regressions use five-year intervals), leading to the conclusion that nearly 1% of the lagged gap of a country is added to the average global growth rate of productivity.

There may be concern that the estimate of $\widehat{\rho}$ reflects a policy designed to narrow the productivity gap within every five-year period, rather than TFP growth based on the convergence potential that fundamentals and past policies yield. To tackle this concern we run regressions that include the change in the policy variables during every five-year period (quality of roads, economic freedom and educational inequality). Interestingly, the estimate for the effect of the change in economic freedom on the growth of TFP is positive and significant, meaning that some convergence does take place through the effect of better policy in the short run. Nevertheless, we find that the estimate for $\widehat{\rho}$ is essentially robust to the adding of the change in policy variables.

Tables 10 and 11 present the estimate for the speed of convergence of productivity through physical and human capital. The estimates that are parallel to $\widehat{\rho}$ are not stable in the various specifications, they are not significant in all of them, and some of the estimates in the case of human capital are negative. These empirical findings support our assumption that the convergence in labor productivity is achieved mainly through TFP. The drivers of physical and human capital growth are dealt in depth in Argov and Tsur (2017).

# 6 Predictions

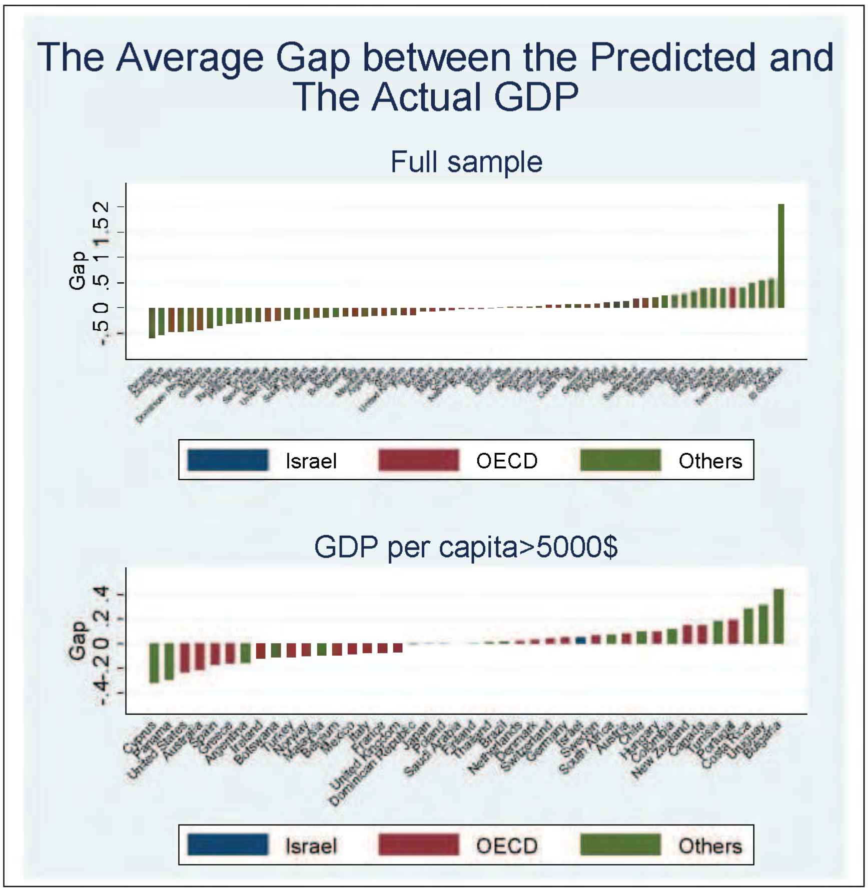
## 6.1 The Predicted Gap

As explained in the previous section, we would like to use information from several specifications that include all the fundamental variables, and three policy variables, one for each area—institutions, physical infrastructure, and educational quality. Although Israel belongs to the sample of the richer countries when it comes to general prosperity, we will take into account both the estimates that are based on the full sample and the estimates that are based only on countries with GDP per capita above 5000$ in 2000 (a total of 16 regressions). That is because Israel is in the lower end of the distribution in some of the policy affected variables (Figures 6-8), especially when it comes to institutions and to the quality of education among some population subgroups. Our preference for taking into account the estimates from the full sample is also based on the proximity that we mentioned in Section 5.2 between the quality of education estimates obtained in these specifications to other findings in the recent literature, such as Hanushek and Woessmann (2012). However, since the level of productivity in Israel is already high, we assume that the relevant average global growth rate in TFP and speed of convergence are those of the richer countries. Therefore we based these parameters on the sample of countries with GDP per capita that was above 5000$ in 2000 (equation 4 in Table 9).

There are several options for weighting the predicted gaps that result from the 16 level regressions. We decided to average between the predicted gaps from the 16 specifications. Figure 2 shows the average gap for each country in the sample. The analysis that uses the full sample finds that the average gap (between the predicted *prod* and the actual one) for Israel is positive but small. Developing countries such as Honduras, Senegal, Bulgaria and China are the countries with the largest positive gap, suggesting that these countries have a higher growth potential compared to the average, leading to the conclusion that they are rising toward the productivity level of richer countries. Countries at the left side of the graph have, according to our analysis, actual productivity that is higher than the one predicted for them based on the fundamental and policy variables that we use.

The analysis using the sample of countries with GDP per capita>5000$ finds just a slightly smaller gap for Israel. The gap for most of the other countries seems to be robust as well to the choice of sample.

Figure 2:



The Average Gap between the Predicted and
The Actual GDP
Full sample
Gap
-.5 0 .5 1 1.5 2
Israel
OECD
Others
GDP per capita>5000$
Gap
-.4 -.2 0 .2 .4
Cyprus
Panama
United States
Australia
Spain
Greece
Argentina
Ireland
Botswana
Turkey
Norway
Malaysia
Belgium
Mexico
Italy
France
United Kingdom
Dominican Republic
Japan
Poland
Saudi Arabia
Finland
Thailand
Brazil
Netherlands
Denmark
Switzerland
Germany
Israel
Sweden
South Africa
Austria
Chile
Hungary
Colombia
New Zealand
Canada
Tunisia
Portugal
Costa Rica
Uruguay
Bulgaria
Israel
OECD
Others

### 6.2 TFP Forecast for Israel

Using the calculation presented in equation 6 we create a long-term forecast for TFP growth. The baseline TFP growth for the years 2015–60 (0.47%) is in the proximity of the historical growth rate of Israel's TFP (0.5%, Figure 3), and this growth rate remains stable because it includes only a small component of positive convergence. The forecast reflects mainly the average TFP growth for the years 1990–2010 over the sample of countries with GDP per capita>5000$, which equals 0.39%. These years include mainly the period of ICT productivity wave (1990–2005) as well as a short period of slow growth (2005–10) associated with the global crisis. Choosing this combination of periods assumes that global growth is not facing a long period of slow TFP growth, but it also assumes that the speed of growth during the ICT revolution will not persist at the rate of the years 1990–2005. The convergence component of the Israeli economy contributes 0.08% to the annual TFP growth. Since the gap for Israel is 8.5% (in 2010) and the average gap for the OECD countries is around -2%, the Israeli productivity is expected to slowly close the lag (-13% in GDP per worker, and -24% in GDP per hour worked) vis-?-vis the OECD countries average productivity. This finding is somehow encouraging, although it is not driven by faster TFP growth in Israel compared to the past, but rather on slower growth in some OECD countries. Furthermore, most of the gap compared to the average productivity among six comparison countries that we mentioned in Section 1 will remain, since their average gap is 0, and Israel's lag compared to them is currently 30%.

