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Technology and Income Distribution Issues in Trade Models

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Abstract

In a world characterized by global competitive market conditions, technological improvements initially localized in one sector of one country cause real income changes at home and abroad, sometimes in paradoxical fashion. A foreign technological advance in the production of a commodity not produced at home may worsen the home country's real income. As well, a foreign technological advance in a commodity the home country exports may serve to raise home real incomes. These paradoxes are explained and related to the basic proposition that a country moving from autarky to free trade must gain. (JEL codes: F10, F11, O30)

Keywords: Turning points, technology transfers, large shocks.

Neo-classical models of international trade have proved useful in the analysis of two kinds of income distribution effects of changes in growth and technology in a globalized world. With countries interconnected by international trade, economic shocks, such as improvements in technology that take place in a specific sector of a specific country are like stones thrown into a pond; not only do shocks disturb the originating sector and country, but they also send out general equilibrium types of reverberations to other sectors and other countries. These reverberations affect both the distribution of income between countries and, as well, the functional distribution of income within trading regions. Attention is often focused on wage rates (and/or unemployment), although that may take the form either of concern with the so-called double factoral terms of trade (the foreign wage rate compared with the home wage rate), or instead with how local wages fare compared with land rents or returns to capital or highly skilled labor. This article pays special attention to the intercountry effects of technology shocks in a globalized trading world, and accentuates the usefulness of the standard competitive Ricardian model of trade. This Ricardian model was the one selected by Prof. Paul Samuelson in his celebrated 2004 paper in the *Journal of Economic Perspectives* in which he warned that some in the profession are perhaps too enthusiastic in promoting the widespread benefits of globalization without warning of the general result whereby one country's growth may well harm the terms of trade of other

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countries who find price reductions and job losses in their export sectors.[1] In addition, countries without recourse to local energy sources may find their real incomes adversely affected by the high growth rates in countries such as China and India that serve to drive up prices of energy imports.

A general optimistic view of international trade and its positive effects in a globalized world is based in large part on a result concerning the gains from trade that is absolutely basic: any country that is initially in a state of autarky can gain if it engages in relatively free trade with other countries. This is indeed a strong result, but it does *not* say that once a country is engaged in trade further enlargements in the degree of globalization must yield ever larger gains from trade. That is, greater globalization may hurt some existing trading areas. Nevertheless, two recent papers (Ruffin and Jones 2007; Jones and Ruffin 2008) have utilized the Ricardian model to show that even if a country is hurt by a small terms of trade deterioration, it *may* end up being helped if the deterioration shock is large enough. My purpose here is to discuss the basic nature of such results within a wider investigation as to the fallout effects of technological change in one country (and one sector) on real incomes both at home and in the country's trading partners.

The Ricardian trade model is characterized by a huge simplification: each country is capable of producing a variety of commodities by employing only the services of labor. Clearly unrealistic, especially coming from an economist also known for emphasizing differential land rents in agriculture, it has nonetheless proved its worth as a vehicle for economic reasoning for almost 200 years.[2] The model thrusts into prominence intercountry (as well as intercommodity) differences in the 'productivity' of a country's inputs, with such differences providing the basis for the law of comparative advantage. 'Technology' becomes an amalgam of all those characteristics that help to determine the quantity of labor that is required to produce one unit output of each commodity, characteristics that include training and education of the workforce and climatic

[1] Samuelson's article caused quite a storm in the popular press, e.g. see the *New York Times* coverage, 9 September 2004. Samuelson's article has frequently been interpreted as a criticism of trade theory's support for free trade. More recently, it has been cited in the coverage of the US 2008 primary presidential campaign (David Ranson, *Wall Street Journal*, 6 February 2008).

[2] That is, the competitive trade model can be expanded to include, say in agriculture, firms with access to different quality land earning different rents in competitive equilibrium. More generally, specific factors with different qualities could be used by firms in the same competitive industry. Melitz (2003) and followers use such firm heterogeneity in models with imperfect competition.

conditions as well as a more narrow conception of technology embodied in 'blueprints' or sets of instructions on how to apply labor in the production process. In discussing technology in this article, I shall assume that technical progress is represented by new and better sets of blueprints that may, via multinationals or other means, not only be made available to other countries, usually requiring payments, but also capable of being stolen or transferred without compensation.

