Eppur si Muove! Spain: Growing without a Model*

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Contents

1 Introduction

Through the lenses of a couple of neoclassical dynamic general equilibrium models —that is to say: models with a convex production set— we try making sense of the Spanish growth experience since the transition to democracy in 1978. We are not sure we can claim full success, but the following pages contain some useful insights about Spain and about applied growth theory. Our temporary conclusion is that, maybe, "España es diferente" from what standard theory predicts, but not by much. On the one hand, it is true that the Spanish growth experience is inconsistent with what the most established models of economic growth predict. On the other hand, the Spanish growth process can be rationalized by a "not so strange" dynamic general equilibrium model of technology adoption once three, specific, historical and institutional characteristics of Spain are taken into account.

i) In the late 1970's Spain was, and has remained since, far from the technological frontier;

ii) In the late 1970's Spain had a rigid and non-competitive labor market that was only partially reformed in the 1980s and 1990s. It turned not into a competitive market, but into a dual one; and

iii) During the last decade or so, Spain has witnessed a dramatic inflow of cheap migrant labor that increased its labor force of about 25%.

Taking these peculiarities into account, we believe to have learned something useful along three dimensions. First, about what kind of growth patterns this class of models may or may not explain, at least at a qualitative level. Second, about how actual growth experiences take place, and about which theories are consistent with them. Third, about which policies may be useful in the current situation, and in the very near future. We will elaborate on each of these themes in due course.

The paper is organized as follows. We start with a description of the aggregate time series and we highlight a number of puzzles, or questions. Next we use a standard, neoclassical growth model with exogenous TFP, competitive markets and a Cobb-Douglas technology to perform a growth accounting exercise and explain why the puzzles identified in the historical analysis are indeed puzzling in the light of established economic theory. Then we discuss —albeit briefly— why models of the so called "new growth theory" variety (models with externalities, increasing returns, and so on) are worthless in understanding the Spanish growth experience. After this, we sketch out our general theoretical model and, in Section 5, we outline how it can explain, at least at a qualitative level, the Spanish facts. Finally, in the last section, we wrap up our analysis and discuss some of its policy implications. We include a data Appendix at the end of the paper.

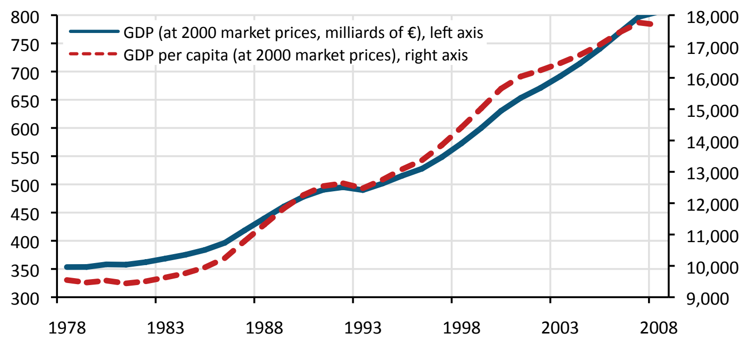
2 A Look at the Spanish National Accounts

2.1 Demand Side

Here is Spanish GDP from the beginning of democracy, thirty years ago, to today, expressed in the market prices of the year 2000. First things first: Spain grew. Over three decades, aggregate GDP grew by 128%, which corresponds to an average annual growth rate of 2.4 percent, and per-capita GDP grew by 84 percent, which corresponds to a 1.7 percent average annual growth rate, pretty close to Ed Prescott's magical 2% number. In Figure 1 we represent both time series.

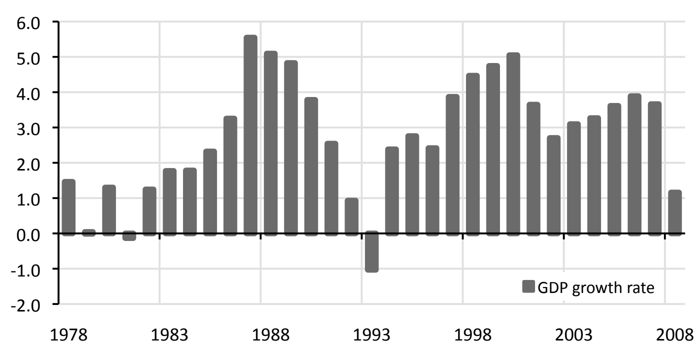
In Figure 2 we represent the GPD growth rate and two very long "growth cycles" stand out immediately. The first cycle started roughly at the time of Spain's admission into the European Union in 1985, or perhaps sligthly before, and it ended quite abruptly in 1992-93. The second cycle started in 1994-95 and, as we all know, it ended even more abruptly, last year. Had we gone back further in time, as far back as the available

Figure 1: GDP and GDP per Capita (2000 constant market prices)



set of consistent time series allows us, we would have found a third, even longer, growth cycle that started in 1959-60 and lasted until 1973-74. It was followed by almost a decade of economic stagnation. Two full cycles in about thirty years, and each one of them about 15 years long, are clearly not the matter of "standard" business cycle theory. At least, this is certainly not the frequency at which business cycle analysis is carried out, and business cycle models are written, calibrated and simulated. Because of this, we look at growth models for guidance and we ask whether they can account for the Spanish experience in one way or another. We also ask whether they can help us to understand it, and to make informed guesses about the times to come.

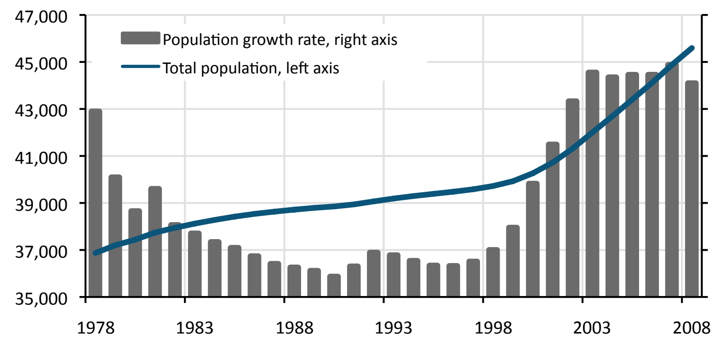
Figure 2: GDP growth rate (2000 constant market prices)



Per capita income has traveled roughly along the same waves, even if the last one —which seems bigger than the previous one in the aggregate data — is in fact smaller when measured in per capita terms. It so happens that after about thirty years of very slow growth, Spanish population grew at a remarkable pace during the last ten years from 39M to 45M people (see Figure 3 and Table A.1 in the Appendix). This implies that the growth rate of per capita income has been about 1.5 percentage points lower than the aggregate growth rate.

While they do not really add much to the information contained in Figure 1, it is also worth looking at the evolution over time of the various components of Spanish GDP. Consumption is first (see Figure A.1) and it reveals nothing we would not already know or expect: it also displays two growth cycles, but less pronounced than those in GDP, as elementary economic theory predicts. Government consumption grows remarkably faster than private consumption and it is also quite pro-cyclical. The diligent reader may want to

Figure 3: Spanish Population annual growth rate



make a note of the latter, as a number of models, frequently adopted to either interpret the data or provide prescriptions for policy, predict or advocate government spending to be counter-cyclical. In Spain, at least, it certainly has not been.

Again, as elementary economic theory predicts, investment fluctuates more than GDP. In fact, as Figure A.2 shows, the growth rate of Gross Capital not only went negative twice already in Spain (the third time is still taking place and it is only barely hinted at in the available data) but it also displays, especially in the equipment component, three cycles, as the slowdown of 2001 was substantial and the recovery during 2002-2008 is clearly visible.

Finally, because the National Income Accounting of the demand side is not complete without a look at the external sector, but also because Spain is a small and progressively *much more* open economy[1], we should take a look at imports and exports (and the trade deficit), also reported in the Data Appendix. Again, we find the two long cycles, with, again, the inflexion around 2001 that may suggest they were actually three, and the dramatic growth of which we are all aware, especially in imports, during the last seven years.

2.2 Supply Side

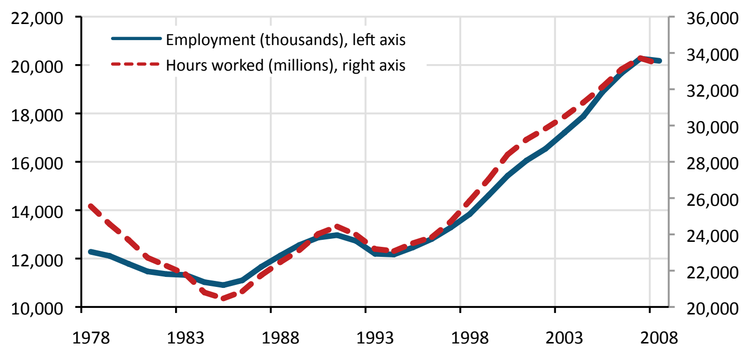
To approach the supply side of the story, we adopt a production function point of view. What this means is that we assume the existence of some, time variant, relation $F_t(K_t, L_t, ...)$ summarizing the link between inputs and outputs. Value added is the result of "mixing" and operating together labor and capital, under varying technological conditions.

2.2.1 Employment

Let us start from the aggregate employment numbers, reported in Figure 4. Here comes the first surprise: the two cycles, so visibly similar in the output and demand data, are still visible but they are less similar here (see also Figure A.9 where we report the employment growth rates). During the first growth cycle employment grew, but not a lot: by about 1.2 million workers in absolute terms from trough to peak, which corresponds to about 10% of the initial value of employment. During the second growth cycle, employment grew much more in both absolute and relative terms: by about 8 million workers and 66%. Therefore, while total output grew at very similar annual rates during the two growth waves (see Table A.1) the labor input, at least when measured in numbers of people, did not.

[1]Spain has an openness ratio, $(X + M)/GNP$, of 0.7 which is bigger than Great Britain, France, or Italy.

Figure 4: Employment and Labor Hours



Maybe a reconciliation of these two facts can be found in the behavior of total labor hours, which are the product of total hours per workers and the number of workers. But (see Data Appendix) the answer is not there either: hours per worker have been declining, albeit not steadily, since 1978. Hence, as we can see in Figure 4 total hours worked have behaved almost like the number of workers: they increased by about 11% during the first growth wave and by about 40% during the second wave.

From a long run perspective, and focusing on the number of workers, there was an almost *de facto* stagnation between 1976 and 1994, followed by a spectacular growth of about 86 percent from trough to peak between 1994 and early 2008, when employment started to decline again, and at a dramatic pace. In more detail: the Spanish economy destroyed about 1.8 million jobs between 1976 and 1984. Then it recovered them, only to remain stuck at a total employment figure of about 13 million workers until 1993, when it lost about 1 million workers in roughly two years. To put it differently, in the fifteen years that preceded the 1993-94 recession, the growth rates of total employment had been positive, but far from impressive: between 0.5 and 0.9 percent per year, to result in a total increase of about 1.4 million jobs in almost 12 years (between 1980 and 1992). Then, during the next 14 years, the number of jobs created grew by more than fivefold!

In this long-run scale, the recession of 1993-94, with the major job destruction that it brought about —to which many pundits associated miraculous effects on wages and labor market— is barely visible. If it really "created" the "wage moderation" that explains the subsequent employment growth (se for example Bentolila and Jimeno (2006)), then it was indeed miraculous. Instead, what appears to us to be truly miraculous are the 8 million jobs created between the second quarters of 1994 and 2008. This huge increase needs explanation vis-a-vis the earlier very long stagnation in job-creation and the current, and no less dramatic, process of job destruction.

Figures A.7-A.17, in the Data Appendix, document some more facts of the Spanish labor market. While it is true that, after 1992, the employment of women more than doubled and grew, in percentage terms, a lot more than the employment of men, in absolute terms the increases were about equal: 4 million extra employed males and 4.3 million extra employed females. Hence, Spain's "new" employment was tremendously egalitarian amongst the sexes while the most recent data suggests that the "new" unemployment is not. Because most of the labor adjustment, approximately 55 percent, has taken place in the construction sector, males are being fired an order of magnitude faster than females (see Figure A.10 and A.11).

Figure A.12 also shows that the expansion that just ended was not all "bricks and mortar". Employment in the services sector roughly doubled during the same period, from 7.2 million in the second quarter of 1994 to 13.9 million in the third quarter of 2008. This means that most of the extraordinary growth in employment took place in the service sector[2]: about 6.5 million went into services, 1.7 million went into construction

[2]Real state services, during the last expansion, represented less than 1% of total employment in services.

and 1.8 million went into industry. Figure A.13 shows how this increase was split, 55-45, between Spanish nationals and immigrants. The following table summarizes our main findings about the two growth cycles that are the object of our investigation.

Table 1: Changes in the Labor Market during the two Growth Waves

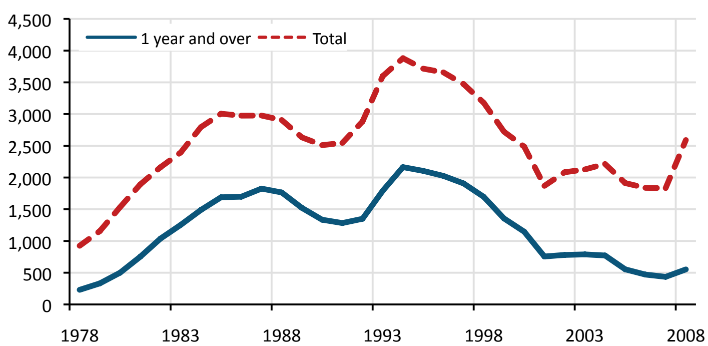
	ΔL^a	$\Delta L\%^b$	$\Delta(L/N_1)^c$	$\Delta(L/N_2)^d$	ΔH^e
1984–1993	1,172.9	10.6%	2.4%	–0.1%	11.5%
1994–2008	8,006.0	65.9%	18.7%	14.3%	44.7%

[a] Growth in employment (thousands); [b] Growth in employment (%); [c] Growth in Employment per person in the 16–64 age group (%). [d] Growth in Employment per person over 16 (%); [e] Growth in labor hours (%).

2.2.2 Unemployment

While "unemployment" is, for many reasons, a poorly defined concept, we will analyze its reported values next to help us zoom-in on our first "puzzle".

Figure 5: Unemployed (LFS) and more than 1 year unemployed



Beginning with the crisis of 1974-75, a "stock" of about 2.5-3.5 million "unemployed" people was created, in a process that lasted more than ten years and peaked around 1985. That "stock" of unemployment remained there for about 10-15 years and, even during the very best years of the latter expansion, between 2002 and 2006, there were still 2 million officially unemployed people in Spain! During the 1975-2000 period, the stock of working age people grew at a moderate rate of about 0,8% per year and scholarization grew tremendously[3] still, as Figure 5 shows, the stock of people unemployed for more than a year dropped below 1.5 million only in 2000. After that date, and in spite of a much higher growth rate of the working age population, which runs at around 1.7% between 2001 and 2008, the number of long term unemployed drops below 0.5 million.

