Summary
We use direct measures of the skill level of labour market entrants, constructed from the results of the International Adult Literacy Survey (IALS), to examine the role of human capital in explaining the evolution of living standards in Portugal relative to fourteen other OECD countries. In our sample of countries between 1960 and 2000, an increase in the average skill level of labour market entrants, corresponding to one additional year of education, increases per capita GDP by 7%. Based on this estimate, we find that the skill gap of Portuguese labour market entrants relative to the other OECD countries at the end of the period under study accounts for 47.5% of the gap in real per capita GDP between Portugal and the OECD average. The remaining of the Portugal per capita GDP gap is accounted for by the relative lack of physical capital (28.5%), a lower employment rate (11.8%) and a technology lag (12.2%).
1 – Introduction

Despite a relatively high level of economic integration with the well developed countries of Western Europe, Portugal remains behind most OECD countries in terms of living standards. What factors can account for the evolution of GDP per capita in Portugal over the last half century and for the remaining gap in living standards between Portugal and the other OECD countries? In which areas should economic policy focus in order to close this gap?

In this paper, we attempt to provide elements of answers to these questions. As for a large part of the recent economic growth literature, our analysis focuses on the critical role of human capital accumulation. Following the pioneering contributions of Lucas (1988) and Mankiw, Romer and Weil (1992), among others, human capital is now seen by most macroeconomists as one of the few ultimate drivers of economic growth in developed countries. This is especially the case in open economies with well integrated financial markets. Since there will be inflows of financial capital from abroad to finance domestic investments if the return to physical capital is sufficiently high, the level of human capital of the work force, which complements physical capital in production processes, will ultimately determine the dynamics of physical capital accumulation (Barro, Mankiw and Sala-i-Martin, 1995). This may well be so for technological flows as well, given the complementarities between new technologies and skills, and the fact that technical innovations are often imbedded in capital goods.

Our analysis uses direct measures of human capital constructed from the test scores of the International Adult Literacy Survey (IALS) to examine the role of skills accumulation in explaining Portugal’s living standard relative to other OECD countries between 1960 and 2000. Our main result is that the relative skills deficiency of Portugal’s labour force relative to the OECD average is by far the main determinant of the gap in real GDP per capita between Portugal and other OECD countries. Although there have been substantial improvements in the skill level of Portuguese over the 1960-2000 period, the skill gap of labour market entrants in Portugal relative to other OECD countries remained relatively large at the end of the period under study, and corresponded to 3 years of education. We argue that policies aimed at increasing educational attainment would likely produce high macroeconomic benefits.
In the next section, we set the stage for our analysis by reviewing a few specific parts of the literature on human capital and economic growth. In section 3, we take a first look at the comparison between Portugal and other OECD countries in terms of living standards, human capital accumulation, and a few other determinants of economic growth. In section 4, we estimate the main determinants of growth in a sample of fifteen OECD countries over the 1960-2000 period, and provide a decomposition analysis of the gap in real GDP per capita between Portugal and the OECD average. We discuss our results and conclude in section 5.

2 – Human Capital\(^1\)

2.1 – From the beginning to micro-Mincerian returns

In economics, the idea that it is valuable for an individual, for himself and for the economy overall, to acquire skills, either by studying or by apprenticeships, goes back at least to Adam Smith’s *Wealth of Nation* published in 1776. By doing so, an individual is investing in skills and acquiring human capital.

Human capital was first studied seriously by economists in the early 1960s in response to the growth accounting framework proposed by Solow (1957). In this framework, output was produced by physical capital, labour, and technology. It was not possible to measure technology but it was possible to measure physical capital by the summation of the value of investment minus depreciation, and labour by hours worked. Solow (1957) proposed to measure technological progress in the United States by taking the differences between the growth of output on one side, and fractions of the growth of physical capital and labour inputs. The fraction used for labour growth in the accounting framework was around 2/3 and corresponded to the share of wages in national income. Similarly, the share of capital (profits) in national income was around 1/3 and this number was used to weight capital in the growth accounting framework. Solow’s (1957) main finding was that a considerable percentage of U.S. economic growth was not accounted for by the increases in physical capital and labour. Consequently,

\(^1\) Parts of this this section borrows from Coulombe and Tremblay (2009a).
technological progress was a very important driver of the increase in living standards in a modern economy.

Human capital was proposed as a competitor to technological progress to account for the discrepancy between the growth of output and the growth of inputs. The growth of labour was not limited to the growth of hours worked but should also include the growth of the skills of labour or of human capital. However, from the 1960s to the 1980s, economic growth became a neglected topic in economics. Most researches, textbooks, and courses were mainly focusing on the important issues of the time: business cycles, unemployment, and inflation. During this period, the human capital concept was developed by microeconomists in the field of labour economics following the seminal works of Mincer (1958) and Becker (1962, 1964). Contrary to macroeconomists, microeconomists were not interested in measuring and explaining the determinants of the growth of living standards in the overall economy. They were instead focussing in their micro-studies on explaining the wage distribution of heterogenous individuals. Human capital, which was mainly acquired by education, was one of the main determinants of the differences in wages across individuals along with experience, gender, and race.