A general question that can be asked and answered at the outset, concerns the effect of a *small* improvement in the technology of producing the k-th commodity in one country on another country that does *not* produce the k-th commodity. First, assume that there is some other commodity that they both *do* produce in common, and that for convenience it is selected as numeraire. (Common production serves to lock their nominal wage rates together.) Technology in each country thus establishes the initial wage rate in each and therefore the prices of all commodities produced in that country. Now suppose that in the country (call it Home) that does produce commodity k an improvement in technology reduces the labor coefficient for commodity k (which is not produced in Foreign). The price of the k-th commodity faced by consumers is reduced in both countries by the extent of the relative size of reduction in labor costs in Home. The world must gain, with (for these two countries) the gain reflected in the sum of their two demands for commodity k, $(D_k + D_k^*)$, multiplied by the absolute value of the price reduction. In Foreign, the real income gain is D_k^* (Foreign consumption) times the price reduction so that at Home real incomes are improved as well, by D_k times the price reduction. Both countries gain; trading relationships serve to spread the world's gain to all consuming countries, proportional to their consumption.[3] 'A rising tide lifts all boats.'

The spillover effects just described (for small improvements in technology) would be seriously altered if one of these countries (but only one) experiences technology improvement in the production of the commonly produced commodity. As proved in Jones (1979), such a country must gain in real income by a greater amount than does the world as a whole; the other country must lose. This setting fits the description provided by Samuelson (2004) in which one country (China) improves its productivity in a commodity produced as well (before and after) by the other country (United States). The United States would lose. Such a loss does not depend on whether the United States is an importer or exporter of the commodity from China, since (assuming that commodity remains

[3] The transformation curve of the producing (Home) country shifts out, more than balancing the deterioration in its terms of trade. Further details for this and other cases of infinitesimal changes in technology are found in Jones (1979).

the numeraire) the Chinese wage rate would be bid up, and with it the prices of all goods exported to the United States.[4]

So far nothing has been said about conditions of demand. It was assumed that the two countries produced some commodity (k) in common, and this of course linked the wage rates in the two countries together, establishing all prices except for that of the commodity in which one of the countries had an improvement. However, countries need not produce any commodity in common, in which case the link between wage rates in the two countries would be severed. In such a case the pattern of demand becomes important. Suppose one of the commodities produced by Home experiences a labor cost reduction, further enhancing Home's comparative advantage in that commodity. The relative price of that commodity is reduced by the amount of the improvement compared with the cost and price of all other commodities produced by Home, and the profile of relative prices of all commodities produced in Foreign remains the same, except that the link between the wage rates (and thus price levels) between the countries depends as well on demand patterns. At initial Foreign prices, the single price reduction at Home stimulates both a substitution effect and income effect in both countries' demand for the bundle of commodities produced in Foreign. On the one hand, the price reduction at Home will tend to cause consumers in both countries to switch from consuming Foreign goods (and all other Home goods) toward the Home commodity that has gone down in price (assuming all commodities are substitutes). This substitution effect will tend to reduce the prices of all Foreign commodities along with Foreign's wage rate. On the other hand, at initial prices the technological improvement represents an increase in world real income, shared by both countries (at the initial price), and this tends to increase all Foreign prices. A natural in-between case posits a balance between substitution and income effects—a result guaranteed if both countries share common Cobb–Douglas demand conditions.[5] In what follows I maintain this demand assumption.

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[4] Of course models in which markets are imperfectly competitive have welfare effects ruled out in competitive models. For example, in Demidova (2006) an extension of the model of monopolistic competition of Melitz (2003) is developed in which in the sector producing differentiated products prices exceed marginal costs so that changes in the volumes consumed introduce a separate route by which welfare is affected.

[5] This was the assumption made by Dornbusch et al. (1977) to simplify their exposition of the continuum case. In reaction to this assumption, in Jones (1979) I examined both the case in which demand elasticities could be very low (leading to possible real income losses of the immiserizing growth variety for Home) or very high (making possible real income losses to Foreign). Subsequent analyses by Samuelson (2004), Ruffin and Jones (2007) and Jones and Ruffin (2008) simplified by retaining the assumption that demand in both countries exhibited constant and equal expenditure shares on all commodities, as in Cobb–Douglas.