Summing up: the two growth cycles differ in their duration but, most importantly, they differ in their impact upon employment and unemployment. The first growth wave, between 1985 and 1993, was a somewhat "jobless" expansion that lead to a very small reduction of the Spanish unemployment rate. The second growth wave, between 1995 and 2007, lead to a very large increase in employment and to a substantial drop in the measured unemployment rate. Therefore, our first research question is the following:

[3] In 1978, 77 percent of the working age population had either primary or lower levels of education, while, in 2008, 50 percent of the working population had secondary education or higher.

Question No. 1 *What, if anything, happened to the Spanish labor market between 1993 and 1995 that may help us understand the large differences in the behavior of employment between the two growth waves?*

Question No. 2 *If the change or the cause of the change was not in the labor market, where was it?*

2.2.3 Productive Capacity

One way of assessing how installed productive capacity evolved over time is to look at the movements of the capital/output ratio, K/Y, that we report in Figure 6 and Figure 7 at 2000 prices. Two facts stand out: during the great expansion that ended around 1973, the K/Y ratio dropped dramatically, suggesting either very large productivity gains or a "wearing out" of productive capacity due to an investment rate lower than what a sustainable growth process would require. Which of the two hypotheses is supported by data will be clear momentarily. After 1974, K/Y starts growing again and it does so in a cyclical fashion. Puzzling as this may be, it is hardly consistent with the predictions of standard growth models, be they of the endogenous or exogenous variety.

Figure 6: The Growth Rates of the Capital-Output Ratio and GDP

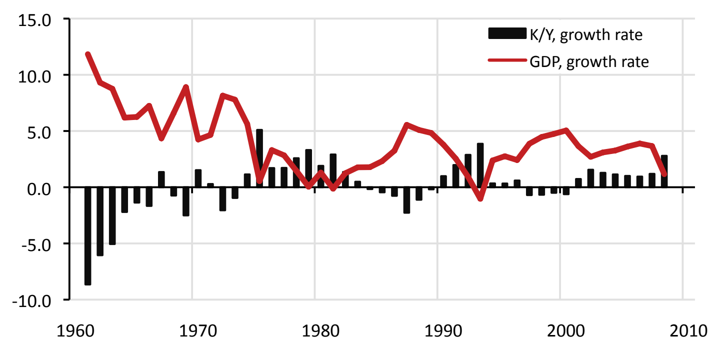


Table 2: The Correlations of the Growth Rates of Output, Labor, K/Y, and K/L

	Period 1961–2008				Period 1961–1975				Period 1976–2008			
	ΔY	$\Delta(K/Y)$	$\Delta(K/L)$	ΔL	ΔY	$\Delta(K/Y)$	$\Delta(K/L)$	ΔL	ΔY	$\Delta(K/Y)$	$\Delta(K/L)$	ΔL
ΔY	1.00				1.00				1.00			
$\Delta(K/Y)$	–0.89	1.00			–0.95	1.00			–0.81	1.00		
$\Delta(K/L)$	–0.20	0.36	1.00		–0.73	0.87	1.00		–0.85	0.80	1.00	
ΔL	0.35	–0.27	–0.87	1.00	0.47	–0.35	–0.43	1.00	0.89	–0.65	–0.95	1.00

Data reported in the Appendix (Figures A.18, A.19 and A.20) confirm both of these findings: the recession of 1973-74, and the long stagnation following it, define a shift in the statistical relation between capital and output. In the earlier period, capital is growing faster than labor (hence K/L is increasing) but a lot slower than output (hence K/Y is decreasing); this is because Total Factor Productivity is growing at a remarkable pace, as Figure 8, below, confirms. In other words, while the two ratios comove, and they are both countercyclical, their growth rates are of different magnitudes, and the difference is accounted for by a positive TFP growth rate. After, roughly, 1974-75, K/L and K/Y (see Figure 7) move in steps and their growth rates become similar also in absolute value. That the answer to the question we are going to ask next is not in the trivial observation that relative prices changed, or at least their trend moved around, is proved by Figure A.21: in Spain, like everywhere else, the relative price of capital and durable goods has been declining pretty much monotonically during the whole relevant period. The difference seems to be the dramatic drop in the growth rate of TFP for most of the years following 1975. Hence we ask:

Question No. 3. *Why are K/Y and K/L so often counter-cyclical in Spain?*

Figure 7: The Capital-Output and Capital-Labor Ratios

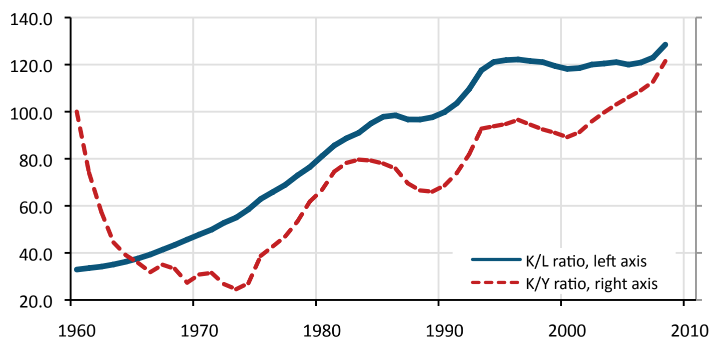
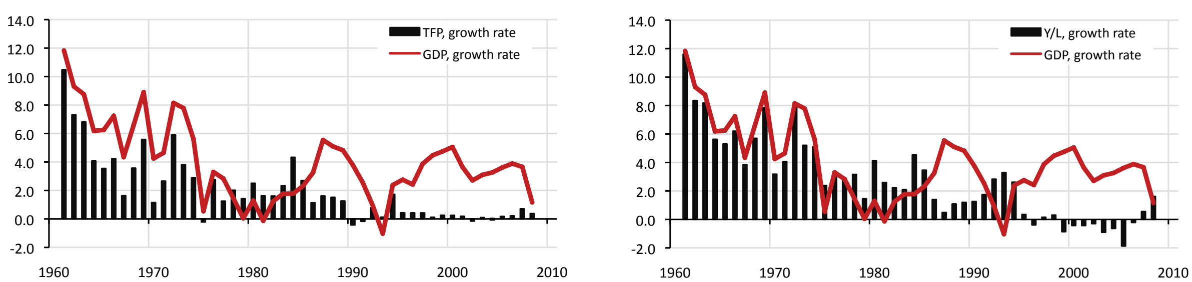


Figure 8: The Growth Rates of Total Factor Productivity, Y/L, and GDP



2.2.4 Productivity

Next, in Figure 8, we show the growth rates two standard measures of aggregate productivity: labor productivity (Y/L) and total factor productivity (TFP). The message here is clear: productivity growth in Spain is also countercyclical. Both measures of productivity increase during the recessions or periods of very slow growth, and they decrease when output and employment are growing at above average rates.

The change, that took place after 1975 in the sign of the correlations between output and all three measures of productivity (TFP, output per worker and output per hour) is particularly remarkable (see the last two blocks of Table 3). For example, the correlation between the growth rates of output and output per worker changed from being 0.95 between 1961 and 1975 during the catching up period to being –0.60 between 1976 and 2008. The changes in the correlation between the growth rates of output and TFP are —from 0.95 to –0.25— are similarly striking. Such a radical change cries for an explanation. Specially since it cannot be reconciled with the predictions of any of the readily-available off-the-shelves growth models. Nor can it be attributed to some kind or another of a "business cycle" shock, because the first pattern lasted for almost twenty years and the second one has been with us for more than thirty years now.

Table 3: The Correlations of the Growth Rates of Output, TFP, and Y/L

	Period 1961–2008				Period 1961–1975				Period 1976–2008			
	ΔY	ΔTFP	Δ(Y/L)	Δ(Y/H)	ΔY	ΔTFP	Δ(Y/L)	Δ(Y/H)	ΔY	ΔTFP	Δ(Y/L)	Δ(Y/H)
ΔY	1.00				1.00				1.00			
ΔTFP	0.74	1.00			0.95	1.00			–0.25	1.00		
Δ(Y/L)	0.62	0.92	1.00		0.95	0.99	1.00		–0.60	0.74	1.00	
Δ(Y/H)	0.53	0.94	0.94	1.00	0.93	0.98	0.99	1.00	–0.59	0.90	0.84	1.00

This puzzling behavior of output and productivity substantiates Question 4, which we formulate as follows:

> **Question No. 4.** *Why is it that in Spain after 1975 the growth rates of both labor productivity and TFP became both negligible and countercyclical?*

2.3 Changes in the Spanish Labor Market

The two main reforms of the Spanish labour market took place in 1984 and 1994. The 1984 labour reform completely liberalized term contracts, which started to be used extensively after that date. This created, *de facto,* a dual labor market*:* jobs that existed before the reform remained "protected", and jobs created after the reform could fall into either of the two separate worlds, permanent jobs and term jobs. As it should be expected, term contracts grew slowly at the beginning, and then they spread across the economy. By the early 1990s, one third of Spanish workers had a liberalized term contracts (see Figure A.17).

The 1994 reform was more far-reaching. It allowed private employment agencies to operate freely, and it substantially altered the *Estatuto de los Trabajadores*, weakening many of the previous employment protection rules. It also introduced additional flexibility in firing costs and in the collective bargaining process, allowing for a large variety of "opt-out" clauses that could be used by companies subject to one form or another of "economic distress". Finally, the 1994 reform also reduced the generosity of the unemployment insurance program. It was completed in 1997 with the introduction of a new contract called the *Contrato de Fomento a la Contratación Indefinida*, which lowered severance pay albeit in a controversial way: the new contract did not apply to workers in the 30-44 age group who had been unemployed for less than a year, thereby consolidating the dual nature of the Spanish labor market. A further reform took place in 2002, leading to a minor reduction in firing costs.

2.4 Factor Prices and Factor Shares

2.4.1 Cyclical Labor Shares

Figures 9 and 10 report factor shares, and their growth rates, together with the growth rates of output. Quite visibly, Spanish factor shares follow a cyclical pattern until the early stages of the last expansion, after which the cyclicality remains but becomes somewhat more blurred (our hunch, though, is that when the data for the current recession will become available, the cyclicality, as described below, will become even more apparent). This overall cyclical nature is confirmed by the sample correlations, reported in Tables 4-7. Notice, first of all, that these large and regular oscillations contradict the standard growth model we just presented, where shares are supposed to be constant and, therefore, acyclical. While many researchers tend to minimize the relevance of this fact, we believe it contains important information about how the growth process develops and how technologies and markets interact, hence we should examine the cyclical nature of factor shares a bit more closely. To avoid repetitions we focus on the labor share as the capital share, obviously, behaves the opposite way.

Begin by pointing out that the labor share grew substantially between 1960 (when the first reliable data become available) and about 1975[4]: it increased by almost 16 percentage points of GDP, and after that "structural adjustment" it never went under 62% again. Secondly, the labor share is strongly countercyclical all along but, after 1995 or so this relation becomes more complicated. In particular: why output increases for more than a decade, the labor share first recovers with a lag (as it was also the case in the past) but then, after 2000, it starts decreasing again even if output growth remains positive and strong. Recall that this is a period of rapid increase in employment and, before the year 2000, the labor share always increased whenever employment increased. In other words, somewhere around year 2000 something happens that terminates a long-standing correlation.

Figure 9: Capital Share and GDP

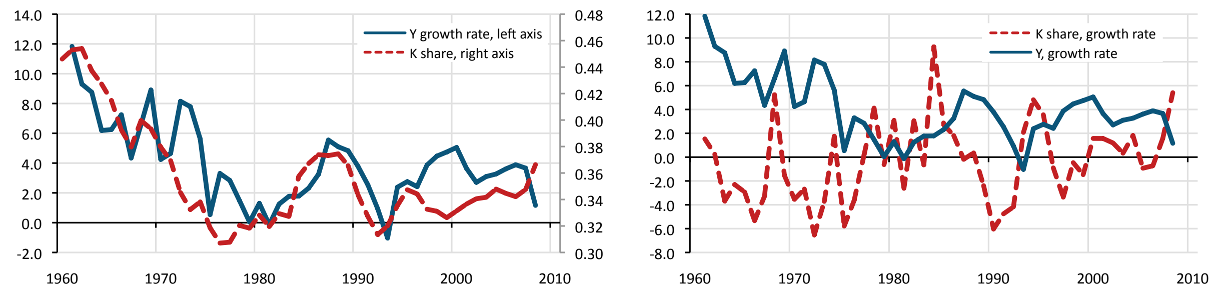
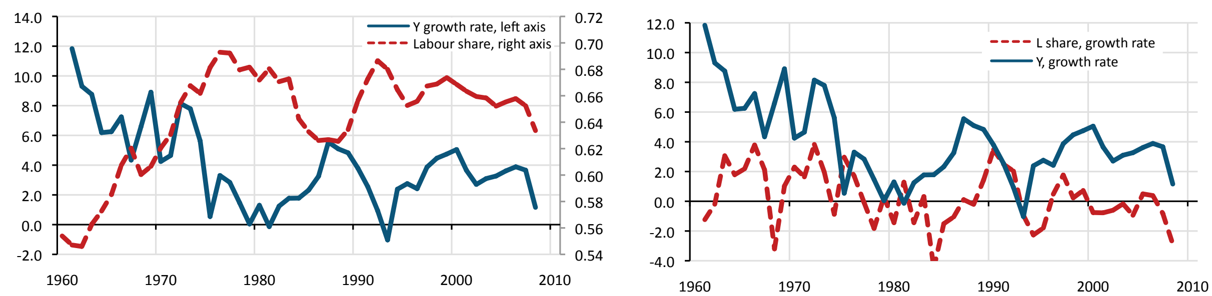


Figure 10: Labour Share and GDP



[4]1977, in fact, but we prefer using always 1975 as a reference point for the "transition to democracy break", even at the cost of some imprecision in particular instances.

Table 4: Correlations between the Growth Rate of Output and the Factor Shares (1961-2008)

	ΔY	L share	K share
ΔY	1.00		
L share	-0.75	1.00	
K share	0.75	-1.00	1.00
	ΔY	Δ(L share)	Δ(K share)
ΔY	1.00		
Δ(L share)	0.27	1.00	
Δ(K share)	-0.25	-0.99	1.00

Table 5: Correlations between the Growth Rate of Output and the Factor Shares (1961-1975)

	ΔY	L share	K share
ΔY	1.00		
L share	-0.63	1.00	
K share	0.63	-1.00	1.00
	ΔY	Δ(L share)	Δ(K share)
ΔY	1.00		
Δ(L share)	-0.28	1.00	
Δ(K share)	0.32	-0.98	1.00

2.4.2 Correlation between real wages and labor productivity

Figure 11 and Table 8 confirm that, at least at the most basic level, the Spanish labor market behaves "normally": on average, real wages grow when labor productivity grows and viceversa. Still, a particular "anomaly" emerges when one looks at the relation between employment, labor productivity and real wages. Once again the period around 1975, that is the period of the transition to democracy, seems to signal some kind of a structural break.