The Mincerian return to schooling is a key concept developed by labour economists, and is a concept that will be very useful in our analysis of the Portugal case study. The micro-Mincerian return is the individual return, in terms of increased wages, of one extra year of schooling. Hundreds of microeconomic studies have focussed on estimating Mincerian returns for different economies, at different points in time, by gender, and so on. Overall, estimates of micro-Mincerian returns range between 5 and 15% (Psacharopoulos 1994). This means that on average, an individual that spends one extra year in school will earn a wage that is between 5 to 15 % higher than otherwise. The micro-Mincerian return is decreasing. It is larger for individuals with little schooling and lower for well educated people.

2.2 – Human capital and modern economic growth

With the development of the cross-country data bank of Summers and Heston (1984, 1988, 1991), the birth of the Endogenous Growth literature (Romer 1986, 1990, and Lucas, 1988), and the convergence debate (Mankiw, Romer, and Weil, 1992, and
Barro and Sala-i-Martin, 1995), economic growth came back at the front stage of the economics research agenda. In this new growth literature, and especially with the contributions of Lucas (1988) and Mankiw et al. (1992), human capital has been right from the start, one of the key ingredients in explaining growth and determining differences in living standards across countries.

In a very influential paper, Mankiw et al. (1992) demonstrate that the role of human capital was necessary to reconcile the predictions of the neo-classical (Solow) growth model with the quantitative aspects of economic development. Mankiw et al. (1992) argue that the predictions of the Solow model pass relatively well the test of cross-country empirical analysis. Long-run living standards across countries are positively correlated with investment ratios and negatively correlated with population growth, and the growth rates of countries appear to converge. On quantitative grounds however, the Solow growth model under-predicts the differences in living standards across countries. The order of magnitude of the differences in living standards between the 5 richest countries and the five poorest is a 25 to 1 ratio. Based on the accumulation of physical capital only, the original growth model is able to account for a ratio of 3 to 1 only. The reason for this problem is that the neo-classical growth model relies only on capital accumulation to account for differences in living standards across countries in the long run. In national income, the returns to capital as measured by the share of profits account for only 1/3 of a country’s income. The remaining 2/3 is the share of wages. With these numbers, capital accumulation is not important enough as an economic activity to account for a 25 to 1 ratio. Mankiw et al. (1992) show that if the returns to capital would account for around 0.8 of national income, the neo-classical growth model would be able to account for such a ratio between the living standards of the richest and the poorest countries. The solution to this puzzle is to recognize that the return on another type of capital is hidden in the share of labour income. Human capital is the only candidate for this role. According to Mankiw et al. (1992), using a back-of-the-envelope calculation based on the mean wage rate and the minimum wage in the United States, the hidden share of income generated by human capital should account for around 50% of national income. Mankiw et al. (1992) show that the extended neo-classical growth model, with a broader capital concept, that includes human capital is roughly consistent with cross-
country data and economic development facts. From an accounting point of view, human capital is more important than physical capital since his income share is around 1/2 versus only 1/3 for physical capital.

With Mankiw et al. (1992), human capital entered the modern economic growth agenda by the front door. With Barro, Mankiw, and Sala-i-Martin (1995), it became the main driver of economic growth. Barro et al. (1995) open the extended neo-classical growth model by assuming that financial capital is perfectly mobile across countries. They first show that, in the absence of set-up costs or some borrowing constraint, the perfect capital mobility assumption implies that the convergence process should be instantaneous. Because of decreasing returns to capital accumulation (for both physical and human capital), the return to capital should be higher in poor countries. In an open economy framework, capital should flow to the poorest country of the globe which should then catch-up instantaneously to the level of the rich countries. This prediction is strongly rejected by facts since convergence is a rather slow process.

Barro et al. (1995) propose that only physical capital can be financed abroad and human capital has to be financed in the domestic economy. The borrowing constraint on human capital is justified by the intrinsic nature of human capital: human capital cannot be used as collateral for financing investment in education. Consequently, human capital cannot be financed easily without the intervention of the state. Practically speaking, given that most investments in education are done in childhood, in a free-market economy, the financing of investment in education has to rely on altruistic behaviour from the family.

In the framework of Barro et al. (1995), the investment in physical capital is not a constraint for the growth performance of a poor economy. Contrary to human capital, physical capital can be financed abroad. Investments however do not flow massively in poor countries even if physical capital is missing, simply because the level of human capital is too low. Investment in human capital becomes the necessary step for economic growth. The lack of human capital is the ultimate barrier to economic development.
2.3 – Macroeconomic versus microeconomic returns

Despite the earlier success of Mankiw et al. (1992), the following empirical analyses performed at the cross-country level encounter important problems in estimating the effect of human capital investment on per capita income or labour productivity. As we will see in the next section, it is now understood that those problems were related to the measurement of human capital for cross-country comparison. Before turning to that, it is important to point out that, for several reasons, the individual returns (the micro-Mincerian returns) to human capital accumulation may not translate into equivalent return for the economy as a whole (macro-Mincerian returns).