The Minimum and the Maximum lines in Figure 3 represent the lowest and the highest TFP forecasts that were calculated based on the 16 specifications that produced the average TFP forecast. The spectrum of the 18 forecasts is narrow and balanced, 0.36%-0.57%. We conclude that the forecast is relatively robust to the selection of any of the specifications instead of using the average among them.

Figure 4 presents four additional scenarios for TFP growth. The first three scenarios are based on gaps that were calculated with better policy values—we added one standard deviation for each policy variable. The fourth scenario combines the three other improved scenarios. This graph essentially ranks the relative effect of the three policy variables, calculated based on the 16 specifications that produced the average TFP forecast. The graph shows that improving infrastructures by one standard deviation yields the biggest effect, the effect of better education is ranked second, and the effect of better institutions is ranked third. Improving the three policy variables by one standard deviation at the same time contributes 0.4% to the growth of TFP at the beginning of the forecast horizon. The contribution of the better policy gradually narrows, since the positive gap that was opened decreases from period to period along the process.

Figure 5 presents four other scenarios for TFP growth. The first three scenarios are based on hypothetical initial gaps that were calculated given that Israel achieves very good policy values; the value of each policy variable was set equal to the 95th percentile among countries with GDP per capita above 5000$. The fourth scenario combines these three policy scenarios. Unlike the scenarios that were presented in Figure 4, the scenarios that are presented in Figure 5 show the potential of the Israeli economy to improve by getting its policy closer to the best practice. The effect of improving infrastructure, improving the quality of education and improving institutions in Israel up to the 95th percentile is very similar. This finding reflects the relatively strong estimates of improving infrastructures on one hand, and the relative inferiority of the Israeli institutions and quality of education on the other hand. One should notice that we focus in this study only on the quality of education, whereas in Argov and Tsur (2017) deal with the contribution of the quantity of education. Better educational policy is expected to increase both the quantity and the quality of education. Therefore the effect of better educational policy that is presented here might be partial.

The effects that were reported here should be treated with some caution: while the basic differences between the economies were well controlled for using the fundamentals variable as well as the panel specifications, the threat of reverse causality cannot be ignored. We can't rule out the option that a growth process in a single country may lead to better policies. The effects that were reported here can provide a general direction for policy makers, but better assessing the potential contribution of a specific policy step should be based on more focused research.

Figure 3:

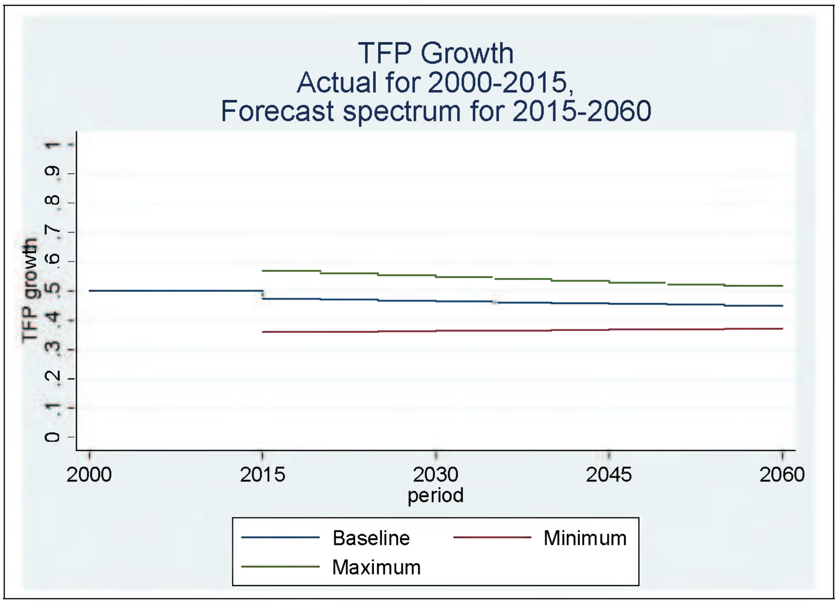


Figure 4:

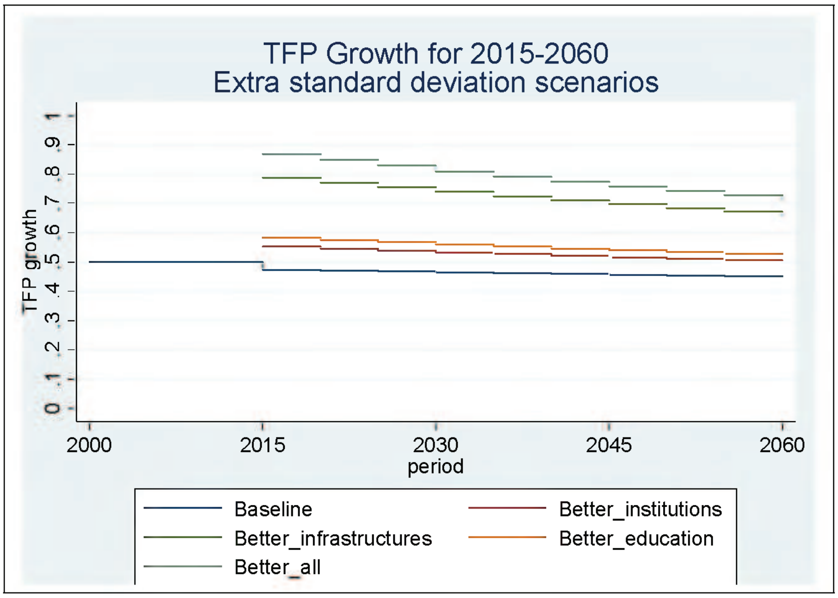
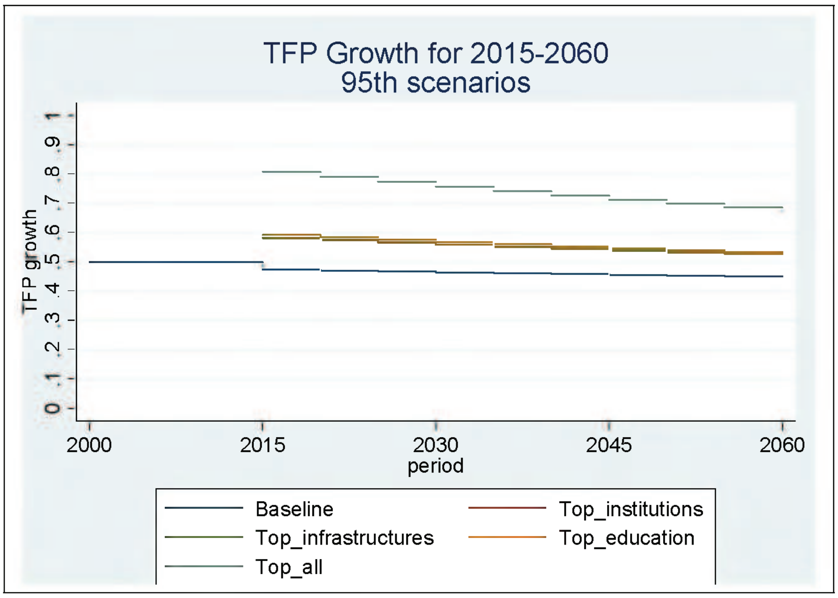