Before 1975, variations in real wages are essentially uncorrelated with variations in employment, while the correlation becomes strongly negative after that year. This means that when employment grew more than on average, wages either decreased or grew below average, and viceversa. Recall that a low correlation between the aggregate real wage and employment is also a feature of the US data at business cycle frequency, and it coincides with the prediction of a standard RBC model when labor contracts are present or labor supply is highly elastic (Danthine and Donaldson, 1990). A negative correlation, though, could obtain only absent any form of technological progress as firms, facing decreasing marginal productivity of labor, travel along their static demand curve for labor. Secondly, but this fact we already know from earlier on, while before 1975 the correlation between employment and labor productivity is weak but positive, after that year it is very strongly negative. Notice, again, that most standard models (in which employment is basically determined by labor productivity) predict that the correlation should be positive and strongly so. Hence, post 1975, Spain becomes an "anomalous growth country": as employment increases productivity and real wages do not grow or even decrease.

2.4.3 Co-movements between the K/Y Ratio, Factor Prices, and Factor Shares

Figure 12 shows that the K/L ratio reacts quite strongly to factor prices: they comove. The comovements are negative until 1975 (when the real wage grows less than on average the K/L ratio grows more than on average) and positive after that. This induces yet another puzzle: we have noted that, among most

Table 6: Correlations between the Growth Rate of Output and the Factor Shares (1976-1995)

	ΔY	L share	K share
ΔY	1.00		
L share	-0.65	1.00	
K share	0.65	-1.00	1.00
	ΔY	$\Delta(L$ share)	$\Delta(K$ share)
ΔY	1.00		
$\Delta(L$ share)	0.21	1.00	
$\Delta(K$ share)	-0.20	-1.00	1.00

Table 7: Correlations between the Growth Rate of Output and the Factor Shares (1995-2008)

	ΔY	L share	K share
ΔY	1.00		
L share	0.87	1.00	
K share	-0.87	-1.00	1.00
	ΔY	$\Delta(L$ share)	$\Delta(K$ share)
ΔY	1.00		
$\Delta(L$ share)	0.57	1.00	
$\Delta(K$ share)	-0.56	-1.00	1.00

dimensions, aggregate variables behave until 1975 in a way that is similar to what our standard growth model predicts, but the same model predicts that when the K/L ratio increases labor productivity and real wages increase, and this seems not to have been the case. Viceversa, after 1975, when Spanish aggregate quantities contraditct the standard growth model along most dimension, this particular correlations gets on line and real wages grow together with the K/L ratio. More headhaches to come, in other words.

Finally, we note that, during both subperiods, employment grows when the labor share decreases even if the correlation is weak.

Figure 11: Real Wages and Y/L Growth Rate

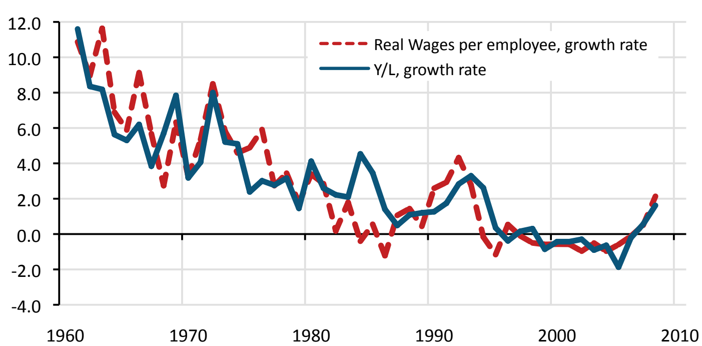
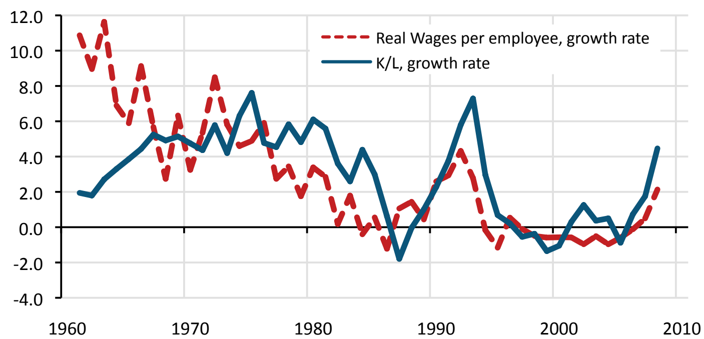


Table 8: Correlations between Real Wages and Productivity (Y/L) (1961-2008)

	Period 1961–2008			Period 1961–1975			Period 1975–2008		
	ΔW	ΔY/L	ΔL	ΔW	ΔY/L	ΔL	ΔW	ΔY/L	ΔL
ΔW	1.00			1.00			1.00		
ΔY/L	0.88	1.00		0.78	1.00		0.63	1.00	
ΔL	-0.39	-0.52	1.00	-0.03	0.15	1.00	-0.59	-0.90	1.00

Figure 12: Real Wages and Capital per Labour Growth Rates



2.5 Summing up

We sum up our long analysis with a list of " Ten Facts".

1. There was growth in both aggregate and per-capita Spanish income since 1975.
2. Growth was not steady, but it came in two big and long waves (they followed an earlier one that had just ended). In other words: no balanced growth in Spain, but cyclical growth along relatively long waves.
3. While before 1975 the aggregate Spanish variables had behaved - with the significant exception of the relation between K/L intensity and real wages - as standard growth models predict, this was no longer

Table 9: Cross-correlations 1961-2008

	ΔY	$\Delta K/L$	ΔW	ΔL	$\Delta Y/L$	ΔTFP	L share	$\Delta(L$ share)
ΔY	1.00							
ΔK/L	-0.20	1.00						
ΔW	0.60	0.51	1.00					
ΔL	0.35	-0.87	-0.39	1.00				
$\Delta Y/L$	0.62	0.54	0.88	-0.52	1.00			
ΔTFP	0.74	0.25	0.79	-0.30	0.92	1.00		
L share	-0.74	0.11	-0.56	-0.06	-0.63	-0.71	1.00	
$\Delta(L$ share)	0.27	0.12	0.49	0.11	0.15	0.05	-0.05	1.00

Table 10: Cross-correlations 1961-1975

	ΔY	$\Delta K/L$	ΔW	ΔL	$\Delta Y/L$	ΔTFP	L share	$\Delta(L$ share$)$
ΔY	1.00							
$\Delta K/L$	-0.73	1.00						
ΔW	0.68	-0.62	1.00					
ΔL	0.47	-0.43	-0.03	1.00				
$\Delta Y/L$	0.94	-0.66	0.78	0.15	1.00			
ΔTFP	0.95	-0.74	0.79	0.21	0.99	1.00		
L share	-0.63	0.88	-0.55	-0.17	-0.64	-0.68	1.00	
$\Delta(L$ share$)$	-0.28	0.21	0.26	-0.13	-0.27	-0.27	0.29	1.00

Table 11: Cross-correlations 1976-1994

Variables	ΔY	$\Delta K/L$	ΔW	ΔL	$\Delta Y/L$	ΔTFP	L share	$\Delta(L$ share$)$
ΔY	1.00							
$\Delta K/L$	-0.86	1.00						
ΔW	-0.23	0.55	1.00					
ΔL	0.94	-0.92	-0.26	1.00				
$\Delta Y/L$	-0.57	0.75	0.22	-0.82	1.00			
ΔTFP	-0.03	0.06	-0.17	-0.26	0.57	1.00		
L share	-0.65	0.81	0.72	-0.62	0.38	-0.13	1.00	
$\Delta(L$ share$)$	0.21	-0.10	0.53	0.37	-0.55	-0.68	0.24	1.00

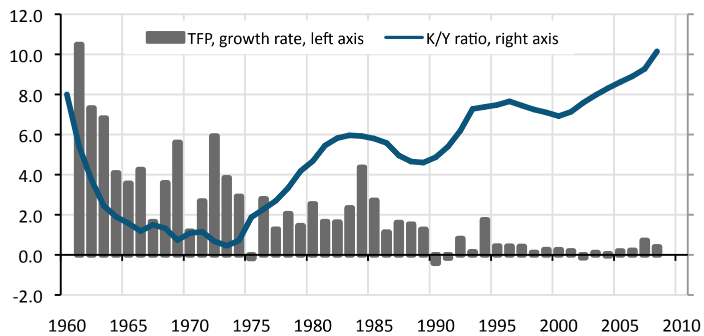
Table 12: Cross-correlations 1995-2008

Variables	ΔY	$\Delta K/L$	ΔW	ΔL	$\Delta Y/L$	ΔTFP	L share	$\Delta(L$ share$)$
ΔY	1.00							
$\Delta K/L$	-0.81	1.00						
ΔW	-0.53	0.70	1.00					
ΔL	0.88	-0.92	-0.68	1.00				
$\Delta Y/L$	-0.44	0.74	0.63	-0.82	1.00			
ΔTFP	-0.09	0.22	0.53	-0.30	0.46	1.00		
L share	0.87	-0.87	-0.61	0.80	-0.47	-0.25	1.00	
$\Delta(L$ share$)$	0.57	-0.74	-0.31	0.65	-0.54	-0.09	0.71	1.00

Table 13: Correlations between Output and Labour Share Growth Rates

	ΔY_{t-3}	ΔY_{t-2}	ΔY_{t-1}	ΔY_t	ΔY_{t+1}	ΔY_{t+2}	ΔY_{t+3}
$\Delta(L$ share$)_t$ period 1961-2008	0.58	0.49	0.43	0.27	0.18	0.14	-0.01
$\Delta(L$ share$)_t$ period 1961-1975	0.36	-0.05	-0.03	-0.28	-0.24	0.06	-0.01
$\Delta(L$ share$)_t$ period 1976-1994	0.69	0.58	0.46	0.21	0.10	-0.40	-0.60
$\Delta(L$ share$)_t$ period 1995-2008	-0.24	0.07	-0.15	0.57	0.70	0.23	0.17

Figure 13: TFP Growth Rate and K/Y



the case after 1975. In other words, something important happened in 1975 that altered a number of structural relations.

4. The extent of the change can be seen by comparing the correlations reported in Tables 10 and 11. A large fraction of the entries do not just change in magnitude but in sign. In fact, the relation between labor share and the other main aggregate variables is almost the only one not to vary (too much): the labor share is countercyclical all along and it increases with both employment and the K/L ratio. Its relation with productivity, measured both as TFP and Y/L, though, switches from negative to very mildly positive (one could say that it vanishes) from one sub-period to the next.

5. The first growth cycle was the product of a relatively small increase in employment and a relatively strong increase in productivity. The opposite during the second: extremely weak productivity growth and historically high employment growth.

6. The K/L and K/Y ratios are neither constant nor monotone, as basic theory predict.

7. The long-run slow down in productivity growth is dramatic: productivity grows strongly until 1975, slows down but remain positive between then and 1995, after which (in correspondence to the second growth wave of democratic Spain) it all but disappears. On top of that, productivity growth, which before 1975 was procyclical, now becomes either a- or counter-cyclical.

8. Factor shares are far from constant and their variations are large. Even assuming that the dramatic 16pp increase between 1960 and about 1975 was due to the standard "structural change" (as Spain experienced the transition from an agricultural to an industrial economy), factor shares have not stabilized since. They have moved cyclically (more precisely: labor share is counter-cylical and lags theover growth in GNP of about a year or two) and varied of as much as 6-7pp of GDP.

9. Real wages and labor productivity are positively correlated. Nevertheless, while before 1975 employment and real wages are positively, if weakly correlated, they become very negatively correlated after that and in particular after 1995 (-0.68) and even more after 2000 (-0.82).

10. After the year 2000, roughly speaking, a number of other historical regularities break down: output keeps growing but the labor share declines, employment grows strongly but real wages are flat, productivity stagnates almost completely.

3 The Standard Growth Model Does Not Work

In order to assess the extent to which the standard neoclassical model of long run growth fits or does not fit the Spanish experience, we will carry out a growth accounting exercise following Kehoe and Prescott (2002). We use a standard Cobb-Douglas aggregate production function of the form

$$Y_t = A_t K_t^{\theta} L_t^{1-\theta} \tag{1}$$

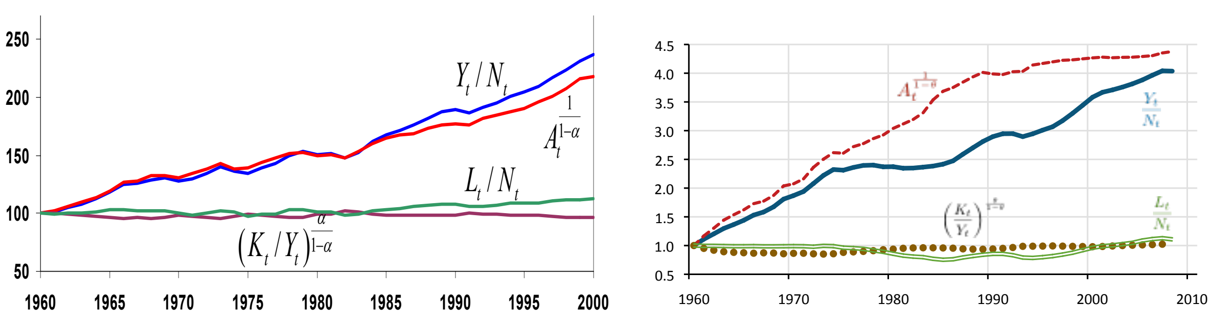
where Y_t denotes output, A_t total factor productivity and K_t and L_t the capital and labor inputs.