Let us consider first the case where microeconomic returns might exceed the macroeconomic returns of education. As advocated in the work of Spence (1973), education might act as a signalling device. In this case, the investment in education may have a greater effect on an individual’s wage than on its productivity. Holding a diploma may provide a signal to employers regarding some hardly observable characteristics of the worker leading to a higher wage even if education does not have any effect on productivity. In this case, individual returns from education may be high even if macroeconomic returns are low or even nil.

But the macroeconomic returns might also exceed microeconomic returns. The acquisition of human capital by an individual might generate positive external effects (externalities) to other individuals and the society as a whole. Such external benefits may happen if the human capital of workers has a positive effect on the productivity of co-workers, or if highly skilled individuals have a determinant effect on innovation. Similarly, crime rates might be smaller and participation in the democratic process more efficient if people are better educated. With substantial externalities of human capital investment, the estimated macroeconomic return to education in terms of aggregate labour productivity or national income might exceed the microeconomic returns on wages even if education acts as a signalling device.

From an economic policy perspective, large public investments in education may be more difficult to motivate using economic theory if the macroeconomic returns to education are not in the same order of magnitude as the individual returns. The empirical evidence on this point is limited. Using the same direct measures of skills for OECD
countries than the ones used in this paper, Coulombe and Tremblay (2006) estimated the macro-Mincerian rate of return of the skills acquired in one extra year of schooling to be around 7 percent. This is extremely close to the average micro-Mincerian estimate of 6.8 percent for the same countries in Psacharopoulos (1994).

Similarly, Cohen and Soto (2007) use a new set of years of schooling data, corrected for various sources of measurement error. They also find macro-Mincerian estimates in the same range as the micro estimates of Psacharopoulos (1994) for a broad set of around 80 countries. They estimated a macro-Mincerian return in the overall population of approximately 9 percent.

2.4 – The measure of human capital: quantity and quality

Microeconomic studies are generally performed using individual data within a country. The other determinants in the human capital accumulation production process, such as the quality of education, are relatively homogeneous across individuals. What differs across individuals in the same country is not as much the quality of the education people receive as the years they spent at school. Consequently, the years of schooling of individuals, along with experience, is a good proxy for human capital in those microeconomic studies.

The initial approach in cross-country studies (such as in Mankiw et al., 1992, and Islam, 1995) was to use schooling data as a proxy of human capital following the stance established by the Mincerian tradition. To this end, Barro and Lee (1993 and 2001) have spent considerable effort at developing a cross-country schooling data bank that could be used along with the Summers and Heston (1991) data on per capita GDP and productivity.

But the assumption that the other determinants of the educational system are relatively homogeneous falls when the purpose of the study is to measure the returns to human capital using cross-country data. Coulombe, Tremblay, and Marchand (2004) and Coulombe and Tremblay (2006) argue that it is for this reason that the estimated macroeconomic effect of human capital in cross-country growth analyses is either inconsistent (across sexes for example) or not significant (e.g. Benhabib and Spiegel, 1994; Islam, 1995; Caselli et al. 1996; Barro, 2001; and Pritchett 2001, among others).
When the sample is reduced to OECD countries, the effect of human capital on economic growth is at best nil (Islam, 1995; Barro, 2001).

A more recent approach in the literature, following Hanushek and Kimko (2000), has opted to directly measure human capital by making the best use of cognitive skills tests. Hanushek and Woessmann (2008) provide an excellent survey on the growing literature on cognitive skills. Coulombe et al. (2004) and Coulombe and Tremblay (2006) compare the effect of direct measures of human capital with years of schooling data on the growth of OECD countries. Using data from the International Adult Literacy Survey (IALS), conducted between 1994 and 1998, and the demographic profile of the 16 to 65 years old, they derived synthetic time series of the literacy level of labour market entrants over the 1960-1995 period. Their results indicate that direct measures of human capital clearly outperform traditional measures based on years of schooling. Clearly the skill data contains more information regarding future growth of countries than years of schooling data.

The poor performance of years of schooling data across countries appears to be related to the varying quality of educational systems across countries following evidence provided in Coulombe and Tremblay (2009b). Using data from the large Canadian sample of the 2003 Adult Literacy and Lifeskills Survey (ALL), Coulombe and Tremblay (2009b) show that, on average, international immigrants to Canada have more years of schooling but a lower skill level than the Canadian-born population. They measure in a practical manner the typical skill deficiency of the foreign-born population in Canada by introducing the concept of the skill-schooling gap. Evaluated at the mean of the skills distribution, they show that the skills deficiency of Canadian international immigrants corresponds to roughly three years of formal education in Canada. One of these three years can be imputed to the lower language skills in either English or French of international immigrants. They assimilate the remaining two years of the skill-schooling gap to a lower average quality of education, compared to Canada, of the schooling received by international immigrants in their home country. This diagnostic follows from the fact that, as in the pioneering analysis of Borjas (1987), the skill-schooling gap is negatively correlated with the per capita GDP of the home country. The skill gap of Canadian immigrants tends to be larger when they come from relatively poor countries.
3 – A First Look at the Data