Although a country's own research efforts are often responsible for improvements in productivity, an alternative involves the *transfer* of technology from an advanced economy to one with larger labor coefficients. Kemp and Shimomura (1988) pointed out that a country that has an absolute advantage in producing a commodity that it nonetheless imports because another country has a comparative (but not absolute) advantage in producing the commodity would gain if it sold its technology for producing that commodity.[6] It could even gain if it gave the blueprints away! Why? Its terms of trade would improve. (On the other hand, if demand elasticities were sufficiently low the less advanced country could be immiserized by such a gift. The possibility of improvements in productivity ending up doing harm to its recipients is all too common in agriculture. If supply and demand elasticities are especially low, productivity improvements can result in severe welfare reducing falls in the commodity price, i.e. a terms-of-trade deterioration.)

It might be thought that the logic behind such gains for transferring technology to produce a country's imports would signal as well that any gift of the superior technology possessed for producing a country's *export* commodity must, instead, *lower* real income in the giving country. Such logic was disproved in Ruffin and Jones (2007) for a two-commodity case. The argument was made in more simple terms in Jones and Ruffin (2008) for the case of many commodities in the Ricardian model. The key in either case is to assume that such a transfer of technology not only allows Foreign to become a competitive producer to Home's own production, but also it would typically completely wipe out Home's production of that commodity. Once the two countries share the same technology for producing one of Home's original export commodities (in which it is assumed to have an absolute advantage or else technology transfer makes no sense), the higher wage Home country loses its ability to compete at all in producing this commodity with low-wage Foreign. However, it is this *finite* change in prices and wages that leads to the possibility that is counter to Samuelson's scenario whereby if China gets a little better at producing a commodity produced as well by the United States, but not enough to wipe out US production, the US loses. Large shocks that cause a country to change its production pattern can have a nonmonotonic effect on real incomes.[7]

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[6] This argument is also found in Beladi et al. (1997).

[7] Much of trade theory uses the calculus, and thus *small* shocks, in comparative statics exercises. This allows the *pattern* of production to remain the same. Given that international trade allows countries greatly to concentrate production to relatively few traded items, with *large* shocks (such as technology transfer) the *pattern* of production can easily be altered. See Jones (2008) for other examples (e.g. involving price changes, international capital flows, or fragmentation of production processes) of nonmonotonic real income response to large shocks.

To keep the discussion here within bounds, I shall assume a two-country world, made up of Home and Foreign. This simplification still permits asking about the effect of one country's productivity improvement on real wages and incomes of another country that also produces the same commodity without sharing the benefit of a reduction in the labor input/output coefficient. Although 'comparative advantage', as expressed in the *relative* labor costs of production in Home and Foreign, provides the key to patterns of trade, I shall adopt the stance of Jones and Ruffin (2008) and assume, first, that a unit of each commodity is defined as the amount that can be produced by a single unit of Home's labor, second, that the numeraire is picked as any commodity produced at Home (so that Home's nominal wage rate is unity), and, finally, that Home has an absolute advantage in the production of all commodities. That is, letting a_j^* indicate the amount of Foreign labor required to produce a unit of commodity j, all foreign a_j^* exceed unity. Furthermore, suppose that if n commodities can be produced in Home and Foreign,

$$a_1^* > a_2^* > \ldots > a_n^* > 1 \tag{1}$$

That is, Home's greatest comparative advantage lies in the first commodity, and its least in the n-th. Further to emphasize the potential paradoxical flavor of the outcome whereby a transfer of technology without compensation is made to Foreign, Jones and Ruffin (2008) assume that the technology that is passed on to Foreign (perhaps by Foreign theft) is for the first commodity, the one in which Home possesses its *greatest* comparative advantage. (As illustrated below, the paradox holds for the transfer of superior technology for any of Home's export commodities.)

The first result to be expected from such transfer is that if Foreign is large enough to satisfy world demand for the first commodity, it will become its sole producer. Foreign's wage rate is lower than that at Home, so that Home would be uncompetitive in producing the first commodity if Foreign should obtain the superior Home technology. Could this possibly end up raising real wages (and real incomes) in Home? Yes, it could, but not necessarily. (Once more, the economist needs two hands—on the one and on the other.) The key to unraveling the possibilities lies in the observation that the relative size of Home and Foreign, coupled with the profile of technology whereby Home has an initial absolute advantage in producing all commodities, determines Foreign's relative wage rate. Generally speaking, in a diagram with the ratio of Foreign to Home wage rates on the vertical axis (and this reduces to w^* since Home's nominal wage is always unity) and the relative size of Foreign's labor force, L^*/L, on the horizontal, the locus is roughly downward sloping, and would be precisely that in the continuum case popularized by Dornbusch et al. (1977). However, assuming a finite number of