We decompose output per working-age person as follows:

$$\frac{Y_t}{N_t} = A_t^{1/(1-\theta)} \left(\frac{K_t}{Y_t}\right)^{\theta/(1-\theta)} \left(\frac{L_t}{N_t}\right) \tag{2}$$

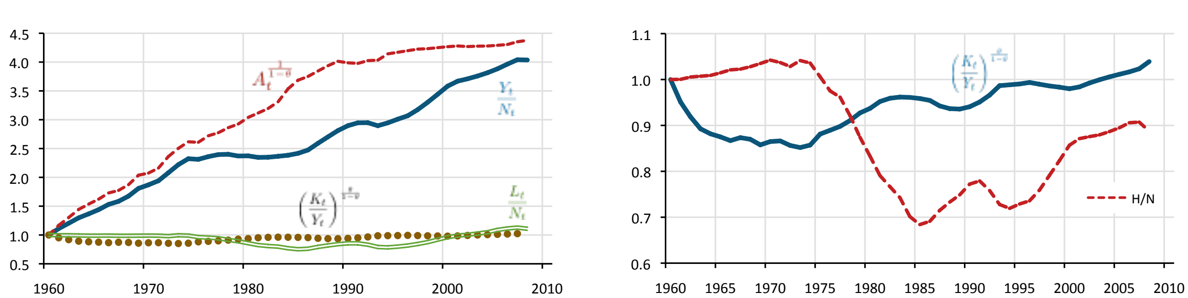
where N_t denotes the number of working-age people. Along a balanced growth path the capital-output ratio and hours worked per working-age person are constant over time. Therefore output per working-age person should grow at the same rate as total factor productivity. We report the results of this growth accounting exercise for the United States and for Spain in Figure 14 and for Spain in the first panel of Figure 15.

Figure 14: Growth Accounting for the USA and for Spain



Clearly the United States is pretty much on a balanced growth path during the entire period considered, while Spain departs form its balanced growth path sometime around 1975. After this year, Spanish output per working age person grows slower than TFP until about 1986, then it speeds up recovering some of the lost ground and, eventually, catching up with TFP in 2007.

Figure 15: Growth Accounting for Spain



Combining the two panels of this figure, one can see how these differing tendencies result from the combination of non-monotone movements in TFP and hours worked. During the first twenty years (1975-1994) the employment rate and hours worked per employed person decrease, while TFP growth remains positive, albeit lower than before. This leads Y/N to fall substantially behind TFP. After 1995, though, TFP growth comes almost to a halt, while employment growth accelerates again so that output per working age person overtakes total factor productivity in 2007, which is the last year for which we have reliable data. The oscillations in the K/Y ratio, also reported in the second panel, we have already noted earlier. Notice, again, that after 1975 the shape of the hours per working-age person series is almost a mirror image of the capital-output ratio series.

4 Which Kind of Model May Work?

As stated at the beginning, our aim is to understand the post-1975 evolution of the Spanish economy. Before then, and since the middle 1950s, Spain is undergoing a structural transformation by rapidly accumulating industrial capital and shifting large quantities of labor out of agriculture and into the industrial and services sectors. Nothing really special to explain there. What is difficult to capture and, as we have briefly shown, contradicts all existing growth models is what happens after 1975.

To capture those facts we need a model where

A. There is growth, but it does not come at a constant pace. Hence some kind of endogenous growth model is needed, but not of the usual varieties.

B. Growth in output and employment brings about a sharp increase in labor cost and labor share in the first wave, none of that in the second. Recessions bring about the opposite movement. This requires a model where these oscillations take place in equilibrium.

C. Technological change aims at reducing labor cost, along the lines of a "creative destruction" mechanism. But the process of destruction takes place "all at once", during the big recessions (to fire you need to shut down the firm). The process of adoptions of new techniques takes place slowly, during the expansions.

D. Historical analysis suggests that the first fact in C is due to institutional constraints, as there is little labor flexibility in "normal" times. It also suggests that only when an extra supply of "cheap" and "unprotected" workers become available, growth generates employment (second expansion).

E. When cheap labor is not available, growth does not generate much employment, it generates lots of K/L substitution with new firms adopting new, more K-intensive and less L-intensive technologies. This captures the main difference between the first (low employment growth) and the second (high employment growth) growth cycles.

F. In summary, we need an endogenous growth model that allows for K/L ratios depending on the availability of labor and its relative price.

5 A Variant of the Neoclassical Growth Model

We illustrate here our basic analytical framework, retaining the assumptions of a representative agent and of recursively complete financial markets. There is no doubt that neither representative individuals, nor complete sequential financial markets were sitting around Spain during the last thirty years, but this is neither here nor there as the purpose of the theoretical exercise is that of illustrating the general mechanism at work, not the details of the actual historical process, which we are unable to capture at this stage of our investigation. What we want to clarify is that one can provide a "neoclassical" interpretation of Spanish economic growth since the transition to democracy, and that such interpretation may potentially answer a few of the puzzling questions we raised in our empirical analysis as well as providing a relatively straightforward rationale for what happened and for what is currently happening.

For this reason, we abstract from the lack of complete financial markets, the large (and growing) role of the government, public spending and general taxation, as well as monetary policy. We make no excuses for these omissions: all we aim at doing is to provide a framework for a qualitative interpretation of the data, not a machinery to mimic them.

5.1 Preferences

There is a continuum of size one of identical agents, whose preferences are represented by standard expected utility

$$\max E_t \left\{ \sum_{t=0}^{\infty} \delta^t \left[u(C_t) + v(1 - L_t) \right] \right\}.$$

The utility functions $u(C_t)$ and $v(1-L_t)$ are monotone increasing, strictly concave, continuously differentiable and real valued. The budget constraints under which maximization takes place is presented later, after the market structure and the available financial instruments are introduced.

5.2 Technology

Production takes places in two different sectors, $s = a, b$, both composed of homogeneous firms. Description of the two sectors follow.

Firms in the first sector use their *active technologies* to produce *aggregate consumption*, C_t, through labor, L, and productive capacity, Π, according to a neoclassical production function $G(\Pi, L)$. In each period, starting with a given productive capacity, they hire labor in a competitive[5] market, produce and sell output, and purchase the investment goods determining future productive capacity. This is done in two ways: by augmenting the capital stock embodying already active technologies, or by *restructuring*, i.e. adopting a not-yet-active technology, embodied in a new capital stock. Once a firm introduces a new technology[6] we label the latter as *active* . Because this is a relatively small country operating strictly inside the world technology frontier, we are going to abstract from the problem of invention and innovation: new, more advanced technologies are already available out there. To restructure themselves, firms only need to purchase the capital goods embodying the new techniques and pay some additional adoption costs.

Firms in the second sector also use labor and productive capacity to produce *aggregate investment*, I_t, again according to a neoclassical production function $H(\Pi, L)$. Apart for labels, everything works as in the consumption sector, including the process of restructuring.

The total endowment of leisure/labor time is fixed at one in all periods. There are as many capital goods, K_t^j, as there are technologies, $j = 0, 1, 2, ...$ Abstracting from the time dimension, there are three homogeneous goods (consumption, investment and labor) and a countable infinity of technology-specific capital goods. The current value prices are denoted, respectively, by $\{p_t^a\}_{t=0}^{\infty}$ for the (dated) consumption good, $\left\{p_t^b\right\}_{t=0}^{\infty}$ for the (dated) investment good, $\{w_t\}_{t=0}^{\infty}$ for the (dated) labor, and $\left\{q_t^j\right\}_{t,j=0}^{\infty}$ for the (dated and technology-specific) capital goods. Set $p_0^a = 1$ as the numeraire. Because of uncertainty, to be introduced momentarily, prices are also functions of the state of the world that realizes in period t; to save on notation such dependence is omitted, when not strictly necessary.

[5]For the time being, we assume that a competitive labor market is active in each period. Different labor market arrangements are considered in the following section.

[6]Or capital good, as the latter embodies the former: the two terms are synonymous. With "productive capacity" we refer, instead, to the aggregation of all existing capital goods-technologies.

5.2.1 Consumption Sector

Production Firms operating in sector $s = a$ may invest, under the conditions specified below, in a countable number of technologies, indexed by the superscript $j = 0, 1, \ldots$. We say that a technology j is *active* in period t if $K_t^j > 0$, i.e. the (representative) firm making up this sector owns a positive amount of capital stock of type j. Denote with $J_t = \{\underline{j}_t, ..., \overline{j}_t\}$ the set of all technologies that are active at time t. The reader should think of the technologies as plants, each one exhibiting constant returns to scale. Decreasing returns come around at the firm level, due to the finite amount of managerial resources available. In other words, in the tradition of McKenzie (1959), the size of firms is limited by the span of control of their entrepreneurs, as in Lucas (1978).

Using technology (plant) $j \in J_t$, a firm $f \in F^a$ obtains output[7]

$$Y^{f,j} = \min\{K^{f,j}, \alpha^{f,j} L^{f,j}\},$$

where $K^{f,j}$ and $L^{f,j}$ are capital and labor used by firm f in technology (plant) j, and $\alpha^{f,j}$ is the labor productivity parameter, the details of which I illustrate momentarily. Aggregating over plants owned by the same firm

$$Y^f = \sum_{j \in J_t^f} Y^{f,j},$$

I define the markeatable output of firm f as

$$C^f = A^f \left(Y^f\right)^\theta,$$

where $A^f \in \mathcal{A} = [0, \overline{A}]$ is a firm-specific productivity parameter, while $\theta \in (0,1)$ captures the decreasing returns induced by limited span of control at the firm level. Because, in what follows, nothing is gained by assuming that different firms, within the same sector, have a different productivity parameter, we set $A^f = A$ for all $f \in F^a$ and $F^a = [0,1]$. It is important to notice that C^f is marketable, while neither $Y^{f,j}$ nor Y^f are.[8]

Labor productivity is explained next. Assume that each technology j comes with an average labor productivity parameter α^j, where $\alpha > 1$ and j is an exponent. Hence, technological progress is, on average, labor-saving because $\alpha^j > \alpha^{j-1}$. The choice of technologies is endogenous, and carried out at the firm level: each firm knows α^j when adopting technology j. A degree of idiosyncratic uncertainty may be introduced by assuming that a random shock $\varepsilon_t^{f,j}$ affects labor productivity, that is

$$\alpha_t^{f,j} = \alpha^j + \varepsilon_t^{f,j},$$

where $\varepsilon_t^{f,j}$ is an N-state, first order Markov process with transition matrix Θ. Because the shock is relevant only in calibrated simulations, its role will be underplayed in what follows

At the beginning of period t, due to past investment decisions, a representative firm f owns a vector of capital stocks $K_t = \{K_t^{\underline{j}_t}, ..., K_t^{\overline{j}_t}\}$, with $\underline{j}_t \le \overline{j}_t$ (the superscript denoting the firm will be omitted here, as it is redundant). This allows the definition of firm f's *potential productive capacity*

$$\Pi_t = A \left[\sum_{j \in J_t} K_t^j\right]^\theta,$$

[7]The notation is somewhat cumbersome in super- and sub-scripts, as I keep track of different firms (f), sectors (s), technologies (j), and time periods (t). Whenever there is no danger of confusing the reader, as in the following formula, some, or all, of these super/sub-scripts will be omitted.

[8]Returns are therefore decreasing in capital and labor at the firm but not at the plant level. The parameters A and θ summarize firm-specific factors, reconciling the model with constant return to scale in the full list of productive factors.

and *potential employment*

$$\Lambda_t = \sum_{j \in J_t} \frac{K_t^j}{\alpha_t^{f,j}},$$

in period t.

Finally, let $\varphi_t^{f,j} \in [0,1]$ denote the *degree of capacity utilization* for technology j, in firm f, in period t,

$$\varphi_t^{f,j} = \frac{\alpha_t^{f,j} L_t^{f,j}}{K_t^j}.$$

Marginal productivity of labor at the plant level is

$$\frac{\partial Y_t^{f,j}}{\partial L_t^{f,j}} = \alpha_t^{f,j}, \text{ for } \varphi_t^{f,j} < 1, \text{ and zero otherwise.}$$

Because total output of firm f is

$$C_t^f = A \left[\sum_{j \in J_t} \alpha^{f,j} L^{f,j} \right]^{\theta},$$

the marginal productivity of a unit of labor in firm f and plant j is

$$\frac{\partial C_t^f}{\partial L_t^{f,j}} = \theta A \alpha_t^{f,j} \left[\sum_{j \in J_t} (\alpha_t^{f,j} L^{f,j}) \right]^{\theta - 1}, \text{ for } \varphi_t^{f,j} < 1, \text{ and zero otherwise.}$$

Finally, total output of the consumption sector is

$$C_t = \int_0^1 C_t^f df.$$

Expansion of Productive Capacity A firm f, starting period t with productive capacity equal to $K_t^f = \{K_t^{\underline{j}_t}, ..., K_t^{\bar{j}_t}\}$ and scrapping the amounts $S_t^f = \{S_t^{\underline{j}_t}, ..., S_t^{\bar{j}_t}\}$, is left, at the end of the same period, with a productive capacity of $(1-\mu)K_t^f - S_t^f$, where the latter should be read in vector notation and the scrapping vector S_t^f may have both positive and negative entries as a firm may be scrapping some of its equipment of type j while adding to its equipment of type j'. The way in which scrapping takes place should be clarified: it corresponds to trade of productive capacity among firms. As long as the price of the capital of type j is positive, firms with a low productivity parameter $\alpha_t^{f,j}$ will be scrapping S_t^j and sell it to firms with a high productivity parameter $\alpha_t^{f',j}$. When $\alpha_t^{f,j}$ is low for all firms, and expected to remain so, the price of the capital of type j will become zero and scrapping becomes irrelevant: everyone would like to sell that type of productive capacity but no one is willing to buy.

Output of the investment sector is homogeneous but specializes once applied to a specific technology. Let $I_t^{f,j}$ be the amount of investment goods firm f allocates to active technology $j \in J_t$. We set

$$K_{t+1}^{f,j} = (1-\mu)K_t^{f,j} + \gamma^j I_t^{f,j} - S_t^{f,j},$$

where $1/\alpha < \gamma < 1$, i.e. machines embodying more advanced technologies are costlier to accumulate but, in expected value, more convenient than those embodying less advanced technologies because they are, proportionally, more labor saving . Let $I_t^f = \sum_{j \in J_t} I_t^{f,j}$, and notice that this addition is meanigful because new machines are identical before being applied to a technology. We assume that investment/scrapping decisions are taken at the end of the period, i.e. after production has been carried out, but before the shock $\varepsilon_{t+1}^{f,j}$ is realized. Because $\alpha\gamma > 1$, in the deterministic version the only active technology with positive gross investment will be the *best available technology* $\overline{j}_t$.[9] We define the *marginal technology* $\widehat{j}_t$, in period t, as the lowest indexed technology for which $L_t^j > 0$. Notice that $\widehat{j}_t \geq \underline{j}_t$, with strict inequality holding most of the times as the fact that a plant is available does not imply it will be also used for production in a given period. In particular, very old plants that were not fully scrapped before they become too improductive, will sit idle.

At the end of each period a firm may also purchase investment goods in order to restructure itself, i.e. introduce the *new technology* $\overline{j}_t + 1$. Let D_t^f be the total amount allocated to this purpose, we assume that

$$K_{t+1}^{f,\overline{j}_t+1} = (\zeta)^{\overline{j}_t+1} \cdot D_t^f,$$

with $\zeta < \gamma$, i.e. it is costlier to introduce a new technology than to accumulate any among the old ones. This implies that restructuring does not take place automatically: new technologies are introduced along an equilibrium path only when their labor saving effect is strong enough, i.e. the cost of labor is high enough to justify the additional cost, as discussed below.