Before discussing the evolution of human capital indicators, it is useful to take a look at the catching-up process of Portugal’s living standard relative to other OECD countries between 1950 and 2000. Figure 1 depicts real GDP per capita in purchasing-power-parity for Portugal and for the average of the fourteen other OECD countries included in our sample. Overall, the relative growth of Portugal has been substantial. The gap in per capita real GDP between Portugal and the other countries decreased from 123% in 1950 to 44% in 2000. Convergence towards the OECD average was relatively constant, although there was a relative growth slowdown in the first half of the 1980s. In Section 4, we will decompose this 44% gap into the parts attributable to gaps in physical capital, human capital, labour market participation and technology.

![Figure 1: Log of Real GDP Per Capita](image)

Note: GDP data are adjusted for terms-of-trade changes.

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2 The fifteen countries included in our analysis are Belgium, Canada, Denmark, Finland, Germany, Ireland, Italy, Netherlands, Norway, New Zealand, Portugal, Sweden, Switzerland, United Kingdom, and the United States.

3 The relative growth of Portugal in terms of real GDP per worker has been very similar. The gap with the OECD average was 117% in 1950 and decreased to 39% in 2000. Figure A.1 in the Appendix shows the evolution of real GDP per worker for Portugal and for the average of the other OECD countries.
Source: Penn World Tables, version 6.1

The human capital indicators that we use in the empirical analysis of section 4 are from the 1994-1998 International Adult Literacy Survey (IALS). The IALS tested a range of cognitive skills of individuals between 16 and 65 years old in different OECD countries. Following Coulombe et al. (2004) and Coulombe and Tremblay (2006), we constructed measures of the skills of labour market entrants in each period between 1960 and 1995 by using the demographic profile of the test scores. More specifically, we took the average test scores of individuals who were aged between 17 and 25 years old in each year (1960, 1965,…, 1995) as a proxy for each country’s level of human capital investment in each period. We have these indicators for the fifteen countries in our sample, for both gender and for men and women separately.

The IALS measured the skills of individuals over three domains: prose literacy, quantitative literacy and document literacy. These domains are defined by the IALS as follows (OECD, 2000):

**Prose literacy**: the knowledge and skills needed to understand and use information from texts, including editorials, news stories, brochures and instruction manuals.

**Document literacy**: the knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables and charts.

**Quantitative literacy**: the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers imbedded in printed materials, such as balancing a chequebook, figuring out a tip, completing an order form, or determining the amount of interest on a loan from an advertisement.

The main measure of skills that we use is the average score over the three domains, although in the discussion below, we also discuss outcomes in each domain. Individuals’ performances in each domain are either reported as a score on an arbitrary 0-500 scale, or according to five broad levels of proficiency (levels 1 to 5). The test items in each domain include tasks covering a broad range of difficulty levels. For example, level 1 tasks in the document domain ‘require the reader to locate a piece of information based on a literal match. Distracting information, if present, is typically located away from the correct answer’ (OECD, 1997). At the other extreme, level 5 tasks ‘require the
reader to search through complex displays of information that contain multiple
distractors, to make high-level inferences, to process conditional information, or to use
specialized knowledge’ (OECD, 1997). Thus, the human capital indicators that we report
below capture different types of skills that range from very simple to very complex, and
that are acquired over the entire spectrum of education levels from elementary schooling
to university. Level 3 is seen as the ‘minimum level of competence needed to cope
adequately with the complex demands of everyday life and work’ (OECD, 2000).

In contrast to human capital indicators derived from schooling data, our skills
indicators provide direct measures of the quality of human capital. As discussed earlier,
there are several comparability problems that arise with schooling data given that
educational system and the quality of education vary considerably across countries. Since
the IALS performance tests are the same across countries, our indicators are not subject
to such comparability issues. Note that the IALS is also designed so that respondents’
performance is independent of culture.

On the other hand, the construction of our synthetic time-series cannot take into
account any skill gains or losses that occur during the active lives of individuals in the
labour market. By inferring past investment in human capital from the test scores of
individuals in different age-cohorts, our indicators will tend to over-estimate past
investment if the skill gains of individuals after the formal education period are larger
than the skill losses, and vice-versa. Nonetheless, our indicators will constitute good
proxies for countries’ relative investment in skills as long as the pattern of skills gains
and losses over individuals’ lives is relatively similar across countries. Another drawback
of our indicators is that they cannot take into account the effect of migration over the
period. For instance, if immigrants to a given country are relatively more skilled than
individuals who were educated in the country, our indicators will tend to over-estimate
the country’s past human capital investments.