Figure 5:



# 7 Summary

The first goal of this study was to forecast TFP growth for Israel using a conditional convergence framework, as part of a broad project of constructing a long-run growth model over a horizon of approximately 50 years. Based on various specifications that include fundamental and policy affected variables, we forecast that the Israel's annual TFP growth will be 0.47% over this horizon. This TFP growth rate reflects the average global growth rate combined with a low positive convergence component, since the initial gap in Israel's GDP per worker was found to be small. The baseline forecast was obtained under the assumption that the current policy parameters will stay unchanged. The second goal of this study was to evaluate how different policy steps are expected to affect long run TFP growth. We found that better physical infrastructures contribute the most to TFP growth. However, taking into account the relatively extensive inferiority of the Israeli institutions and quality of education, the potential of the Israeli economy to grow by improving these policies is also large. Our broad project, and specifically the TFP growth forecast, is not intended just to produce a good guess for future growth. Rather, the goal is to establish a well-organized tool to help policy makers reach better considered decisions.

# References


Acemoglu, Daron. 2008. *Introduction to modern economic growth.* Princeton University Press.

Acemoglu, Daron, Simon Johnson, and James A Robinson. 2005. "Institutions as a fundamental cause of long-run growth." *Handbook of economic growth* 1:385–472.

Angrist, Noam, Harry A Patrinos, and Martin Schlotter. 2013. "An Expansion of a Global Data Set on Educational Quality: a Focus on Achievement in Developing Countries." *World Bank Policy Research Working Paper* (6536).

Argov, Eyal and Shay Tsur. 2017. "A Long Run Growth Model for Israel." *Bank of Israel - The Research Department. Discussion Paper, Forthcoming* .

Ashraf, Quamrul and Oded Galor. 2013. "Genetic Diversity and the Origins of Cultural Fragmentation." *The American Economic Review* 103 (3):528–533.

Barro, Robert J. 1991. "Economic growth in a cross section of countries." *The quarterly journal of economics* 106 (2):407–443.

Barro, Robert J and Jong Wha Lee. 2013. "A New Data Set of Educational Attainment in the World, 1950–2010." *Journal of Development Economics* 104:184–198.

Barro, Robert J and Xavier Sala-i Martin. 1992. "Convergence." *Journal of political Economy* :223–251.

Barro, Robert J, Xavier Sala-i Martin, Olivier Jean Blanchard, and Robert E Hall. 1991. "Convergence across states and regions." *Brookings papers on economic activity* :107–182.

Battisti, Michele, Gianfranco di Vaio, and Joseph Zeira. 2018. "Convergence and Divergence:New Data and New Results." .

Becker, Sascha O and Ludger Woessmann. 2009. "Was Weber wrong? A human capital theory of Protestant economic history." *The Quarterly Journal of Economics* 124 (2):531–596.

Botticini, Maristella and Zvi Eckstein. 2007. "From farmers to merchants, conversions and diaspora: Human capital and Jewish history." *Journal of the European Economic Association* 5 (5):885–926.

Braude, K. 2013. "A Long Term Forecast." *Bank of Israel - internal memo* (Hebrew).

Castelló, Amparo and Rafael Doménech. 2002. "Human Capital Inequality and Economic Growth: Some New Evidence." *The Economic Journal* 112 (478).

Cette, Gilbert, Remy Lecat, and Carole Ly-Marin. 2016. "Long-term growth and productivity projections in advanced countries." *OECD Journal: Economic Studies* 2016 (1).

Diamond, Jared. 1997. "Guns, steel and germs: The fate of human societies." *New York* .

Durlauf, Steven N. 2009. "The rise and fall of cross-country growth regressions." *History of Political Economy* 41 (Suppl_1):315–333.

Geva, A. 2013. "The Demographic Changes and their Consequences on Public Expenditure in the Years 2013-2059." *Bank of Israel Review* 87 (Hebrew):7–30.

Guillemette, Yvan, Alexandre Kopin, David Turner, and Andrea De Mauro. 2017. "A Revised Approach to Productivity Convergance in Long-Term Scenarios." *OECD Economics Department Working Papers* (1385).

Hanushek, Eric A and Ludger Woessmann. 2012. "Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation." *Journal of economic growth* 17 (4):267–321.

Islam, Nazrul. 1995. "Growth empirics: a panel data approach." *The Quarterly Journal of Economics* 110 (4):1127–1170.

———. 2003. "What have we learnt from the convergence debate?" *Journal of economic surveys* 17 (3):309–362.

Jones, Benjamin F and Benjamin A Olken. 2005. "Do leaders matter? National leadership and growth since World War II." *The Quarterly Journal of Economics* 120 (3):835–864.

North, Douglass C and Robert Paul Thomas. 1973. *The rise of the western world: A new economic history.* Cambridge University Press.

Sala-i Martin, Xavier X. 1997. "I just ran two million regressions." *The American Economic Review* :178–183.

Solow, Robert M. 1956. "A contribution to the theory of economic growth." *The quarterly journal of economics* :65–94.

Thomas, Vinod, Yan Wang, and Xibo Fan. 2001. *Measuring education inequality: Gini coefficients of education*, vol. 2525. World Bank Publications.

Ziesemer, Thomas. 2016. "Gini Coefficients of Education for 146 Countries, 1950-2010." *Bulletin of Applied Economics* 3 (2):1–8.

# 8 Appendix

The Codes and Full Names of The Variables in The Regression Tables

| Code | Full name |
|---|---|
| Log[y] 1980 | Log GDP per Worker in 1980 |
| Neolit | The years that elapsed since the neolithic transition |
| Arable | The fraction of arable land |
| Tropical | The fraction of population in tropical zones |
| W way | The average distance to waterway |
| OPEC | OPEC dummy |
| Div | Genetic diversity |
| Div sq | Genetic diversity squared |
| E frac | Ethnic fractionalization |
| Rel | Three variables: The Shares of Muslims, Catholics and Protestants |
| D Buis | Doing Business Index |
| Phones | Main telephone lines and mobile phones per 1000 workers |
| Grades | National tests scores |
| E Free | Economic Freedom index |
| Roads | The quality of roads |
| E Ineq | Inequality in education (Gini coefficients) |

Figure 6:

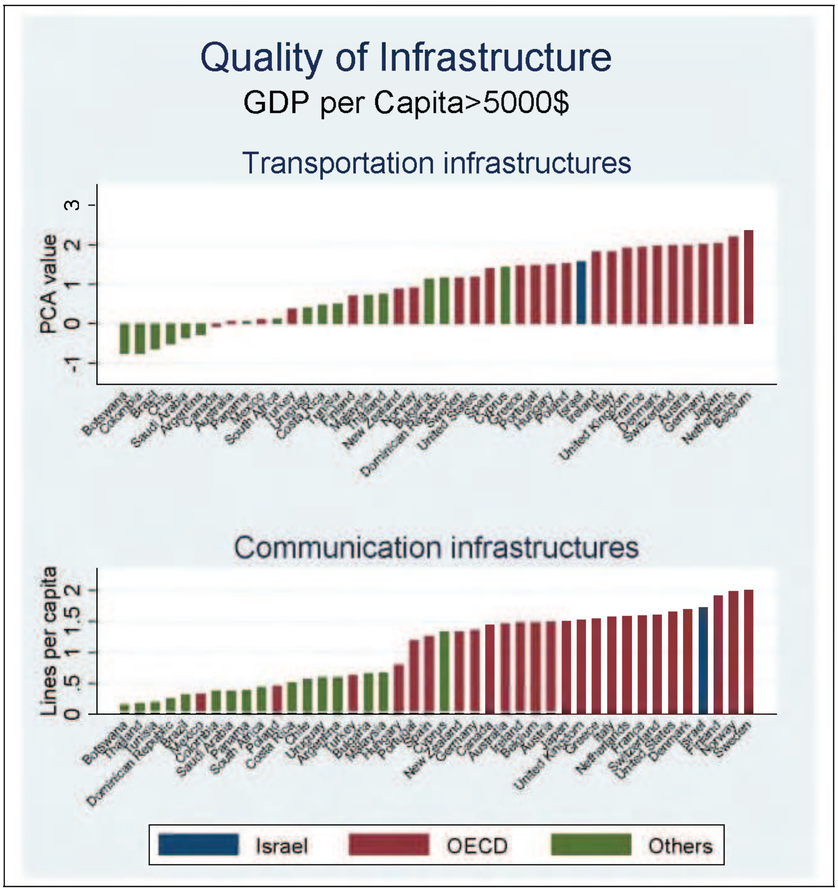
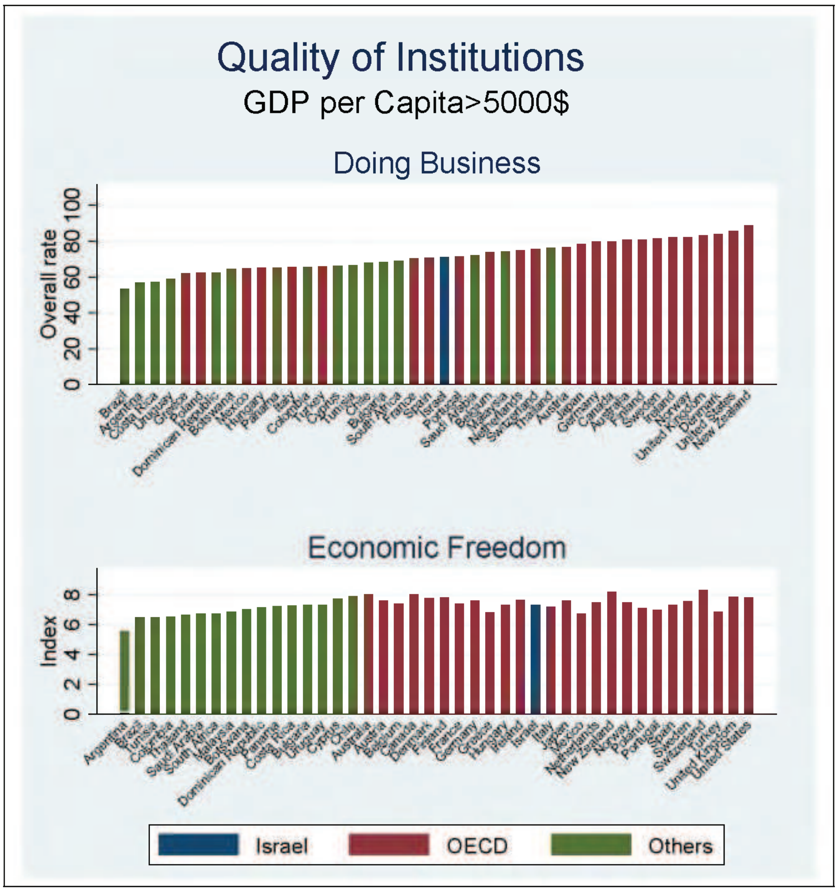
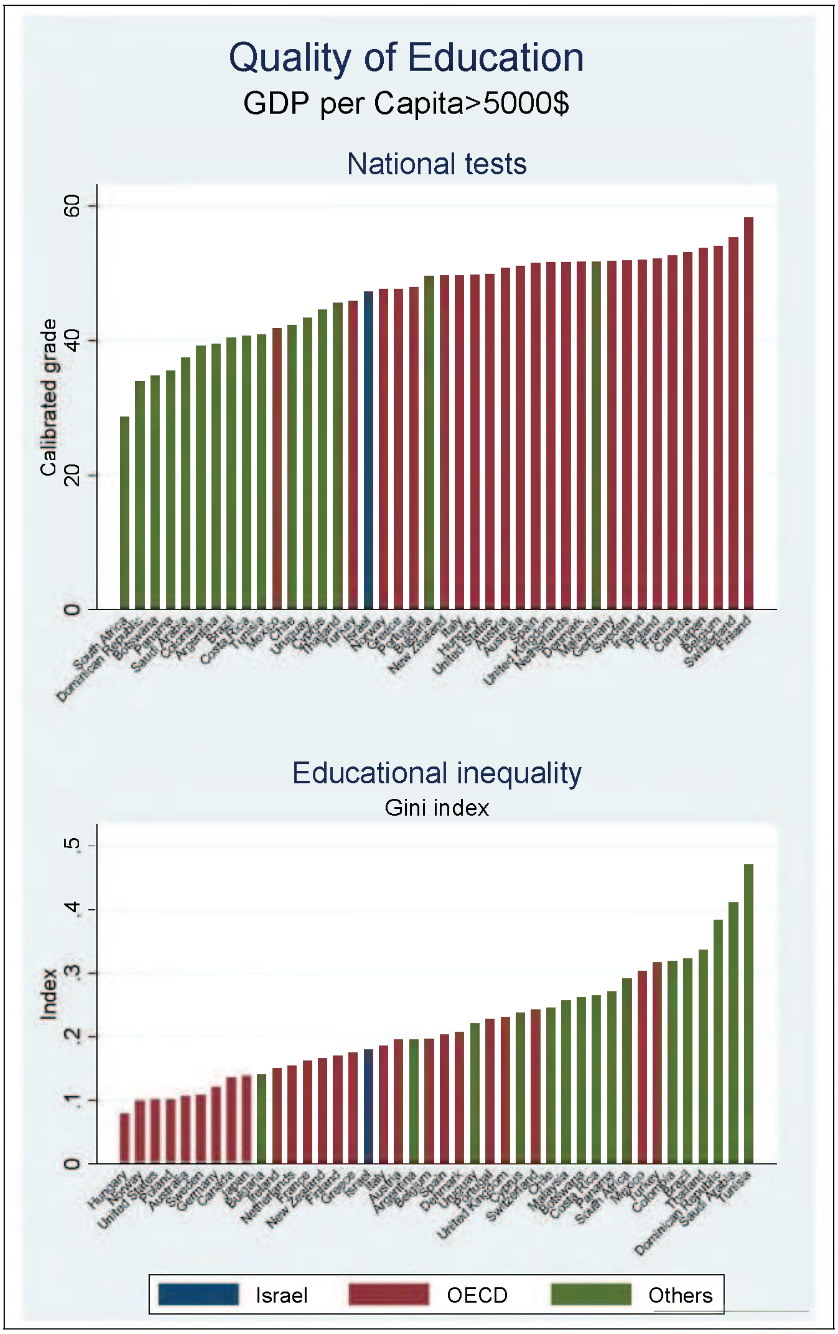