5.2.2 Investment Sector

Production The structure of the second sector parallels that of the first, hence we can describe it more succintly. Again, let $J_t = \{\underline{j}_t, ..., \overline{j}_t\}$ be the set of all technologies that are active at time t for the representative firm $f \in F^b$. Using technology $j \in J_t$, a firm obtains output

$$Y^{f,j} = \min\{K^{f,j}, \beta^{f,j} L^{f,j}\},$$

where $\beta^{f,j}$ is the labor productivity parameter, and the rest of the notation is as before. Also in this sector, the labor productivity parameters satisfy

$$\beta_t^{f,j} = \beta^j + \varepsilon_t^{f,j}.$$

From a theoretical perspective, both $\alpha > \beta > 1$ and $1 < \alpha < \beta$ are admissible; the data from the last few decades seem to suggest the second is the realistic case.

Potential productive capacity is

$$\Pi_t = B \left[\sum_{j \in J_t} K_t^j \right]^\theta .$$

and *potential employment* is

$$\Lambda_t = \sum_{j \in J_t} \frac{K_t^j}{\beta_t^{f,j}}.$$

The rest is defined in analogy with the first sector; in particular, *marginal productivity of labor* is

$$\frac{\partial Y_t^{f,j}}{\partial L_t^{f,j}} = \beta_t^{f,j}, \text{ for } \varphi_t^{f,j} < 1, \text{ and zero otherwise,}$$

total output of firm f is

$$Y_t^f = \sum_{j \in J_t} Y^{,j} = B \left[\sum_{j \in J_t} \beta_t^{f,j} L_t^j \right]^\theta ,$$

[9] In the stochastic version, a technology is the best available only in an expected value sense, and positive investment in active technologies other than the best one is an equilibrium outcome when shocks have some degree of persistence.

and total output of the investment sector is

$$I_t + D_t = Y_t^b = \int_0^1 Y_t^f df,$$

where I_t and D_t are obtained by aggregating across firms' demand in both sectors.

Expansion of Productive Capacity The law of motion of the capital stock, at the firm level, is

$$K_{t+1}^{f,j} = (1-\mu)K_t^{f,j} + \gamma^j I_t^{f,j} - S_t^{f,j},$$

with $1/\beta < \gamma < 1$. The *best available* and the *marginal technology* are also defined identically to those for firms in the consumption sector, and a *new technology* may be obtained according to

$$K_{t+1}^{f,\bar{j}_t+1} = (\zeta)^{\bar{j}_t+1} \cdot D_t^f.$$

The indeces $j = 0, 1, ...$ refer to the same technologies in the two sector, which allows for machines scrapped in one sector to be traded economy-wide.

5.3 Equilibrium Notion

The notion of equilibrium is standard. In each period, given productive capacity and the realization of idiosyncratic shocks, firms maximize their market value by hiring labor[10] and selling their output in competitive markets. Given initial wealth, and the realization of the shocks the representative agent supplies labor, receives factor payments, and makes intertemporal consumption-saving decisions. Next, firms maximize their expected value by investing in either active or new technologies for next period. Because we assume that financial markets are sequentially complete, we write the competitive equilibrium for the baseline model as the solution to a dynamic programming problem.

5.3.1 Markets

At time t, the state of the world x_t encompasses the collection of vectors

$$\left\{K_t^f\right\}_{f \in F^a, F^b}, \left\{\alpha_t^{f,j}\right\}_{f \in F^a, j \in J_t}, \left\{\beta_t^{f,j}\right\}_{f \in F^b, j \in J_t}.$$

Recall that, for all $f \in F^a, F^b$ and for all $j \in J_t$, the random variable $\varepsilon_t^{f,j}$ is an N-state, first order Markov process with transition matrix Θ. For the sake of simplicity we make the, somewhat heroic, assumption that financial markets are sequentially complete: in each period t there exists a set of $\left(|F^a| + |F^b|\right) \times |J_t| \times N$ independent securities to which the continuum of identical agents have access. This means that, given x_t and the set $\mathcal{X}_{t+1}(x_t)$ of possible future states, for all $x \in \mathcal{X}_{t+1}(x_t)$ there exists, at time t, a competitive market in which contingent claims $A(x)$ are traded, with payoff $\xi[A(x), x_{t+1}] = 1$ if $x_{t+1} = x$, and zero otherwise. Let $m(x, x_t)$ be the price, in units of current consumption, of asset $A(x)$ in period t and state x_t. To save on notation, $A_t(x)$ indicates also the quantity of the Arrow security "x" acquired in period t.

5.3.2 Firms' and Households' Problem

Given initial wealth $A_0(x_0)$, the representative agent maximizes the intertemporal expected utility given earlier under the sequence of budget constraints

[10] We allow for inaction, i.e. $L_t^{f,j} = 0$, without requiring the firm to disband. Alternatively, one could assume that inactive firms are shut down forever, i.e. that $L_t^{f,j} = 0$ implies $K_t^{f,j} = S_t^{f,j}$.

$$p_t c_t + \sum_{x \in \mathcal{X}_{t+1}(x_t)} m(x, x_t) A_t(x) \leq w_t L_t + p_t A_{t-1}(x_t); \text{ for all } t \geq 0.$$

A firm $f \in F^s$ begins period t with capacity K_t^f and labor productivity vector σ_t^f, where, from here onward, $\sigma = \alpha$ when $s = a$ and $\sigma = \beta$ when $s = b$; by analogy we will also use S in place of either A or B, hoping this is not confused with the scrapping term S_t^j that is always technology and period specific. The problem of the firm consists, first, of maximizing period's profits by choosing the current level of capacity utilization, and, second, of maximizing its expected market value by choosing tomorrow's productive capacity.

For $s = a, b$, given the stocks $K_t^{f,j}$, the firm's static optimization problem is

$$\max_{\{L_t^{f,j}\}} \ \pi_t^f = p_t^s S \left[\sum_{j \in J_t} \sigma_t^{f,j} L_t^j \right]^\theta - w_t \sum_{j \in J_t} L_t^j,$$

$$\text{subject to: } \sigma_t^{f,j} L_t^{f,j} \leq K_t^{f,j}.$$

The intertemporal optimization problem is, instead,

$$\max_{\{K_{t+1}^{f,j}\}} E_t\left(V_{t+1}^f\right) = \sum_{j \in J_{t+1}} \left[E_t\left(q_{t+1}^j K_{t+1}^{f,j}\right) - p_t^b [I_t^{f,j} + D_t^{f,j}] + q_t^j S_t^{f,j} \right]$$

subject to

$$K_{t+1}^{f,j} = (1-\mu) K_t^{f,j} + \gamma^j I_t^{f,j} - S_t^{f,j}, \ j \in J_t^f$$

and

$$K_{t+1}^{f,j} = (\zeta)^j \cdot D_t^{f,j}, \ j \in \{J_{t+1}^f \setminus J_t^f\}.$$

5.3.3 Market Clearing

Sectoral output corresponds, respectively, to aggregate consumption and aggregate investment. In the baseline model we assume that capital goods are technology specific, hence, the laws of motion given above are enough, together with the definition of potential productive capacity, to characterize market clearing in the markets for machines. Equilibrium in the market for consumption amounts to say that total consumption demand from the households equals the output of that sector.

Aggregate labor demand is $L_t = L_t^a + L_t^b \leq 1$, where

$$L_t^s = \sum_{f \in F^s} \mu^s(f) \left(\sum_{j \in J_t^f} \frac{\varphi_t^{f,j} K_t^{f,j}}{\sigma_t^{f,j}} \right), \text{ s=a,b}, \ \ \sigma = \alpha, \beta.$$

Equilibrium in the financial markets means, respectively, that the expected market value of firms is fully "owned" (or "owed") to households holding financial assets:

$$\sum_{x \in \mathcal{X}_{t+1}(x_t)} m(x, x_t) A_t(x) = \sum_{f \in F^a, F^b} \mu^s(f) E_t\left(V_{t+1}^f\right),$$

and that the net payoff to households equals the realized, end-of-period, market value of firms:

$$\sum_{f \in F^a, F^b} \mu^s(f) V_t^f(x_t) = p_t A_{t-1}(x_t)$$

Finally, there are the obvious non-negativity constraints

$$K_t^{f,j} \geq 0, I_t^{f,j} \geq 0, D_t^f \geq 0, C_t \geq 0, L_t^{f,j} \geq 0.$$

6 Equilibrium and Optimality

We proceed to illustrate the dynamic behavior of the main economic aggregates in the competitive equilibrium. Next we build up and formulate the dynamic programming problem that summarizes the optimal intertemporal allocation. Because the general model illustrated so far is of substantial complexity, we avoid addressing a number of detailed points and, to facilitate intuition and to ease calculations, introduce a number of simplifying assumptions when necessary. In particular, to simplify, we will focus on the properties of a very special case in which there are no heterogeneous firms, no decreasing returns and no uncertainty, that is to say no technological shocks.

6.1 Competitive Equilibrium

The cyclical dynamics of the innovation and growth process, and the special role that the cost of labor plays in determining the time and nature of innovations, is most clearly seen by focusing on the profit maximizing behavior of firms.

6.1.1 Employment and Factor Payments

Given productive capacity $K_t^f = \{K_t^{\underline{j}_t^f}, ..., K_t^{\overline{j}_t^f}\}$, price of output p_t^s, and wage rate w_t , firm $f \in F^s$, $s = a, b$ sets

$$\begin{aligned} 0 &< L_t^{f,j} \leq \frac{K_t^{f,j}}{\sigma_t^{f,j}} \text{ , if } \theta S^f \sigma^{f,j} \left[\sum_{j \in J_t} \sigma^{f,j} L^{f,j} \right]^{\theta - 1} \geq \frac{w_t}{p_t^s} \\ L_t^{f,j} &= 0, \text{ otherwise.} \end{aligned}$$

Labor supply, L_t, follows from the usual static first order condition equating the marginal disutility of labor to the real wage rate w_t/p_t^a times the period marginal utility of consumption. Labor market clearing, from earlier on, requires

$$L_t = \sum_{s=a,b} \left[\sum_{f \in F^s} \mu^s(f) \left(\sum_{j \in J_t} \frac{\varphi_t^{f,j} K_t^{f,j}}{\sigma_t^{f,j}} \right) \right].$$

This set of conditions implies that, for each firm and each period, there exist a *marginal plant* $\widehat{j}_t^f$ for which $0 < \varphi_t^{f,j} \leq 1$. **In fact**, it is easy to see that, for a given firm f ,

$$L_t^{f,j} = \frac{K_t^{f,j}}{\sigma_t^{f,j}} \text{ , i.e. } \varphi_t^{f,j} = 1,$$

will hold at all plants at which the marginal productivity of labor is larger than w_t/p_t^s, where s is the sector where the firm operates. This implies, because the installed capacity of each plant is finite and the functions involved are continuous, that there will exist a plant $\widehat{j}$ such that

$$\varphi_t^{f,j} = L_t^{f,j} = 0, \text{ at all plants } j < \widehat{j}.$$

Notice that, in principle, one may have $\widehat{j}$ =min$_j$ $\left\{ J_t^f \right\}$ =min$_j\{\underline{j}_t^f, ..., \overline{j}_t^f\}$ and $\varphi_t^{f,j} = 1$, for all technologies and all firms in both sectors; this will be the case when the technology shocks are particularly good or labor supply is especially abundant, hence cheap. More generally we have that in each period $t = 0, 1, 2, ...$, for each sector $s = a, b$, and firm $f \in F^s$, $s = a, b$, there exists a marginal plan, $\widehat{j}$ such that

$$\theta S^f \sigma_t^{f,\widehat{j}} \left[\sum_{j \in J_t^f} \sigma_t^{f,j} L^{f,j} \right]^{\theta - 1} = \frac{w_t}{p_t^s}.$$

For all other plants $j \in J_t^f$, for which $L_t^{f,j} > 0$, the following hold

$$\theta S^f \sigma_t^{f,j} \left[\sum_{j \in J_t^f} \sigma_t^{f,j} L^{f,j} \right]^{\theta - 1} > \frac{w_t}{p_t^s} \text{ , and } \varphi_t^{f,j} = 1.$$

instead.

This proposition reminds us that there is "exploitation of labor" also in standard neoclassical models of production. Within each firm, almost all workers (i.e. everyone but the marginal worker at the marginal plant) are "exploited" in the sense that they are being paid a wage smaller then their marginal productivity. The (sum total) of the difference between labor productivity and wages, over all the workers employed by a firm, is equal to the gross operating surplus of each firm, that is

$$\pi_t^f = p_t^s S^f \left[\left(\sum_{j \in J_t} \sigma_t^{f,j} L_t^{f,j} \right)^{\theta} - \theta \sigma_t^{f,\widehat{j}} \left(\sum_{j \in J_t} \sigma_t^{f,j} L_t^{f,j} \right)^{\theta - 1} \cdot \left(\sum_{j \in J_t} L_t^{f,j} \right) \right].$$

Because capital markets are assumed to be both complete and competitive, the rate of return paid to capital is uniform across firms and it is determined through the prices $m(x, x_t)$ of the state contingent assets $A(x_t)$ introduced earlier on. Dwelling with the details of this calculation would take us far away and well beyond the limited task this paper is set to accomplish, we will therefore leave it aside. Contrary to workers, capital must be commited up front, before the technological shock is realized; hence we talk here of an expected and a realized rate of return on the capital investment. While the first is identical across firms and sectors, the second is not. As we have assumed that households own the firms through the financial assets they trade, they are also the residual claimants of the profits/losses firms realize, ex post, in the different states of the world.

In this model there is no aggregate but only idiosyncratic risk, induced by the plant/firm specific labor's productivity shocks $\sigma_t^{f,j}$. Such risk can be hardly diversified at the firm level, as each firm owns only a finite number of plants (operate a finite number of technologies) at any time t, hence investment in any specific firm is risky. The shareholders of the firm are the bearer of such risk. Recall, nevertheless, that we assume a continuum $\mu^s(f)$ of firms for each type and in each sector, hence the representative household can and will diversify away the firm's specific risk achieving a deterministic consumption path. There is no aggregate uncertainty in this model.