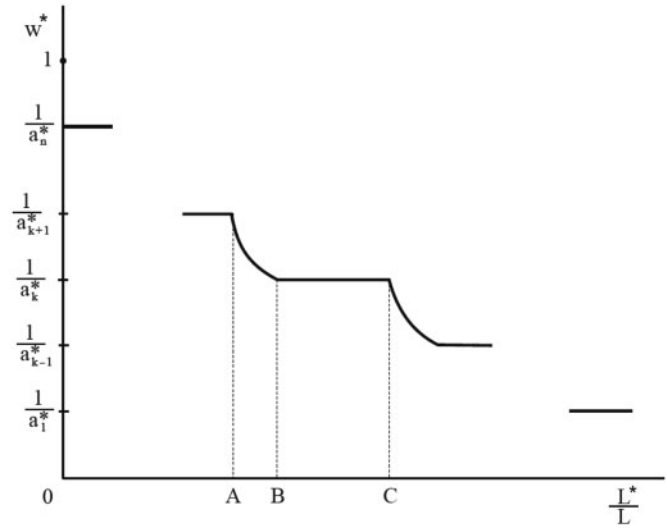

Figure 1 Before technology transfer

commodities (n), wages in the two countries are locked together if they produce a commodity in common, whereas if there is no such commodity any increase in L^*/L will drive down w^* since Foreign's production of all the commodities it produces will increase (for given home L), causing their prices to fall and, as well, w^*, until Foreign can once again compete with a commodity produced by Home. This behavior is captured in Figure 1, which is taken from Jones and Ruffin (2008). In the horizontal BC range both countries produce the k-th commodity. In the AB range, Foreign's wage is falling from $(1/a^*_{k+1})$ until it reaches the level that allows it to compete in producing the k-th commodity. Two further values for w^* are also revealed in Figure 1. If Foreign's relative size is very small, it will not be able to produce enough of its best commodity (n) to satisfy the world market, so its wage rate is linked to that of Home by the relative productivity in producing commodity n. At the other extreme, if Home were so small it could not supply the entire world demand for its best good, Foreign would have to produce it as well, with w^* driven down to $(1/a^*_1)$. The recorded values of points A, B, and C presume equal Cobb–Douglas expenditure shares for each commodity.[8]

[8] If Home produces the first k commodities and Foreign is specialized to commodities $(k+1)$ through n, the ratio of their national incomes, $[w^*L^*/wL]$ (with w equal to unity), must equal $[(n-k)/k]$, with each country's produced income matching its own expenditure (i.e. balanced trade).