Our literacy indicators for Portugal and the average of the other countries are
presented in Figure 2, for both sexes and for men and women separately. So as to better
gauge the extent of Portugal’s skill gap with the OECD average, it is useful to note that
one additional year of schooling is estimated to increase the literacy score on the IALS
scale by about 10 points on average across OECD countries (OECD, 2000).
Between 1960 and 1995, the OECD average has increased continually, although at a decreasing rate. In 1960, men had on average more skills than women, and this gender gap corresponded to approximately one year of education. By 1975, the gap was reduced to less than half a year of schooling, and had vanished entirely by 1995.

There are a number of interesting points to note regarding the indicators for Portugal. First, Portugal’s labour market entrants in 1960 had by far the lowest skill level in our sample (followed by Italy). The initial difference in skills between Portugal and the average of the other countries corresponded to almost 6 years of education. The gap was also much more pronounced for women (7 years) than for men (4 years).

Second, the human capital catch-up of Portugal occurred essentially after 1980. In fact, for men, the literacy level of labour market entrants actually decreased continually between 1965 and 1980. This could partly be the results of increased immigration flows to Portugal that started in the 1970s. Literacy levels also decreased for women between...
1965 and 1970, although it started to increase rapidly and continually after 1970. Between 1970 and 1995, the female skill gap between Portugal and the OECD average decreased from a level corresponding to 8.5 years of education to only 2.5 years. Finally, the Portugal skill gap for men decreased after 1980, going from an equivalent of 5.8 years of education to 3.5 years in 1995.4

Overall, Figures 1 and 2 suggest that the convergence of Portugal toward the OECD average in terms of living standards in the 1960s and 1970s is not likely to be due to a relatively high level of human capital investment. On the other hand, human capital accumulation could explain part of the relatively rapid growth of Portugal after 1980.

Although the analysis in the next section will be based on these literacy indicators, it is nonetheless interesting to examine how schooling attainment in Portugal has evolved relative to the other OECD countries since 1960. To that end, Figure 3 reports the average years of education of the population from the dataset of De la Fuente and Domenech (2006). These are years of schooling that have been corrected for various sources of measurement error in order to improve cross-country comparisons of schooling attainment.

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4 Figure A.2 in the Appendix presents the average scores by skill domain (prose, document, quantitative) of labour market entrants for Portugal and the average of the OECD countries. There is relatively little variation across skill domains, so the relative evolution of Portugal’s indicators by domain is quite similar to the pattern depicted in Figure 2.
Amazingly, there has been no convergence whatsoever in average years of schooling between Portugal and the other OECD countries over the entire 1960-1995 period. Average years of schooling in Portugal increased from 4.4 years in 1960 to 6.7 years in 1995. In the other OECD countries, average years of schooling went from 9.0 to 11.5 over the same period. The relative catch-up of Portugal in terms of skills, combined with the absence of convergence in years of schooling, suggests that the quality of education may have increased in Portugal over the period, or is at least comparable to the quality of education in other OECD countries. This would seem to indicate that increasing the quantity of education in Portugal (average years of schooling) would likely have a large effect on the stock of skills in the labour force even if the quality of education remains constant. This observation may have important implications for policy.

Figures 4 and 5 show the percentage of labour market entrants who had achieved at least level 4, and only level 1, respectively, by literacy domain. There are a number of interesting points coming out of these figures. First, there has been relatively little convergence over the entire 1960-1995 period between Portugal and the other OECD
countries in terms of the percentage of labour market entrants with very high levels of skills (Figure 4). For instance, in 1995, only 5% of labour market entrants had achieved level 4 in document literacy compared to 25% in the other OECD countries. The gaps are not as pronounced in the other two domains although they remain substantial.

Figure 4: Percentage of Labour Market Entrants Who Achieved at Least Proficiency Level 4 by Skill Domain (Prose, Quantitative, Document)

Source: constructed by the authors using data from the International Adult Literacy Survey.

Secondly, as depicted in Figure 5, the catching-up of Portugal to the OECD average has been much greater at the bottom of the skills spectrum, although only after 1980. While the percentage of labour market entrants who had not achieved more than level 1 was not much lower in 1980 than in 1960, it decreased very rapidly from a range of 54-61% in 1980 to 22-27% in 1995. Nonetheless, the percentage of very low skilled individuals entering the labour market in Portugal in 1995 was still approximately 2½ times that of other OECD countries.
Apart from human capital, two of the most important determinants of living standards in cross-country studies include the degree of openness of economies and the investment ratio. Figure 6 presents the openness ratio for Portugal and the average of the other OECD countries. The openness ratio is measured as the sum of imports and exports over GDP, and is averaged over five-year periods. Not surprisingly, the degree of openness has increased dramatically on average in OECD countries, as well as in Portugal, between 1950 and 2000. While the openness ratio was roughly 25% in Portugal and on average in OECD countries in 1950-55, it increased to 70% in Portugal, and 79% in OECD countries by 1995-2000. Interestingly, Portugal’s openness ratio actually decreased between 1970-75 and 1975-80 from 40% to 32%, possibly as a result of the decolonization process.
Finally, Figure 7 presents the ratio of investment to GDP. Portugal’s investment ratio was substantially below the OECD average early in the period, especially in the 1950s. However, the average investment ratio after 1980 was approximately the same in Portugal as the average of the other OECD countries, and was higher in Portugal between 1995 and 2000. At first glance, this seems to suggest that the lack of investment will not explain a large share of the gap in living standards between Portugal and the other OECD countries, at least after 1980. Note however, that the capital stock of an economy adjusts relatively slowly following changes in the investment rate. Therefore, despite the fact that Portugal’s average investment rate after 1980 has been comparable to the OECD average, Portugal may still lag the OECD average in term of capital stocks.