Quality of Infrastructure
GDP per Capita>5000$
Transportation infrastructures
PCA value
-1
0
1
2
3
Communication infrastructures
Lines per capita
0
.5
1
1.5
2
Israel
OECD
Others

Figure 7:



Quality of Institutions
GDP per Capita>5000$
Doing Business
Overall rate
0 20 40 60 80 100
Economic Freedom
Index
0 2 4 6 8
Israel
OECD
Others

Figure 8:



Quality of Education
GDP per Capita>5000$
National tests
Calibrated grade
0
20
40
60
Educational inequality
Gini index
Index
0
.1
.2
.3
.4
.5
Israel
OECD
Others

Table 1: Global and Conditional convergence in GDP per Worker

| | (1) The Full Sample growth | (2) The Full Sample growth | (3) GDP PC>5000 growth | (4) GDP PC>5000 growth |
|---|---|---|---|---|
| Log[y] 1980, | -0.000112 | -0.00499* | -0.00849*** | -0.00999*** |
| | (0.00145) | (0.00253) | (0.00231) | (0.00341) |
| Neolit | | 0.00849* | | 0.00733 |
| | | (0.00479) | | (0.00545) |
| Arable | | -0.00305* | | -0.00149 |
| | | (0.00163) | | (0.00153) |
| Tropical | | -0.0143*** | | -0.00321 |
| | | (0.00509) | | (0.00700) |
| W way | | -0.00940 | | -0.00297 |
| | | (0.00627) | | (0.00733) |
| OPEC | | -0.00608 | | -0.0172 |
| | | (0.00666) | | (0.0105) |
| Div | | 1.244 | | 5.521 |
| | | (2.387) | | (5.641) |
| Div sq | | -0.815 | | -3.801 |
| | | (1.688) | | (3.983) |
| E frac | | 0.00201 | | -0.00608 |
| | | (0.00810) | | (0.00867) |
| Rel | No | Yes | No | Yes |
| Const | 0.0107 | -0.466 | 0.0999*** | -1.944 |
| | (0.0135) | (0.840) | (0.0236) | (1.978) |
| Obs | 96 | 96 | 46 | 46 |
| AdjRsq | -0.011 | 0.149 | 0.218 | 0.345 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: The Effect of Fundamental Variables on GDP per Worker

| | (1) Log[y] | (2) Log[y] | (3) Log[y] | (4) Log[y] | (5) Log[y] |
|---|---|---|---|---|---|
| Neolit | 0.937*** | | 0.892*** | | 1.142*** |
| | (0.176) | | (0.180) | | (0.167) |
| Arable | -0.228*** | | -0.248*** | | -0.297*** |
| | (0.0724) | | (0.0716) | | (0.0638) |
| Tropical | -1.318*** | | -1.251*** | | -1.143*** |
| | (0.199) | | (0.199) | | (0.193) |
| W way | -1.400*** | | -1.201*** | | -1.063*** |
| | (0.246) | | (0.263) | | (0.237) |
| OPEC | 0.465 | | 0.512* | | 0.719*** |
| | (0.301) | | (0.292) | | (0.253) |
| Div | | 616.1*** | 294.7*** | | 306.7*** |
| | | (146.2) | (105.7) | | (93.68) |
| Div sq | | -439.7*** | -208.0*** | | -214.1*** |
| | | (103.3) | (74.92) | | (66.27) |
| E frac | | | | -2.308*** | -0.0624 |
| | | | | (0.388) | (0.338) |
| Rel | No | No | No | Yes | Yes |
| Const | 3.223** | -205.4*** | -100.5*** | 10.59*** | -108.2*** |
| | (1.508) | (51.65) | (37.04) | (0.350) | (33.00) |
| Obs | 96 | 96 | 96 | 96 | 96 |
| AdRsq | 0.616 | 0.163 | 0.640 | 0.296 | 0.739 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: The Effect of Fundamental and Policy Variables on GDP per Worker

| | (1) Log[y] | (2) Log[y] | (3) Log[y] | (4) Log[y] | (5) Log[y] | (6) Log[y] | (7) Log[y] | (8) Log[y] |
|---|---|---|---|---|---|---|---|---|
| Neolit | 1.121*** | | 0.614*** | 0.0508 | 0.390 | 0.929*** | 0.791*** | 0.739*** |
| | (0.220) | | (0.205) | (0.223) | (0.235) | (0.247) | (0.198) | (0.246) |
| Arable | -0.217** | | -0.200** | -0.0679 | -0.307*** | -0.204** | -0.457*** | -0.201** |
| | (0.0923) | | (0.0758) | (0.0708) | (0.0790) | (0.0913) | (0.0925) | (0.0870) |
| Tropical | -1.273*** | | -0.937*** | -0.394* | -0.974*** | -1.264*** | -0.879*** | -0.972*** |
| | (0.269) | | (0.229) | (0.234) | (0.232) | (0.265) | (0.241) | (0.274) |
| W way | -1.029*** | | -0.679** | 0.0138 | -0.877*** | -0.961*** | -0.0135 | -0.947*** |
| | (0.332) | | (0.281) | (0.286) | (0.279) | (0.330) | (0.351) | (0.314) |
| OPEC | 0.500 | | 0.394 | 0.406 | 0.446 | 0.587 | 0.295 | 0.496 |
| | (0.389) | | (0.320) | (0.285) | (0.324) | (0.387) | (0.331) | (0.366) |
| Div | 287.6** | | 133.9 | 89.39 | 175.1* | 276.7** | 124.1 | 226.9** |
| | (112.9) | | (97.17) | (87.28) | (96.69) | (111.4) | (101.0) | (108.2) |
| Div sq | -200.7** | | -90.62 | -60.01 | -120.0* | -193.2** | -88.22 | -158.3** |
| | (80.34) | | (69.21) | (62.12) | (68.86) | (79.32) | (71.65) | (77.00) |
| E frac | 0.365 | | 0.107 | 0.0959 | 0.486 | 0.293 | 0.307 | 0.490 |
| | (0.437) | | (0.362) | (0.322) | (0.365) | (0.433) | (0.369) | (0.414) |
| Rel | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes |
| D Buis | | 0.0232** | 0.0446*** | | | | | |
| | | (0.0106) | (0.00856) | | | | | |
| E Free | | -0.270** | | | | 0.231 | | |
| | | (0.132) | | | | (0.144) | | |
| Roads | | 0.0606 | | | | | 0.671*** | |
| | | (0.0889) | | | | | (0.140) | |
| phones | | 0.395*** | | 0.531*** | | | | |
| | | (0.0771) | | (0.0766) | | | | |
| Grades | | 0.00777 | | | 0.0612*** | | | |
| | | (0.0138) | | | (0.0123) | | | |
| E Ineq | | -0.158 | | | | | | -0.811*** |
| | | (0.185) | | | | | | (0.285) |
| Const | -101.3** | 7.660*** | -46.57 | -26.38 | -58.58* | -97.39** | -39.42 | -77.83** |
| | (39.56) | (0.689) | (34.11) | (30.86) | (34.05) | (39.06) | (35.74) | (38.10) |
| Obs | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| AdjRsq | 0.667 | 0.803 | 0.776 | 0.822 | 0.769 | 0.676 | 0.763 | 0.705 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: The Effect of Fundamental and Policy Variables on GDP per Worker