6.1.2 Equilibrium Price Relations

The time t price of new machines is common to all firms and technologies: it equals the price of output, p_t^b, of the investment sector. The same is true for the price, p_t^a, of consumption, which is proportional to its discounted marginal utility for the representative consumer, $\delta^t u'(C_t)$. The latter is derived from standard first order conditions for the maximization of consumer's utility, which set the (discounted) marginal utility of consumption, at each future date and state of the world pair, equal to the present value price of consumption at that same date and state of the world pair. Because, as explained at the end of the previous sub-section, there is no aggregate uncertainty in this model, the consumers set their consumption levels in each future period in order to fulfill such proportionality, where the proportionality factor is given by the representative agent marginal utility of wealth; the reader is referred to Boldrin and Levine (2002) for a more complete derivation. Because of the non-linearity introduced by the assumption of decreasing returns at the firm level, not much more can be said at this level of generality other than some no-arbitrage relations should hold between the price at time t of new capital and the prices at time $t+1$ of installed capital.

Installed capital is "technology-specific" (in other words, the model is "putty-clay"), hence each existing machine has its own price, q_t^j. We assume that machines are technology - but not firm - specific: in each period any firm can sell any amount of its installed capital stock to other firms, which is what the scrapping terms $S_t^{f,j}$ are supposed to remind us of in the equation for the law of motion of $K_{t+1}^{f,j}$ above. Here we look at the equilibrium relations among these prices (recall these are present value prices), as determined by the profit's maximization activity of each firm.

As long as $I_t^j > 0$, the cost of investing in machine j today must equal the (expected) market value of the machine tomorrow

$$q_{t+1}^j = \frac{p_t^b}{\gamma^j} \text{ , if } I_t^j > 0, \text{ and}$$

$$q_{t+1}^j < \frac{p_t^b}{\gamma^j} \text{ , if } I_t^j = 0,$$

meaning that Tobin Q is always less or equal to one in this model. Therefore, investment can be simultaneously positive for more than one technology as long as the price of machines adjust accordingly and the non-negativity constraint $q_{t+1}^j \geq 0$ is satisfied. Because $\gamma/\alpha < 1$ and $\gamma/\beta < 1$ hold, in the absence of shocks we have $I_t^j = 0$ for all $j = 1, ..., \widehat{j}_t - 1$, and $I_t^{\widehat{j}_t} \geq 0$.

Next, assume a new machine is introduced, i.e. $D_t > 0$. Because the innovation technology is $K_{t+1}^{f,\bar{j}_t^f+1} = (\zeta)^{\bar{j}_t^f+1} \cdot D_t^f$, zero profit implies

$$q_{t+1}^{\bar{j}_t^f+1} = \frac{p_t^b}{(\zeta)^{\bar{j}_t^f+1}}.$$

This implies that, for $D_t > 0$ and $I_t^{\widehat{j}_t} > 0$ to hold simultaneously, the following must also be true

$$(\zeta)^{\bar{j}_t^f+1} q_{t+1}^{\bar{j}_t^f+1} = \gamma^{\bar{j}_t^f} q_{t+1}^{\bar{j}_t^f}.$$

6.1.3 Firm's Investment and Production Decisions

Because new technologies are more efficient than old ones, absent the random productivity shock investment concentrates, in each firm, only on the most recently adopted technology. The model, therefore, predicts that growth takes place according to the following pattern: within each firm capital is scrapped away from older technologies and shifted toward most recent ones together with all the new investment goods. This trend may be altered, temporarily, by the arrival of particularly good technology shocks for the old technologies. In the long run, apart for the small variability induced by the shocks, firms will concentrate all of their productive capacity in the newest technology. When this position is reached the economy is at a temporary steady state, which is an invariant distribution of capital stocks centered around the vector of most recent ones.

The steady state is only temporary because, as we will see momentarily, the process of capital accumulation so described leads to both an increase in the productivity and cost of labor and to a reduction of profits large enough to make it worthwile, i.e. profitable, for firms to invest in new, more labor saving, technologies. After this adoption period has passed the growth process starts again moving the economy toward a new, temporary, steady state with higher productivity and consumption levels.

From this reasoning it follows that employment is procyclical, as it grows with productive capacity, but its growth rate depends on how quickly real wages grow. When real wages grow quickly with output, as in the first expansion, employment does not grow much and new technologies that save on labor are often adopted. This leads to growth in per capita output and in productivity, but not in employment. When real wages do not grow fast, then employment grows a lot but labor productivity and TFP do not. We conjecture that real wages are also slightly procyclical, but this would require numerical simulations to be verified.

To make the matter analytically tractable we drop here the idiosyncratic technological shock and focus on the deterministic case in which $\sigma_t^{f,j} = \sigma^j$ for both $\sigma = \alpha$ and $\sigma = \beta$. This simplifies the analysis greatly, while preserving the basic message. In fact, to understand the inner working of the model, we will start from the even more simplified case in which there are no firms (better, there is a continuum of identical firms or just two aggregate firms, one per sector; $A^f = A, B^f = B$) and returns to scale are therefore allowed to be constant (i.e., $\theta = 1$). Because these simplifying assumptions imply that profit maximization at the firm's level is equivalent to the zero profits condition - there is no "managerial" factor anymore, hence all rents accrue to the capital stocks themselves and are captured by their equilibrium prices - we can start exactly from those conditions.

In this simplified world, production in each sector and technology is $Y^{s,j} = \min\{K^{s,j}, \sigma^j L^{s,j}\}$, and zero profits for technology j gives

$$p_t^s = q_t^j + \frac{w_t}{\sigma^j}$$

for $j = \widehat{j}_t, ..., \overline{j}_t$. Because of utility mazimization, we also have

$$p_t^a = \delta^t u'(C_t).$$

When two technologies are used to produce the same good during the same period, the prices of their capital goods must adjust to yield zero profits, hence:

$$q_t^j = \left[p_t^s - \frac{w_t}{\sigma^j}\right] > \left[p_t^s - \frac{w_t}{\sigma^{j-1}}\right] = q_t^{j-1}$$

holds for $j = \widehat{j}_t, ..., \overline{j}_t$. Clearly, for some $j \in \{\underline{j}_t, ..., \overline{j}_t\}$ we will have $\sigma^j p_t^s < w_t$, for either $s = a$, $s = b$, or both. In the first two cases technology j is not used in sector a (b) during period t, while in the third $q_t^j = 0$, and it is not used in either sector. When this takes place in the deterministic model the technology is scrapped (in fact, abandoned) and it never returns. In this simplified version, technologies are scrapped first in one of the two sectors and then in the other, whereas in the general model scrapping takes place at the firm level without any particular sectorial pattern. In formulas, technology j will be scrapped from sector s as soon as

$$w_t \geq \sigma^j p_t^s.$$

From the zero profit condition for technology $\overline{j}_t$ in period t we conclude that, *when* $I_t^{\overline{j}_t} > 0$

$$\gamma^{\overline{j}_t} q_{t+1}^{\overline{j}_t} = q_t^{\overline{j}_t} + \frac{w_t}{\beta^{\overline{j}_t}},$$

which gives the first order process followed by the prices of the best installed machines.

While this may not be completely apparent, this analysis implies that, as accumulation of the newest technology proceeds, labor is eventually shifted away from old technologies and toward the newest one. Because labor supply is limited and the marginal utility of leisure increasing with employment (or the bargaining power of unions is strenghtening) the wage rate must eventually increase and profits, which had been growing initially, decrease. Because the technologies have fixed coefficients, this leads to the, respectively, procyclical and countercyclical movements of the capital and labor shares in value added.

6.1.4 Conditions for adoption of new technologies

Because, in the deterministic case, only $I_t^{\bar{j}_t} > 0$, it suffices to compare the cost and benefits from investment in the best available technology $\bar{j}_t$ with those from investment in the new technology $\bar{j}_t + 1$. The latter is more profitable than the former if, for both $\sigma = \alpha$ and $\sigma = \beta$,

$$\frac{w_{t+1}}{p_t^b} > \frac{\sigma^{\bar{j}_t^s+1}}{\sigma - 1} \frac{(\gamma)^{\bar{j}_t^s} - (\zeta)^{\bar{j}_t^s+1}}{(\zeta)^{\bar{j}_t^s+1}(\gamma)^{\bar{j}_t^s}}.$$

This inequality already provides us with the general intuition: it is convenient to innovate when labor becomes (better, is expected to become) "expensive enough". If we make the simplifying assumption that $\zeta = \gamma - \varepsilon$ (for ε vanishingly small: recall that in general we assume that ζ is smaller than γ) the previous inequality simplifies into

$$\frac{w_{t+1}}{p_t^b} > \left(\frac{\sigma}{\zeta}\right)^{\bar{j}_t^s+1} \frac{1 - (\gamma - \varepsilon)^{\bar{j}_t^s+1}/(\gamma)^{\bar{j}_t^s}}{\sigma - 1} \simeq \left(\frac{\sigma}{\zeta}\right)^{\bar{j}_t^s+1} \frac{1 - \gamma}{\sigma - 1}.$$

We have assumed that each individual technology is of fixed coefficients, hence in the short run the only capital-labor substitutability allowed in this economy is the one due to the shifting of labour from one to another of the active technologies. Nevertheless, because new labor saving techonologies can always be profitably introduced when labor becomes sufficiently expensive, in the long run capital is always a good substitute for labor and the overall K/L ratio either remains constant, when measured in physical units, or increases, when the improved quality of capital is taken into account.

We also conjecture that, in a suitably parameterized version, it will also be true that it is the increasing cost of labor that brings about recessions and a decrease in the share of income going to labor: labor-saving technologies are introduced only when labor is very expensive, i.e. when employment is at or near its cyclical peak. To the extent that this process of innovation and labor dismissal takes place in most firms simultaneously (as one would expect to be the case if the dispersion of the parameters α and β is not too large across firms) this will lead to a sudden drop in employment, a reduction of wages and a subsequent increase in profitability. The drop in employment and wages should coincide with a drop in the growth rate of output.

7 Which Facts We Can and Which We Cannot Explain

Briefly, and following the list of Ten Selected Facts given toward the end of Section 3, here is our story of how Spain grew.

1. Growth in the aggregate and per capita income comes from adoption of new technology and expansion of their capacity.
2. Growth is not steady, but cyclical.
3. In 1975: the Spanish labor market changed. Wages became rigid downward and did not respond to changes in employment/unemployment levels.
4. This change in the labor market, together with a second change noted below, explains most of the changes in correlations; but NOT all.

5. The first growth cycle was stopped by a rapidly growing cost of labor: labor supply was still mostly unionized and the productivity gains (induced by the incentive to save on labor through the adoption of more efficient technologies) were more than compensated by the raising cost of labor.

6. During the next growth cycles a large, un-unionized, labor supply was available as term contracts became widespread and immigrants (especially after year 2000, this is the second historical shift) arrived plentiful. This prevented the cost of labor from growing with employment, as it had done in the past. Hence employment grew. The new labor supply was not very productive and, lacking the cost incentives to adopt labor-saving technologies, Spanish firms made profits by hiring cheap labor absent productivity gains.

7. The movements in the K/L and K/Y ratios are a consequence of the way in which the model generates growth in face of the two (three, after 2000) different labor markets.

8. Until 1995, productivity growth comes around as long as raising labour costs motivate the adoption of more efficient producton techniques. After 1995 Spanish labor becomes "cheaper and cheaper", at the margin, hence productivity stagnates in a number of sectors. Sectorial analysis, not reported, shows that there are productivity gains in those sectors that are open to international competition and in which immigrant or cheap labor cannot be used, while in those sectors that were either not open to international competition or in which cheap labor could be used, or both, labor productivity and TFP stagnated.

9. Factor shares oscillate as in the data, this is a prediction of the model. The quantitative effect depends on how "rigid" labor supply is and how quickly an increase in employment turns into an increase in real wages. In particular - after 1995 and, even more, after 2000 - when labor supply is no longer binding at the going wage, the labor share does not increase and even slightly declines in spite of a fast growing employment.

10. Real wages and labor productivity are positively correlated in the model, at least in the long-run. The magnitude of the correlation, though, is determined by the power of unions (or, more generally, the rigidity of labor supply), which may increase wages faster or slower than productivity. The weaker are unions the weaker the correlation between wages and productivity, even in the long run.

8 Policy Implications and Further Work

To be added.

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A. Data Appendix

Table 14: Table 1. GDP, GDP per capita and Population

	GDP (2000 constant market prices)	**GDP growth rate**	**Population**	**Population growth rate**	**GDP per capita (2000 constant prices)**	**GDP per capita growth rate**
1978	353416		36873		9548	
1979	353564	0.04	37201	0.89	9467	-0.84
1980	358162	1.3	37439	0.64	9530	0.66
1981	357684	-0.13	37741	0.81	9441	-0.93
1982	362142	1.25	37943	0.54	9508	0.71
1983	368557	1.77	38122	0.47	9630	1.29
1984	375129	1.78	38279	0.41	9762	1.37
1985	383837	2.32	38419	0.37	9952	1.95
1986	396327	3.25	38536	0.3	10245	2.94
1987	418311	5.55	38631	0.25	10787	5.29
1988	439621	5.09	38716	0.22	11311	4.86
1989	460844	4.83	38791	0.2	11834	4.62
1990	478279	3.78	38850	0.15	12263	3.63
1991	490443	2.54	38939	0.23	12546	2.31
1992	495006	0.93	39068	0.33	12634	0.7
1993	489901	-1.03	39189	0.31	12476	-1.25
1994	501575	2.38	39295	0.27	12751	2.2
1995	515405	2.76	39387	0.23	13085	2.62
1996	527862	2.42	39478	0.23	13371	2.18
1997	548284	3.87	39582	0.26	13851	3.6
1998	572782	4.47	39721	0.35	14420	4.1
1999	599966	4.75	39926	0.52	15026	4.21
2000	630263	5.05	40263	0.84	15653	4.17
2001	653255	3.65	40720	1.14	16042	2.48
2002	670920	2.7	41314	1.46	16240	1.23
2003	691695	3.1	42005	1.67	16467	1.4
2004	714291	3.27	42692	1.64	16731	1.6
2005	740108	3.61	43398	1.65	17054	1.93
2006	768890	3.89	44116	1.66	17448	2.31
2007	797052	3.66	44879	1.73	17762	1.8
2008	806288	1.16	45593	1.59	17684	-0.44