Source: Penn World Tables, version 6.1
4 – Empirical analysis

In this section, we first extend the analysis of Coulombe and Tremblay (2006) by including Portugal data into their sample of 14 OECD countries. We will show that their main result regarding the significant impact of investment in skills on per capita GDP remains robust both qualitatively and quantitatively. Second, using growth accounting in levels, we will decompose Portugal’s gap in terms of real per capita GDP relative to the mean of the 14 OECD countries in four components: physical capital per worker, human capital, labour market participation, and technology (total factor productivity or TFP).

4.1 – Econometric analysis

Coulombe and Tremblay (2006) derived synthetic time series over the 1960–1995 period on the literacy level of labour market entrants using the demographic profile of the 1994-1998 IALS data. They used this information to measure investment in education in an econometric analysis of cross-country growth for a set of 14 OECD countries. They
show that their direct measures of human capital based on literacy scores outperformed the traditional measures based on years of schooling. Overall, their human capital indicators based on literacy scores have a positive and significant effect on transitory growth and on the long-run levels of per capita GDP. Quantitatively, an increase in the skills associated with one extra year of schooling increases aggregate per capita GDP by approximately 7%.

In this section, we extend the cross-country sample of Coulombe and Tremblay (2006) by adding Portugal data. The purpose of the exercise is to verify if their main result regarding the impact on living standards of human capital indicators based on labour market entrants’ skills data derived from synthetic cohort approach remains robust. We will show that indeed it remains robust and Coulombe and Tremblay’s 7% macro-Mincerian return will then be used in the subsequent section to calculate the contribution of the human capital component in the growth accounting exercise of the gap between Portugal and the mean OECD living standard.

We use exactly the same empirical analysis of Coulombe and Tremblay (2006) and we focus on their preferred time series and cross-section (TSCS) specification that includes an openness variable:

\[
\Delta Y_{i,t} = \beta Y_{i,t-1} + \phi_1 S(k)_{i,t} + \phi_2 S(h)_{i,t} + \phi_3 n_{i,t} + \phi_4 \text{OPEN}_{i,t} + v_{i,t}.
\]  

(1)

In this set-up, \( i = 1, \ldots, 15 \) for the 15 OECD countries in the sample and \( t = 0, \ldots, 7 \) where period 0 corresponds to 1960 and period 7 to 1995 for variables that are measured at one point in time. For variables that are averaged over 5-year intervals, period 1 corresponds to 1960–1964, period 2 to 1965–1969, and so on. The first growth rate used in the regression is for the period 1960–1964 (period 1). The dependant variable is \( \Delta Y_{i,t} \) represents the percentage growth (first difference of the natural logarithm) of per capita GDP. The lagged level of the logarithm \( Y_{i,t-1} \) is included in the list of controls following the tradition of convergence-growth studies. The investment ratio \( S(k)_{i,t} \) is the 5-year average ratio of investment to GDP in period \( t \), and \( n_{i,t} \) is the 5-year average fertility rate in period \( t \). The key variable of interest in this empirical analysis is \( S(h)_{i,t-1} \),
which is the human capital investment indicator based on literacy scores. The measures of human that entered the regression for the growth rate from 1960 to 1964 are based in this empirical set-up on literacy scores for the 17–25 age group in 1960 (period 0). A measure of the average speed of convergence across the 15 countries of the sample is provided by the point estimate of the $\beta$ parameter. Finally, the $\nu_{i,t}$ include an idiosyncratic error term, cross-section fixed effects, and time dummies. More details on estimation techniques are given in the technical note to Table 1.

The results are displayed in Table 1. In Column (1), we reproduced the main results of Coulombe and Tremblay (2006) coming from their open-economy preferred TSCS specification. The new results coming from the 15-country sample that includes Portugal are displayed in Column (2).

The key point that comes out of the analysis is that the point estimate of the literacy variable remains positive and significant at the 5% critical level. The long-run elasticity, which is equal to $-\phi_i/\beta$ in the set-up of equation (1), remains remarkably the same at 1.43 versus 1.45 in our 2006 analysis. Of course the difference in the point estimate of the literacy variable and its long-run elasticity between the two estimations, with and without Portugal, is not significant. The investment rate in physical capital and the convergence speed (the estimate of initial GDP) remain highly significant. The point estimate of the investment rate, and its long-run elasticity $(-\phi_i/\beta)$, are now higher and the convergence speed smaller, but the differences between the old and the new estimates are not statistically significant.