| | Policy variables combinations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] |
| Neolit | -0.0117 | 0.561** | 0.487** | -0.0329 | -0.0294 | 0.393* | 0.364* | 0.000774 |
| | (0.221) | (0.231) | (0.229) | (0.223) | (0.234) | (0.215) | (0.206) | (0.222) |
| Arable | -0.143* | -0.428*** | -0.445*** | -0.149* | -0.0724 | -0.357*** | -0.339*** | -0.0988 |
| | (0.0755) | (0.0954) | (0.0922) | (0.0774) | (0.0709) | (0.0872) | (0.0862) | (0.0696) |
| Tropical | -0.473** | -0.692*** | -0.806*** | -0.423* | -0.340 | -0.777*** | -0.639*** | -0.392* |
| | (0.226) | (0.248) | (0.231) | (0.230) | (0.240) | (0.217) | (0.224) | (0.230) |
| W way | -0.165 | -0.0406 | -0.296 | -0.146 | -0.0294 | -0.282 | -0.148 | -0.115 |
| | (0.283) | (0.345) | (0.351) | (0.286) | (0.288) | (0.332) | (0.310) | (0.280) |
| OPEC | 0.386 | 0.299 | 0.279 | 0.365 | 0.416 | 0.320 | 0.307 | 0.388 |
| | (0.273) | (0.328) | (0.320) | (0.281) | (0.289) | (0.297) | (0.291) | (0.275) |
| Div | 67.92 | 94.01 | 106.2 | 76.29 | 79.67 | 77.92 | 53.45 | 58.92 |
| | (84.37) | (99.09) | (96.06) | (85.02) | (87.74) | (91.70) | (90.41) | (85.07) |
| Div sq | -44.18 | -67.07 | -73.56 | -50.20 | -53.40 | -52.70 | -36.38 | -38.24 |
| | (60.07) | (70.25) | (68.16) | (60.53) | (62.43) | (65.11) | (64.20) | (60.55) |
| E frac | 0.148 | 0.410 | 0.455 | 0.240 | 0.163 | 0.235 | 0.236 | 0.117 |
| | (0.316) | (0.362) | (0.354) | (0.320) | (0.327) | (0.339) | (0.330) | (0.315) |
| Rel | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| D Buis | 0.0134 | | | | | 0.0256** | 0.0293*** | 0.0188* |
| | (0.0100) | | | | | (0.00980) | (0.00884) | (0.00946) |
| E Free | | -0.0258 | -0.130 | -0.0873 | 0.0108 | | | |
| | | (0.131) | (0.134) | (0.117) | (0.112) | | | |
| Roads | | 0.619*** | 0.437** | | | 0.323** | 0.398*** | |
| | | (0.151) | (0.168) | | | (0.159) | (0.140) | |
| phones | 0.360*** | | | 0.423*** | 0.491*** | | | 0.374*** |
| | (0.100) | | | (0.0907) | (0.0849) | | | (0.0989) |
| Grades | 0.0215 | | 0.0441*** | 0.0313** | | 0.0233 | | |
| | (0.0134) | | (0.0153) | (0.0137) | | (0.0152) | | |
| E Ineq | | -0.589** | | | -0.325 | | -0.484** | -0.327 |
| | | (0.253) | | | (0.236) | | (0.232) | (0.227) |
| Const | -19.20 | -27.65 | -32.44 | -21.25 | -22.50 | -23.87 | -14.64 | -16.07 |
| | (29.78) | (35.15) | (34.03) | (30.09) | (31.06) | (32.39) | (31.99) | (30.05) |
| Obs | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 66 |
| AdjRsq | 0.836 | 0.778 | 0.789 | 0.832 | 0.822 | 0.810 | 0.817 | 0.835 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: The Effect of Fundamental Variables on GDP per Worker

| | GDP per Capita>5000 | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] |
| Neolit | 0.679*** | | 0.564*** | | 0.711*** |
| | (0.181) | | (0.176) | | (0.211) |
| Arable | -0.108* | | -0.116* | | -0.122* |
| | (0.0635) | | (0.0604) | | (0.0675) |
| Tropical | -0.874*** | | -1.008*** | | -0.925*** |
| | (0.192) | | (0.211) | | (0.259) |
| W way | -0.121 | | -0.263 | | -0.288 |
| | (0.295) | | (0.280) | | (0.321) |
| OPEC | 0.342 | | 0.688* | | 0.655* |
| | (0.344) | | (0.373) | | (0.385) |
| Div | | 458.0* | 623.6*** | | 486.9* |
| | | (270.1) | (221.9) | | (246.3) |
| Div sq | | -317.3 | -439.1*** | | -342.9* |
| | | (189.9) | (156.5) | | (173.8) |
| E frac | | | | -0.806** | 0.0253 |
| | | | | (0.372) | (0.377) |
| Rel | No | No | No | Yes | Yes |
| Const | 5.304*** | -154.4 | -214.8*** | 10.77*** | -167.7* |
| | (1.538) | (96.00) | (78.24) | (0.240) | (86.55) |
| Obs | 46 | 46 | 46 | 46 | 46 |
| AdjRsq | 0.429 | 0.070 | 0.503 | 0.092 | 0.486 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: The Effect of Fundamental and Policy Variables on GDP per Worker