Table 15: Spain: Population

			Working Population (15-64)					
	Total Population	(%)	Total	(%)	Female	%	Male	%
1979	37201	0.9	23312	1.3	11771	1.2	11541	1.4
1980	37439	0.6	23590	1.2	11898	1.1	11692	1.3
1981	37741	0.8	23866	1.2	12024	1.1	11842	1.3
1982	37943	0.5	24133	1.1	12145	1.0	11988	1.2
1983	38122	0.5	24392	1.1	12263	1.0	12129	1.2
1984	38279	0.4	24637	1.0	12375	0.9	12262	1.1
1985	38419	0.4	24865	0.9	12481	0.9	12384	1.0
1986	38536	0.3	25076	0.8	12579	0.8	12497	0.9
1987	38631	0.2	25273	0.8	12672	0.7	12601	0.8
1988	38716	0.2	25466	0.8	12763	0.7	12703	0.8
1989	38791	0.2	25659	0.8	12855	0.7	12804	0.8
1990	38850	0.2	25849	0.7	12946	0.7	12903	0.8
1991	38939	0.2	26058	0.8	13046	0.8	13012	0.8
1992	39068	0.3	26281	0.9	13151	0.8	13130	0.9
1993	39189	0.3	26482	0.8	13246	0.7	13236	0.8
1994	39295	0.3	26658	0.7	13327	0.6	13331	0.7
1995	39387	0.2	26807	0.6	13395	0.5	13412	0.6
1996	39478	0.2	26930	0.5	13451	0.4	13479	0.5
1997	39582	0.3	27037	0.4	13500	0.4	13537	0.4
1998	39721	0.4	27151	0.4	13553	0.4	13598	0.5
1999	39926	0.5	27297	0.5	13622	0.5	13675	0.6
2000	40263	0.8	27540	0.9	13732	0.8	13808	1.0
2001	40720	1.1	27877	1.2	13883	1.1	13994	1.3
2002	41314	1.5	28312	1.6	14081	1.4	14231	1.7
2003	42005	1.7	28811	1.8	14311	1.6	14500	1.9
2004	42692	1.6	29310	1.7	14540	1.6	14770	1.9
2005	43398	1.7	29839	1.8	14776	1.6	15063	2.0
2006	44116	1.7	30318	1.6	14992	1.5	15326	1.7
2007	44879	1.7	30873	1.8	15241	1.7	15632	2.0
2008	45593	1.6	31321	1.5	15466	1.5	15855	1.4

Figures

National Accounts

Figure A.1. Consumption

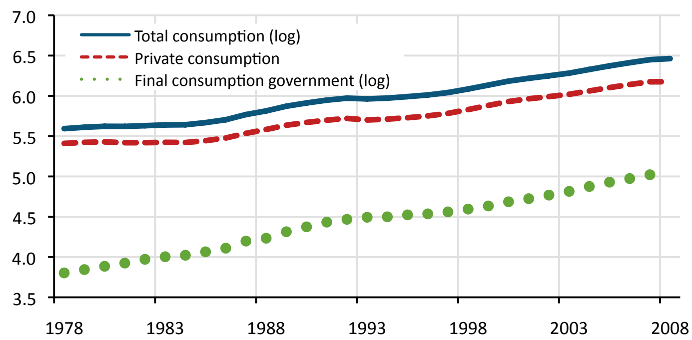


Figure A.2. Gross Capital Formation

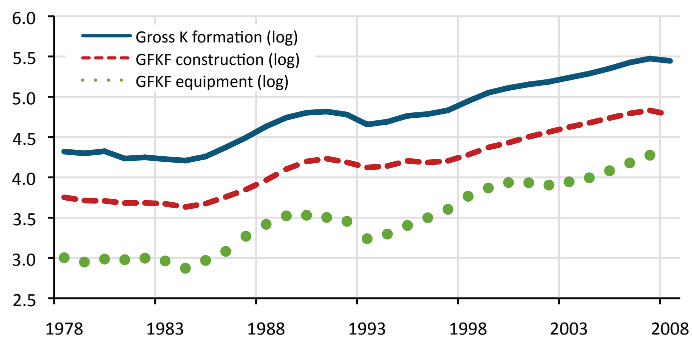


Figure A.3. Public Investment

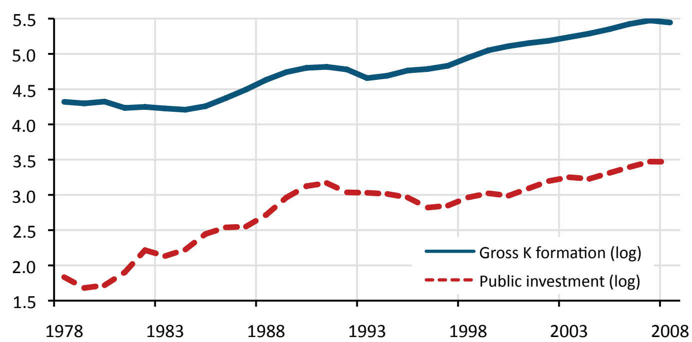


Figure A.4. Public Deficit and Public debt

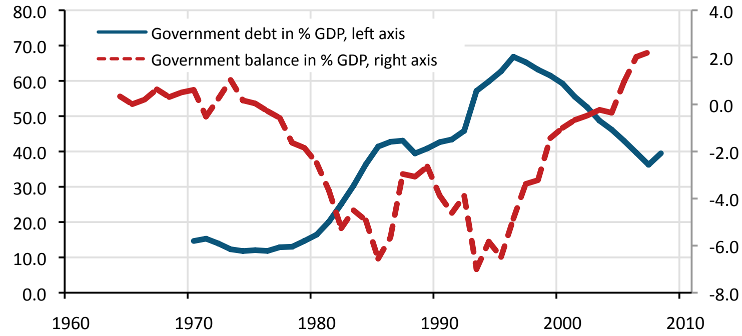


Figure A.5. Exports and Imports

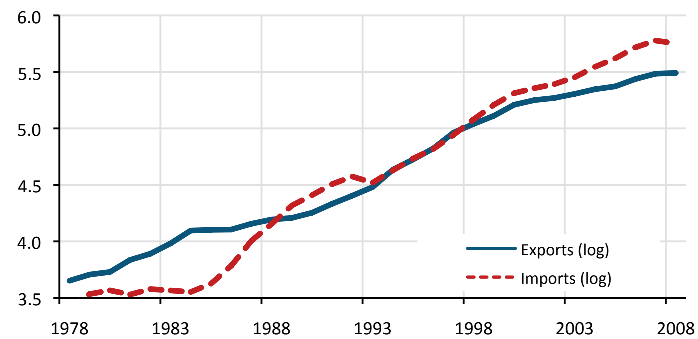
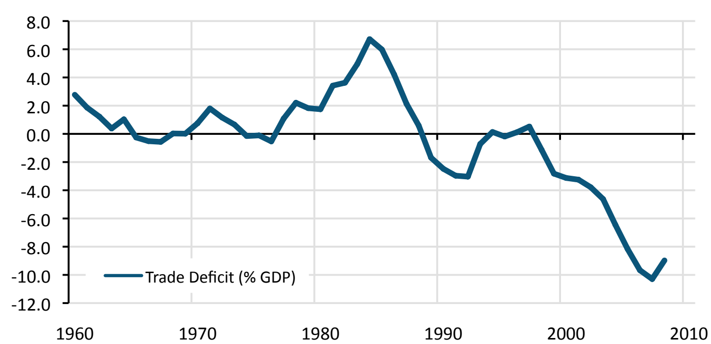


Figure A.6. Trade Deficit (%GDP)



Labor Market

Figure A.7. Employment Growth Rate (LFS)

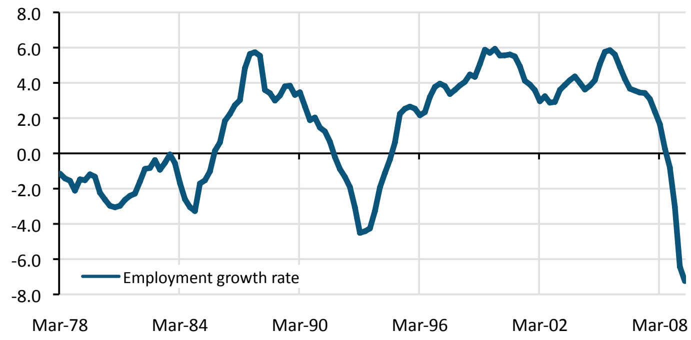


Figure A.8 Total Hours per Worker

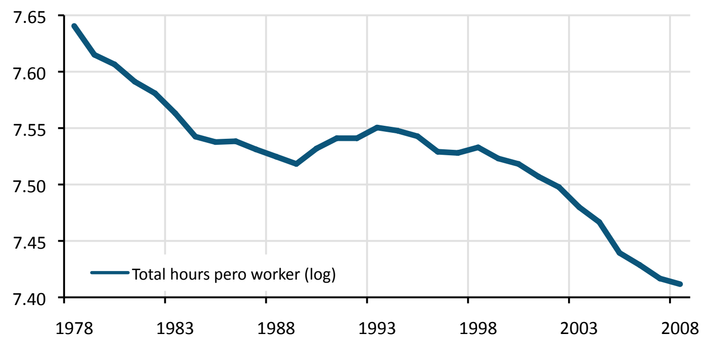


Figure A.9. Employment by gender

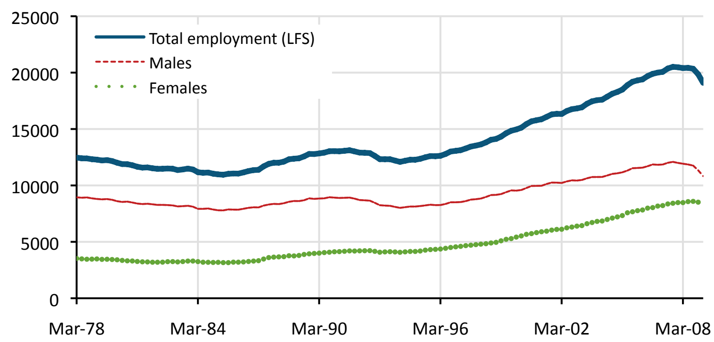


Figure A.10. Employment by Gender and Sector (annual growth, number of workers)

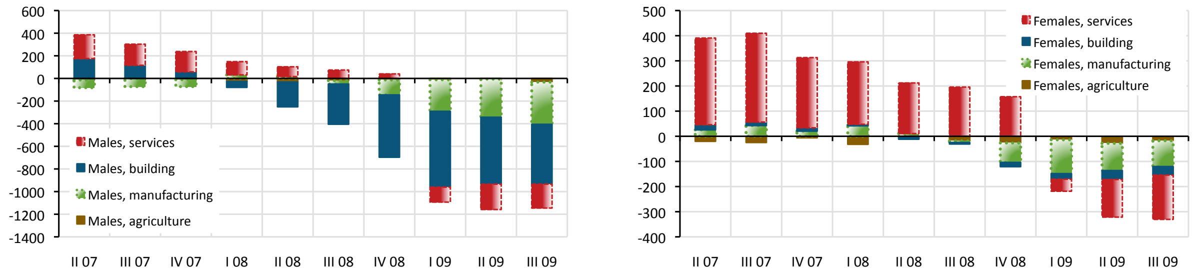


Figure A.11. Unemployment by Gender (annual growth, number of workers)