The only significant difference between the two sets of results presented in Table 1 is related to the openness variable. In the 14-country sample, its point estimate is positive and significant. In the new sample, the significance of the openness variable completely vanished. This result indicates that the positive effect of openness is not robust to the inclusion of Portugal in the data set. This can be explained by the fact that, from a statistical point of view, Portugal is an outlier in the OECD sample. Portugal is by far the poorest country both at the beginning and at the end of the sample. Consequently, in least squares estimations, it is likely to contribute more to the results than other countries that are closer to the average. As mentioned before, the idiosyncratic evolution
of the openness variable in Portugal might have been more driven by the decolonization than by trade policy changes.

What matters for the purpose of the actual exercise is the robust estimation of our literacy variable. Including Portugal does not change the impact of human capital on per capita GDP. A 7% macro-Mincerian return for our literacy variable is fully consistent with results presented in Table 1.
Table 1. Growth regressions with and without Portugal

Dependant variable: growth in per capita GDP

<table>
<thead>
<tr>
<th></th>
<th>14 countries</th>
<th>15 countries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Initial GDP</strong></td>
<td>-0.060(^a)</td>
<td>-0.056(^a)</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.011)</td>
</tr>
<tr>
<td><strong>Literacy</strong></td>
<td>0.087(^b)</td>
<td>0.080(^b)</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.031)</td>
</tr>
<tr>
<td><strong>Investment rate</strong></td>
<td>0.036(^a)</td>
<td>0.045(^a)</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td><strong>Fertility rate</strong></td>
<td>-0.016(^c)</td>
<td>0.006</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.007)</td>
</tr>
<tr>
<td><strong>Openness ratio</strong></td>
<td>0.019(^b)</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.01)</td>
</tr>
<tr>
<td><strong>Number of observations</strong></td>
<td>93</td>
<td>102</td>
</tr>
<tr>
<td><strong>Elasticities (K; H)</strong></td>
<td>(0.60; 1.45)</td>
<td>(0.80; 1.43)</td>
</tr>
</tbody>
</table>

**Notes:**
- Regression (1) is taken from Coulombe and Tremblay (2006).
- 14 OECD countries in Column (1).
- Portugal included in Column (2).
- Regressions are over the 1960–1995 sample.
- Data are averaged over 5-year periods.
- System estimations with instrumental variables using iterated weighted two-stage least-squares.
- All regressions include country fixed effects and time dummies.
- \(a, b, \) and \(c\) imply significance at the 1%, 5%, and 10% levels, respectively.
- Instruments used are initial GDP per capita of the previous period and the lagged values of the investment rate, of the fertility rate. Initial literacy is instrumented by the initial schooling taken from de la Fuente and Doménech (2006).
- No significant serial correlation.
- GDP per capita is not available for Germany before 1970.
- The openness variable is not available for Finland before 1970.
4.2 – Accounting for Portugal’s gap in living standards

In 2000, at the end of the time period under study, Portugal had a gap of 44.2 % in terms of per capita GDP with respect to the mean of OECD countries in our sample. In this section, this gap is decomposed in four components: capital per worker, human capital intensity, participation to the labour market, and total factor productivity or TFP.

The contribution of the participation to the labour market component is measured by the difference in 2000 between the gaps in per capita GDP (44.2 %) and GDP per worker (39 %). This number, which is equal to 5.2 %, corresponds to the contribution to the gap of Portugal’s living standard resulting from the fact that the employment rate was smaller than the OECD average. Consequently, other things being equal including labour productivity, living standards in Portugal would increase by 5.2 % if Portuguese people would have worked as much as other OECD workers.

The contribution of physical capital to the Portugal gap results from the fact that (physical) capital per worker, consequently labour productivity, is smaller in Portugal than in the OECD average. We compute the contribution of physical capital by using the data, and the underlying framework, of Vandenbussche, Aghion, and Meghir (2006). To fix ideas, in this set-up labour productivity is \( y = AK^\alpha \), where \( k \) is capital per worker, \( \alpha \) is the share of profits in national income, and \( A \) includes the contribution of human capital and TFP. Capital stock data are computed from gross investment data using a perpetual inventory approach and a 6% depreciation rate over the 1960-2000 period. Initial capital stocks are computed from gross investment data from the 1950s. In our analysis, \( \alpha \) is assumed to equal 0.3. We found that the lower capital per worker in Portugal in 2000 contributed to a gap of 12.6 % in labour productivity compared with the OECD average.

The contribution of human capital is computed using the human capital gap from the literacy of labour market entrants between Portugal and the OECD mean, and the 7 % macro-Mincerian return that comes out of Coulombe and Tremblay (2006) as well as from the analysis of the previous section. As mentioned before, the gap in literacy at the end of the period corresponds to the skills acquired with 3 years of formal education. The 7 % number is for one year of education. Consequently, the human capital gap contributes in 2000 to a 21 % lower living standard in Portugal compared with other OECD countries.
As usual in this exercise, total factor productivity is measured residually as being the difference between the per capita GDP gap of 44.2% and the sum of the contributions of human capital (21%), physical capital (12.6%), and labour market participation (5.2%). The result, 5.4%, implies that the lower level of technology used in Portugal contributes to lower living standards of 5.4% relative to the OECD average.