GDP per Capita>5000

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] |
| Neolit | 0.392* | | 0.446** | 0.294 | -0.406** | 0.402** | 0.182 | 0.298 |
| | (0.223) | | (0.177) | (0.205) | (0.157) | (0.162) | (0.209) | (0.236) |
| Arable | 0.0188 | | -0.0641 | 0.0363 | 0.0893* | -0.192** | -0.0434 | 0.00788 |
| | (0.0864) | | (0.0708) | (0.0785) | (0.0488) | (0.0740) | (0.0790) | (0.0863) |
| Tropical | -0.918*** | | -0.463** | -0.742*** | -0.111 | -0.644*** | -0.607** | -0.823*** |
| | (0.237) | | (0.214) | (0.224) | (0.164) | (0.179) | (0.232) | (0.248) |
| W way | -0.009 | | -0.0172 | 0.026 | 0.297* | 0.460* | -0.066 | -0.104 |
| | (0.304) | | (0.240) | (0.276) | (0.173) | (0.237) | (0.270) | (0.312) |
| OPEC | 0.551 | | 0.189 | 0.610 | 0.858*** | 0.357 | 0.724* | 0.595 |
| | (0.473) | | (0.382) | (0.428) | (0.265) | (0.344) | (0.421) | (0.471) |
| Div | 362.4 | | -89.45 | 286.9 | -108.7 | 124.1 | 87.64 | 313.9 |
| | (227.2) | | (206.9) | (207.5) | (138.5) | (170.3) | (219.9) | (229.3) |
| Div sq | -256.4 | | 66.98 | -202.3 | 77.04 | -89.30 | -60.30 | -221.9 |
| | (160.5) | | (146.7) | (146.6) | (97.91) | (120.3) | (155.6) | (162.1) |
| E frac | -0.185 | | -0.306 | -0.180 | -0.163 | -0.0403 | -0.0551 | -0.0628 |
| | (0.354) | | (0.281) | (0.321) | (0.197) | (0.258) | (0.316) | (0.366) |
| Rel | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes |
| D Buis | | 0.0131* | 0.0363*** | | | | | |
| | | (0.00684) | (0.00830) | | | | | |
| E Free | | -0.0528 | | 0.317*** | | | | |
| | | (0.112) | | (0.115) | | | | |
| Roads | | 0.0454 | | | | 0.440*** | | |
| | | (0.0643) | | | | (0.0827) | | |
| phones | | 0.511*** | | | 0.679*** | | | |
| | | (0.104) | | | (0.0822) | | | |
| Grades | | -0.00464 | | | | | 0.0346*** | |
| | | (0.0111) | | | | | (0.0113) | |
| E Ineq | | -0.0232 | | | | | | -0.256 |
| | | (0.135) | | | | | | (0.215) |
| Const | -120.5 | 6.901*** | 34.08 | -95.78 | 47.63 | -35.82 | -24.18 | -103.1 |
| | (80.08) | (0.652) | (72.41) | (73.04) | (48.93) | (60.06) | (77.43) | (80.87) |
| Obs | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 |
| AdjRsq | 0.524 | 0.734 | 0.703 | 0.610 | 0.853 | 0.751 | 0.628 | 0.530 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: The Effect of Fundamental and Policy Variables on GDP per Worker

| | GDP per Capita>5000 - policy variables combinations | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] | Log[y] |
| Neolit | -0.257 | 0.313* | 0.334* | -0.384** | -0.415** | 0.396** | 0.372** | -0.286* |
| | (0.166) | (0.175) | (0.181) | (0.162) | (0.164) | (0.167) | (0.160) | (0.167) |
| Arable | 0.0419 | -0.175** | -0.168** | 0.0813 | 0.0834 | -0.177** | -0.184** | 0.0412 |
| | (0.0533) | (0.0805) | (0.0815) | (0.0543) | (0.0496) | (0.0702) | (0.0689) | (0.0505) |
| Tropical | -0.0598 | -0.565*** | -0.584*** | -0.109 | -0.0864 | -0.443** | -0.424** | -0.0372 |
| | (0.159) | (0.189) | (0.194) | (0.168) | (0.168) | (0.191) | (0.187) | (0.159) |
| W way | 0.238 | 0.357 | 0.380 | 0.275 | 0.242 | 0.294 | 0.270 | 0.204 |
| | (0.170) | (0.250) | (0.257) | (0.181) | (0.182) | (0.240) | (0.234) | (0.171) |
| OPEC | 0.674** | 0.421 | 0.438 | 0.862*** | 0.870*** | 0.253 | 0.246 | 0.684** |
| | (0.272) | (0.349) | (0.361) | (0.272) | (0.268) | (0.342) | (0.327) | (0.266) |
| Div | -215.0 | 96.38 | 86.83 | -113.4 | -114.4 | -81.12 | -77.11 | -220.3 |
| | (142.3) | (172.9) | (184.0) | (146.3) | (140.8) | (183.8) | (176.9) | (139.4) |
| Div sq | 153.8 | -69.30 | -62.21 | 80.64 | 81.32 | 58.60 | 55.49 | 157.4 |
| | (100.9) | (122.1) | (130.2) | (103.5) | (99.50) | (130.4) | (125.4) | (98.77) |
| E frac | -0.207 | 0.0314 | -0.0341 | -0.152 | -0.109 | -0.133 | -0.0728 | -0.165 |
| | (0.193) | (0.269) | (0.264) | (0.203) | (0.207) | (0.249) | (0.254) | (0.196) |
| Rel | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| D Buis | 0.0140** | | | | | 0.0194** | 0.0192** | 0.0139** |
| | (0.00680) | | | | | (0.00870) | (0.00851) | (0.00659) |
| E Free | | 0.0737 | 0.0657 | 0.0582 | 0.0641 | | | |
| | | (0.109) | (0.113) | (0.0845) | (0.0797) | | | |
| Roads | | 0.397*** | 0.370*** | | | 0.297*** | 0.318*** | |
| | | (0.0977) | (0.111) | | | (0.105) | (0.0920) | |
| phones | 0.561*** | | | 0.628*** | 0.634*** | | | 0.562*** |
| | (0.102) | | | (0.103) | (0.0934) | | | (0.0928) |
| Grades | 0.00175 | | 0.00752 | 0.00329 | | 0.00520 | | |
| | (0.00816) | | (0.0119) | (0.00893) | | (0.0108) | | |
| E Ineq | | -0.177 | | | -0.114 | | -0.150 | -0.101 |
| | | (0.158) | | | (0.123) | | (0.147) | (0.115) |
| Const | 82.92 | -26.36 | -23.32 | 48.73 | 49.28 | 33.69 | 32.60 | 84.93* |
| | (49.91) | (61.00) | (64.86) | (51.69) | (49.78) | (64.28) | (61.89) | (48.91) |
| Obs | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 |
| AdjRsq | 0.865 | 0.749 | 0.742 | 0.847 | 0.851 | 0.779 | 0.786 | 0.869 |

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: The Effect of Policy Variables on GDP per Worker