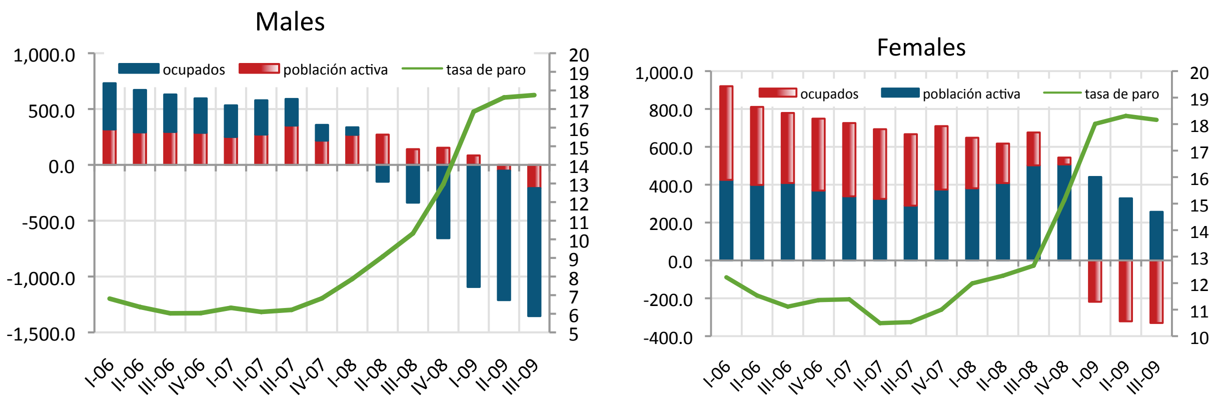


Figure A.12. Employment by Sector

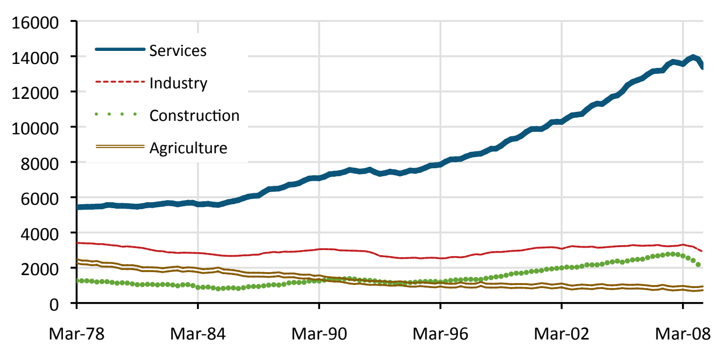


Figure A.13. Employment by Nationality

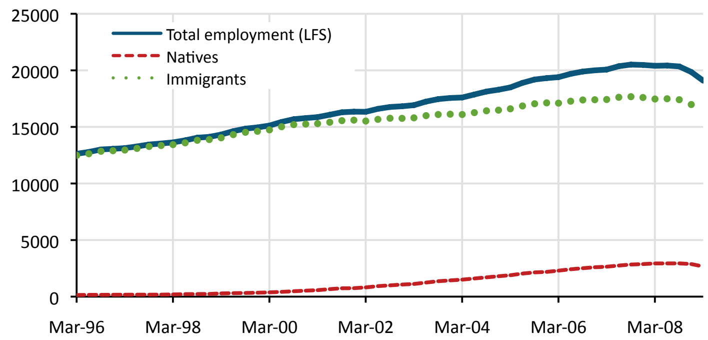


Figure A.14. Employment Rates

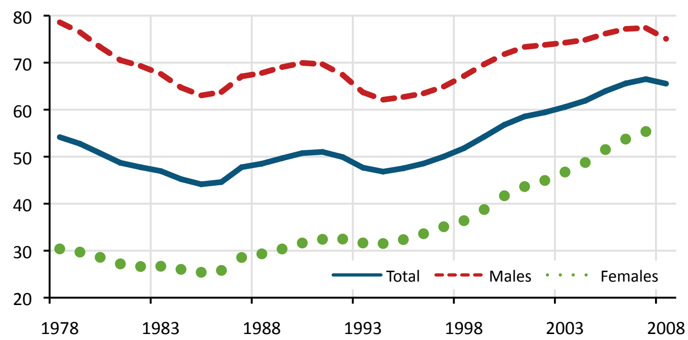


Figure A.15. Unemployment Rates

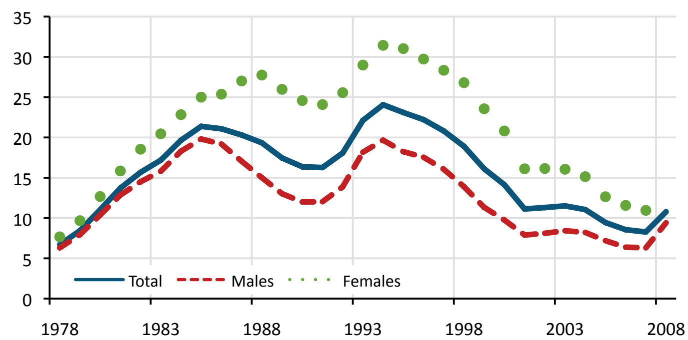


Figure A.16. Activity Rates

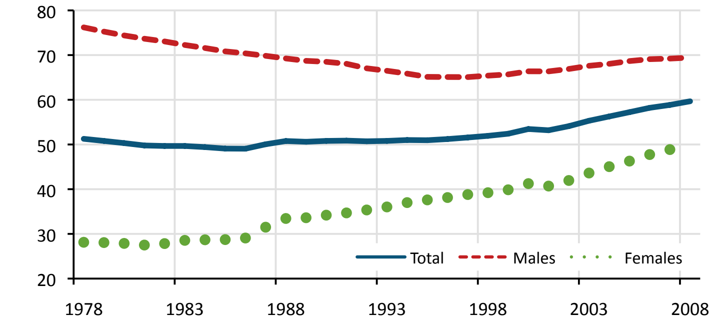


Figure A.17. Permanent vs Temporal Contracts

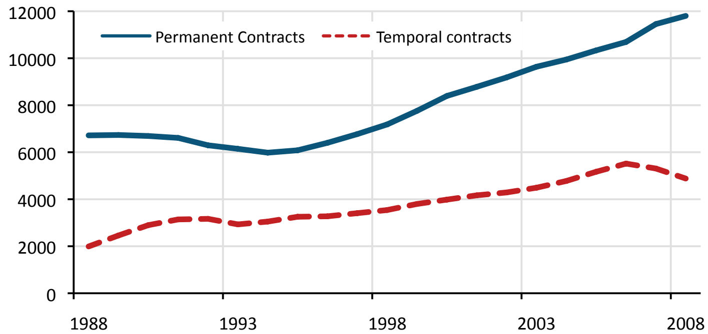
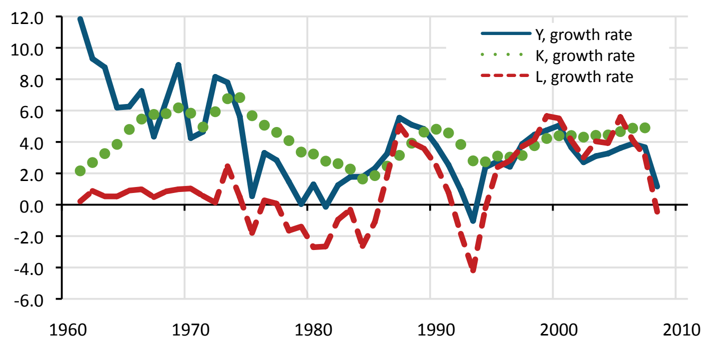


Figure A.17b. Employment, Capital and GDP Growth Rates



Production Function

Figure A.18. Capital per Worker

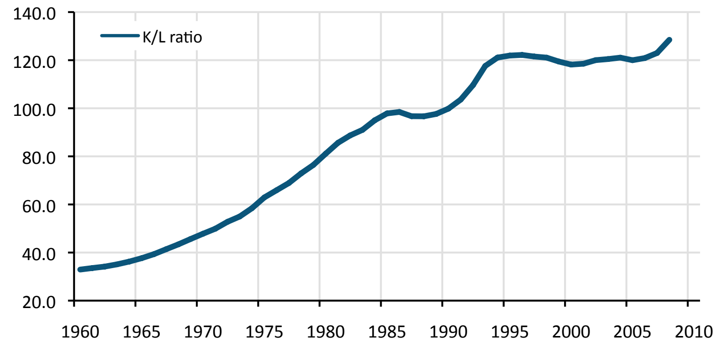


Figure A.19. Capital/Output per Sector

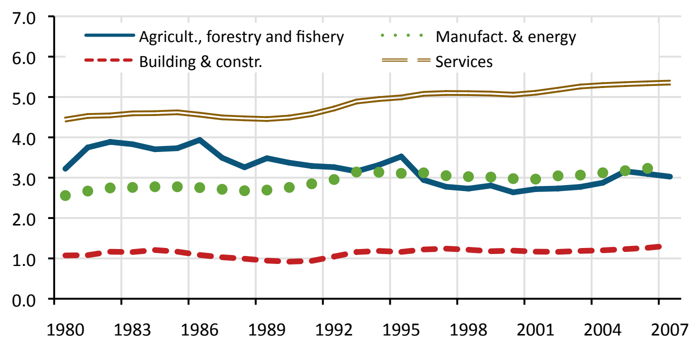
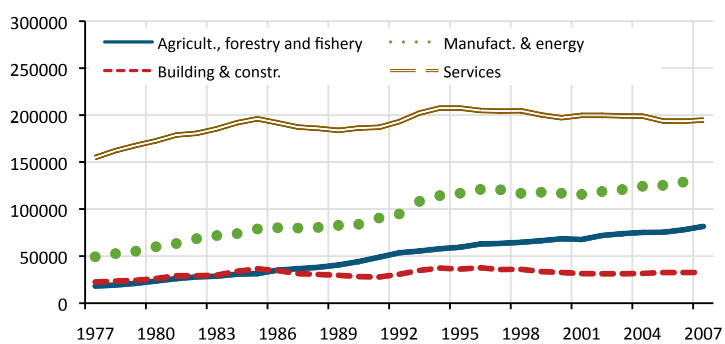


Figure A.20. Capital/Employment per Sector



Prices

Figure A.21. Relative Prices Equipment and Durable Goods

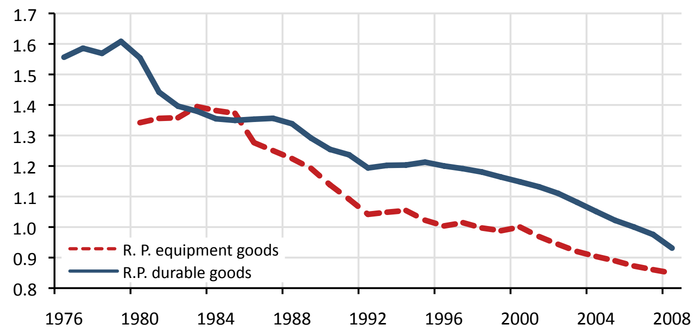


Figure A.22. CPI and GDP Deflactor

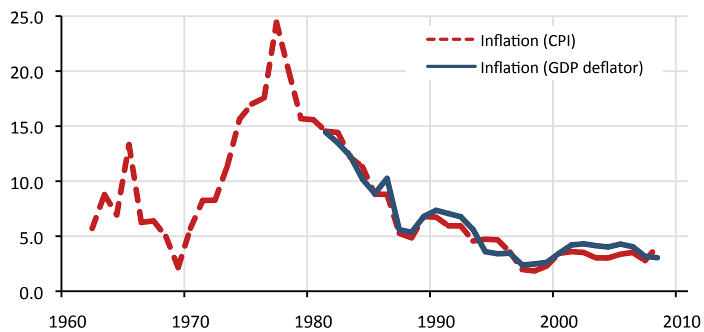


Figure A.23. Relative Prices: Tradeables and Non-tradeables

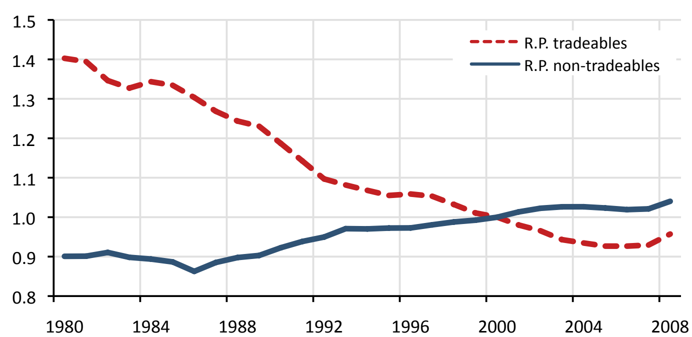


Figure A.24. Real Interest Rate

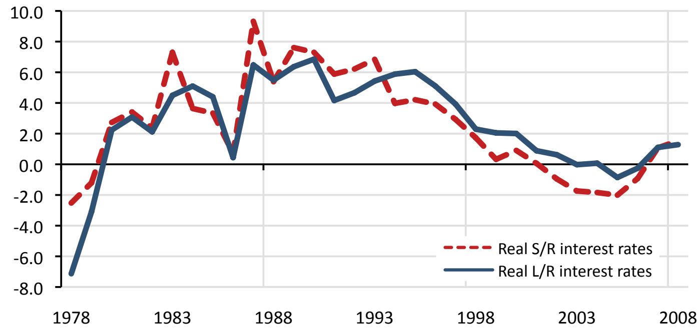
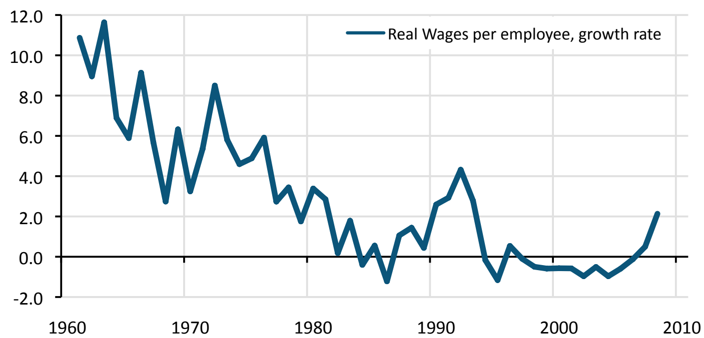


Figure A.25. Real Wage Growth Rate



Data Definitions

Output: Real GDP at 2000 constant prices. Source: European Commission (AMECO). **Capital stock**: Net capital stock at 2000 constant prices; total economy (using national deflator). Source: European Commission (AMECO). **Capital stock per sector**: Net capital stock at 2000 constant prices. Source: Fundación BBVA-IVIE. **TFP**: Total factor productivity, 2000=100. Source: European Commission (AMECO). **Labour share**: Ratio of compensation of employees to GDP at market prices less taxes linked to imports and production and subsidies, less gross operating surplus and mixed income of households and NPISH, and plus consumption of fixed capital by households. Source: European Commission (AMECO) and Instituto Nacional de Estadística (INE). **Capital share**: 1 - labour share. Source: European Commission (AMECO). **Total consumption**: Total consumption at 2000 constant prices. Source: European Commission (AMECO). **Private consumption**: Private final consumption expenditure at 2000 prices. Source: European Commission (AMECO). **Final consumption government**: Final consumption expenditure of general government at 2000 prices. Source: European Commission (AMECO). **GKF**: Gross capital formation at 2000 prices, total economy . Source: European Commission (AMECO). **GFKF construction**: Gross fixed capital formation at 2000 prices, construction. Source: European Commission (AMECO). **GFKF equipment**: Gross fixed capital formation at 2000 prices, equipment. Source: European Commission (AMECO). **Public Investment**: Ratio of gross fixed public capital formation to real GDP. Source: European Commission (AMECO) and Banco de España.

Government debt: General government consolidated gross debt: excessive deficit procedure (based on ESA 1995) and former definition, in percentage of GDP. Source: European Commission (AMECO). **Government Balance**: Government Balance in percentage of GDP. Source: European Commission (AMECO).

Exports: Exports of goods and services at 2000 prices. Source: European Commission (AMECO). **Imports**: Exports of goods and services at 2000 prices. Source: European Commission (AMECO). **Trade Deficit**: Exports less imports over real GDP. Source: European Commission (AMECO).

Population: Total Population. Source: European Commission (AMECO). **Working-age population**: Population between 15-64 years. Source: European Commission (AMECO) and OECD. **Employment**: Civilian Employment. Source: European Commission (AMECO) and Instituto Nacional de Estadística (INE). **Unemployment**: Total unemployment . Source: European Commission (AMECO), Instituto Nacional de Estadística (INE) and OECD. **Hours Worked**: Total hours worked. Source: European Commission (AMECO).

R.P. equipment goods: Relative prices, ratio of equipment goods deflator to GDP deflator. Source: European Commission (AMECO). **R.P. durable goods**: Relative prices, ratio ofvprice index of durable goods to consumer price index. Source: European Commission (AMECO) **R.P. tradeables**: Ratio of industry gross value added deflator to GDP deflator. Source: European commission (AMECO). **R.P. non-tradeables**: Ratio of services and construction gross value added deflator and GDP deflator. Source: European commission (AMECO). **Real S/R interest rate**: 3 month interbank rate. Source: European commission (AMECO). **Real L/R interest rate**: 1979-1987 (state bonds of 2 to 4 years); 1988-1992 (central government bonds at more than two years); from 1993 (central government benchmark bond of 10 years). Source: European commission (AMECO) **Real wages**: Real compensation per employee, total economy, 2000=100. Source: European Commission (AMECO).

B. MATERIAL NOT USED AND FURTHER RESEARCH

Currency devaluations. Spain's inflation differential with the Euro-zone has been at the root of currency devaluations during the 80's and the 90's. The price spikes following the 2nd oil crisis forced the newly elected socialist government to devalue the peseta by 8% against the dollar. The so-called *Boyer devaluation* arrested the outflow of foreign currency reserves (3.000 million dollars had fled the country during the previous month, out of fear of political uncertainty) and restored external competitiveness (the current account balance turned positive until 1987). In 1985 Spain joined the EEC, but would not join the European Monetary System (EMS) until 1989. Under the EMS, the peseta would be allowed to float +/-6% against the ECU (a virtual currency unit composed of a basket of European countries). In practice, the system worked as a peg to the German mark.

The system came under stress in 1992: the implementation of free capital mobility and the tightening of monetary policy that Germany carried out to curb the inflationary pressures built up during the reunification process triggered a massive speculative attack against the EMS currencies. The sterling pound and the lira abandoned the system and other countries were forced to devalue. The peseta was devalued three times over eight months: 5% in September 1992, 6% in September 1992 and 8% in May 1993 (the *Solchaga devaluations*). The EMS was virtually dismantled in August 1993, when broader fluctuation bands of 15% were agreed.

Speculative attacks on the peseta continued as the economic situation and the fiscal position deteriorated. A 7% devaluation against the ECU was necessary in March 1995 (the *Solbes devaluation*).