In Figure 8, the contribution of each component is illustrated with the gap of 44.2% normalized to 100 (%). The human capital component contributes by itself to 47.5% of the living standard gap between Portugal and the OECD mean. The lack of physical capital contributes to 28.5%, the lower employment rate to 11.8% and TFP to 12.2%. As we can see, the deficiency in the human capital of labour market entrants constitutes, by a substantial margin, the single most important contributor to the living standard gap between Portugal and the other OECD countries.

5 – Conclusion

Although the relative economic growth of Portugal in the last half century has been notable, living standards in Portugal remain far below those of most Western European countries. In this paper, we investigated the key role of human capital in accounting for Portugal’s relative living standard. One of the main features of our analysis is the use of direct measures of the human capital of labour market entrants, constructed from literacy tests scores. Using direct measures of skills circumvents several
of the measurement problems that arise when estimating the effect of human capital accumulation, measured by schooling indicators, in cross-country growth studies.

The main findings of our analysis are the following:

- The convergence of Portugal’s living standard to the OECD average between 1950 and 2000 has been substantial. The gap in real GDP per capita between Portugal and the average of fourteen other OECD countries decreased from 123% in 1950 to 44% in 2000.

- The gap in 1960 in the skills of labour market entrants between Portugal and the OECD average, measured from the test scores of the IALS, corresponded to approximately 6 years of education. It was much greater for women (7 years) than for men (4 years). For both sexes taken together, this gap did not start to decrease before the 1980s, although it did start to decrease earlier for female labour market entrants who made amazing progress between 1970 and 1995, a period during which their skill gap relative to the OECD average decreased from the equivalent of 8.5 years of education to 2.5 years only. Overall for both sexes, the skill gap of Portuguese labour markets entrants in 1995 corresponded to 3 years of education.

- Human capital, measured directly from literacy tests scores, is found to be a critical determinant of relative living standards in a set of fifteen OECD countries between 1960 and 2000. The regression results imply that an average increase in skills corresponding to one year of education will increase per capita GDP by about 7%.

- Our decomposition analysis indicates that the skills deficiency of Portugal, relative to the OECD average, accounts for 47.5% of the gap in real GDP per capita between Portugal and the OECD average. Lower physical capital per worker accounts for 28.5% of the GDP per capita gap, while lower labour market employment and total factor productivity account for 11.8% and 12.2% of the gap, respectively.

Despite the considerable improvements of Portugal in terms of skills accumulation, the skill gap of labour market entrants relative to the OECD average remains relatively important. Overall, our analysis suggests that the macroeconomic returns from massive investments in education in Portugal would likely be substantial.
Since the macro-Mincerian rate of return to education may be decreasing as the average level of education increases, 7% may well be a lower-bound estimate for Portugal given that the average years of schooling of Portuguese is relatively far below the OECD average. This would be consistent with the empirical findings of Vieira (1999) and Hartog, Pereira and Vieira (2001) based on individual data for Portugal. They found that the individual returns from education were relatively high, and interestingly, they found that they were increasing with the level of education.

The comparison of the evolution of average years of schooling indicators with direct measures of human capital based on skills tests also suggest that the quality of education in Portugal is comparable to that of other OECD countries and has probably increased considerably in the 1970s and 1980s. As a result, efforts should probably be targeted mostly at increasing the quantity of schooling, rather than the quality. However, given the unavoidable pressures on educational resources, increasing the educational attainment of the labour force without compromising the quality of education can be difficult, and will require a substantial fiscal effort.

There are a number of policy measures that can have a direct effect on the quantity of education. Examples include increasing years of compulsory education and measures aimed at increasing accessibility and enrolment rates in post-secondary education. Our analysis suggests that such measures could have large macroeconomic benefits. Since private capital markets are generally inefficient at financing investments in education, achieving large increases in the average years of schooling in the Portuguese labour force will likely require massive investments of public funds. Public investments may be needed to improve the educational infrastructure of the country, to supply human resources in the education system including teachers, and to reduce the private cost of education to individuals through public scholarship and loan programs to students, for example.

Finally, although the relative lack of physical capital accounts for close to 30% of the GDP per capita gap between Portugal and the OECD average, policy interventions to increase growth should probably not focus on stimulating investment in physical capital. Portugal’s average investment rate since 1980 has been comparable to the OECD average, and has been higher than the average between 1995 and 2000. With such
investment rates, Portugal’s capital stock will tend to converge over time to the OECD average. Moreover, it is now well understood in the economic growth literature that in an open economy, the dynamics of physical capital accumulation are essentially driven by the accumulation of human capital. As workers accumulate skills, international capital markets will finance domestic investment in physical capital.
Appendix

Figure A.1: Log of Real GDP Per Worker

Source: Penn World Tables, version 6.1
Figure A.2: Literacy Scores by Skill Domain (Prose, Quantitative, Document)

Source: constructed by the authors using data from the International Adult Literacy Survey.
References


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