A Panel Approach Using Fixed Effects
1960-2010

| | (1) Full Sample Log[y] | (2) Full Sample Log[y] | (3) Full Sample Log[y] | (4) Full Sample Log[y] |
|---|---|---|---|---|
| E Free | 0.0456 | | | 0.0292 |
| | (0.0306) | | | (0.0327) |
| E Ineq | | -0.452* | | -0.171 |
| | | (0.237) | | (0.166) |
| Roads | | | 0.160 | 0.0621 |
| | | | (0.139) | (0.140) |
| Const | 9.545*** | 8.654*** | 9.847*** | 9.585*** |
| | (0.207) | (0.180) | (0.0539) | (0.348) |
| Obs | 690 | 774 | 636 | 535 |
| AdjRsq | 0.955 | 0.922 | 0.944 | 0.960 |
| Year effect | yes | yes | yes | yes |
| Fixed effect | yes | yes | yes | yes |

| | (5) GDP pc>5000 Log[y] | (6) GDP pc>5000 Log[y] | (7) GDP pc>5000 Log[y] | (8) GDP pc>5000 Log[y] |
|---|---|---|---|---|
| E Free | 0.0595 | | | 0.0717** |
| | (0.0356) | | | (0.0344) |
| E Ineq | | -0.287 | | -0.0491 |
| | | (0.178) | | (0.0971) |
| Roads | | | 0.312** | 0.188* |
| | | | (0.135) | (0.0971) |
| Const | 10.36*** | 10.26*** | 10.50*** | 9.982*** |
| | (0.254) | (0.273) | (0.122) | (0.278) |
| Obs | 372 | 360 | 339 | 321 |
| AdjRsq | 0.913 | 0.860 | 0.900 | 0.933 |
| Year effect | yes | yes | yes | yes |
| Fixed effect | yes | yes | yes | yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: The Convergence of y through TFP( rau)

| | (1) Full Sample | (2) GDP pc>5000 | (3) Full Sample | (4) GDP pc>5000 | (5) Full Sample | (6) GDP pc>5000 |
|---|---|---|---|---|---|---|
| The lagged gap (Fundamentals based) | 0.0645** | 0.0150* | | | | |
| | (0.0245) | (0.00786) | | | | |
| The lagged gap (Fundamentals and policy based) | | | 0.0931** | 0.0438*** | 0.0902** | 0.0383** |
| | | | (0.0357) | (0.0136) | (0.0371) | (0.0149) |
| d1980 | | 0.0791*** | | 0.0783*** | 0.130*** | 0.0180 |
| | | (0.0271) | | (0.0269) | (0.0482) | (0.0215) |
| d1985 | -0.186*** | | -0.186*** | | -0.0445 | -0.0557** |
| | (0.0548) | | (0.0544) | | (0.0287) | (0.0263) |
| d1990 | -0.0670 | 0.0786*** | -0.0670 | 0.0781*** | 0.0474 | 0.00823 |
| | (0.0439) | (0.0240) | (0.0432) | (0.0239) | (0.0296) | (0.0214) |
| d1995 | -0.101** | 0.0730** | -0.101** | 0.0712** | | -0.000125 |
| | (0.0494) | (0.0277) | (0.0486) | (0.0276) | | (0.0171) |
| d2000 | -0.131** | 0.0710*** | -0.131** | 0.0704*** | -0.0119 | 0.00655 |
| | (0.0530) | (0.0221) | (0.0521) | (0.0220) | (0.0195) | (0.0214) |
| d2005 | -0.0635* | 0.0629*** | -0.0635* | 0.0627*** | 0.0828*** | 0.0186 |
| | (0.0374) | (0.0192) | (0.0367) | (0.0193) | (0.0260) | (0.0145) |
| d2010 | -0.0743* | 0.0384 | -0.0743* | 0.0384 | 0.0743*** | |
| | (0.0407) | (0.0264) | (0.0404) | (0.0266) | (0.0258) | |
| roads diff | | | | | -0.0278 | -0.0173 |
| | | | | | (0.0458) | (0.0244) |
| E Free diff | | | | | 0.0720*** | 0.0513*** |
| | | | | | (0.0133) | (0.0131) |
| E Ineq diff | | | | | 0.0804 | 0.0627 |
| | | | | | (0.0875) | (0.0556) |
| Const | 0.113*** | -0.0476** | 0.113*** | -0.0441** | -0.0303 | 0.00342 |
| | (0.0423) | (0.0197) | (0.0418) | (0.0194) | (0.0212) | (0.0121) |
| Obs | 463 | 279 | 463 | 279 | 463 | 279 |
| AdjRsq | 0.100 | 0.059 | 0.109 | 0.084 | 0.149 | 0.139 |

Robust standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 10: The Convergence of y through Physical Capital

| | (1) Full Sample | (2) GDP pc>5000 | (3) Full Sample | (4) GDP pc>5000 |
|---|---|---|---|---|
| The lagged gap (Fundamentals based) | -0.0902 | 0.222 | | |
| | (0.132) | (0.201) | | |
| The lagged gap (Fundamentals and policy based) | | | -0.0779 | 0.308 |
| | | | (0.225) | (0.353) |
| d1980 | | 0.159*** | | 0.158*** |
| | | (0.0402) | | (0.0401) |
| d1985 | 0.0203 | | 0.0203 | |
| | (0.179) | | (0.179) | |
| d1990 | 0.799** | 1.002* | 0.799** | 0.999* |
| | (0.394) | (0.530) | (0.395) | (0.527) |
| d1995 | 0.287 | 0.441 | 0.287 | 0.428 |
| | (0.252) | (0.312) | (0.252) | (0.322) |
| d2000 | -0.0248 | -0.0300 | -0.0248 | -0.0352 |
| | (0.165) | (0.0287) | (0.165) | (0.0326) |
| d2005 | 0.147 | 0.110*** | 0.147 | 0.106*** |
| | (0.175) | (0.0281) | (0.175) | (0.0292) |
| d2010 | 0.209 | 0.199*** | 0.209 | 0.194*** |
| | (0.175) | (0.0375) | (0.175) | (0.0388) |
| Const | -0.0957 | 0.0181 | -0.0957 | 0.0226 |
| | (0.177) | (0.0472) | (0.177) | (0.0570) |
| Obs | 463 | 279 | 463 | 279 |
| AdjRsq | 0.024 | 0.029 | 0.023 | 0.030 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: The Convergence of y through Human Capital

| | (1)<br>Full Sample | (2)<br>GDP pc>5000 | (3)<br>Full Sample | (4)<br>GDP pc>5000 |
|---|---|---|---|---|
| The lagged gap<br>(Fundamentals based) | 0.0419 | -0.131 | | |
| | (0.0736) | (0.156) | | |
| The lagged gap<br>(Fundamentals and policy based) | | | 0.00396 | -0.200 |
| | | | (0.138) | (0.278) |
| d1980 | | 0.0252 | | 0.0262 |
| | | (0.0228) | | (0.0229) |
| d1985 | -0.00372 | | -0.00372 | |
| | (0.0273) | | (0.0275) | |
| d1990 | -0.552** | -0.694* | -0.552** | -0.692* |
| | (0.274) | (0.403) | (0.274) | (0.400) |
| d1995 | -0.157 | -0.242 | -0.157 | -0.234 |
| | (0.149) | (0.251) | (0.149) | (0.259) |
| d2000 | -0.0480* | -0.0247 | -0.0480* | -0.0215 |
| | (0.0260) | (0.0187) | (0.0262) | (0.0199) |
| d2005 | -0.00252 | -0.0122 | -0.00252 | -0.00988 |
| | (0.0244) | (0.0183) | (0.0243) | (0.0196) |
| d2010 | 0.0216 | -0.0117 | 0.0216 | -0.00907 |
| | (0.0255) | (0.0241) | (0.0253) | (0.0240) |
| Const | 0.132*** | 0.0599 | 0.132*** | 0.0547 |
| | (0.0245) | (0.0363) | (0.0238) | (0.0442) |
| Obs | 463 | 279 | 463 | 279 |
| AdjRsq | 0.023 | 0.022 | 0.023 | 0.024 |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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