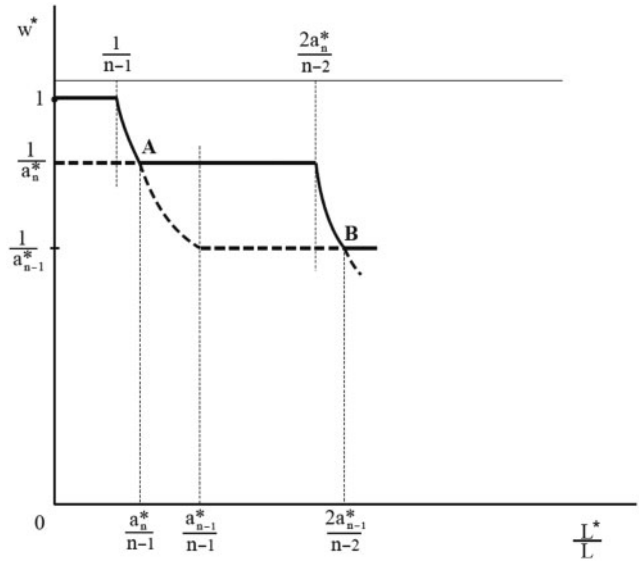

Figure 2 Turning points

Following the argument in Jones and Ruffin (2008), consider (their) Figure 2. The dashed locus shows the relationship between w^* and (L^*/L) before technology transfer and the solid locus the new posttransfer locus. After transfer, commodity 1 becomes Foreign's best. However, given that this is a superior technology to the best it had before, Foreign can completely satisfy the world's demand for the first commodity with a smaller labor force than it initially required to satisfy the world's demand for the n-th commodity. Further increases in L^*/L will drive w^* down from its unit value (which it has if both countries produce the first commodity with the same technology). At point A in Figure 2, w^* has fallen to $(1/a_n^*)$. (The Cobb–Douglas assumption assures such a result.) Points such as A and B in Figure 2 are called 'turning points'. For example, if Foreign's relative labor supply has increased until point A is reached, initially (pretransfer) it will just have finished being the world's only supplier of commodity n. After the technology transfer, at point A Foreign becomes an incipient producer of commodity n (having already produced the entire world's demand for the first commodity). As a consequence, if the ratio of labor forces is at a turning point (such as A), there is no change in Foreign's w^*, while the price of commodity 1 has fallen (since it is now produced by Foreign, whose wage rate has been driven below unity). Home workers face a lower price level than before the transfer of technology, and with their nominal wage still equal to unity,

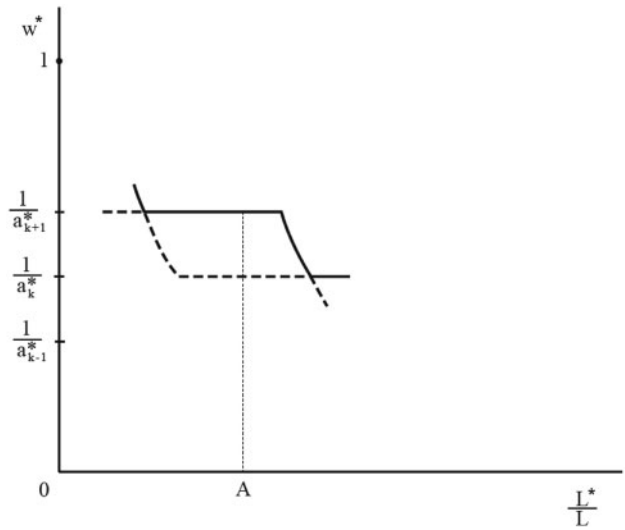

Figure 3 Technology transfer and foreign wage improvement

they unambiguously gain by the uncompensated transfer of technology of their best export commodity.

If the relative country size is not at a turning point, two effects on the price level follow technology transfer: (i) the world price of the transferred commodity (1) falls, tending to lower the price level for all and (ii) the upward shift in Foreign's wage schedule points to an increase in the price of all commodities (save the first) that are exported from Foreign to Home. This serves to raise the price level facing workers at Home and thus to lower the real wage. In the neighborhood of turning points the price level clearly falls, whereas with reference to Figure 2 it is clear that Home is most likely to suffer a fall in the real wage if, both before and after transfer, the two countries produce a commodity in common, albeit a different commodity in the two cases. This is explicitly shown in Figure 3 for a value of (L^*/L) given by point A: Before technology transfer, the prices of commodities 1 through k are all unity (all produced by Home), Foreign's wage rate is $(1/a_k^*)$, and prices of commodities $(k+1)$ through n are given by the series $(a_{k+1}^*/a_k^*), (a_{k+2}^*/a_k^*), \ldots, (a_n^*/a_k^*)$. As a consequence of the unrequited transfer of technology for the first commodity to Foreign, its price falls from unity to $(1/a_{k+1}^*)$, the new (higher) Foreign wage rate. As for the sequence of commodities previously produced by Foreign, commodities $(k+1)$ through n, prices have all been raised by the proportion (a_k^*/a_{k+1}^*), the relative increase in Foreign w^*. The price deflator for the home nominal wage of unity in the Cobb–Douglas case is the

n-th root of the product of commodity prices, and in the situation where (L^*/L) is shown by point A in Figure 3, the product of commodity prices is less than unity (and thus Home gains by the loss of the technology for producing its best export commodity if and only if:

$$\left\{\frac{1}{a^*_{k+1}}\right\}\left\{\frac{a^*_k}{a^*_{k+1}}\right\}^{(n-k)} < 1 \qquad (2)$$

This is formally proved in Jones and Ruffin (2008). The first bracketed term is smaller than unity and refers to the drop in the price of the first commodity as its production shifts from Home to Foreign. The second term, larger than unity, shows the product of the increase in prices of all commodities produced by Foreign. The first term reflects the difference between Home and Foreign wage rates, while the second reflects the extent to which Foreign's wage rate has risen.

Note that the drop in the price of what was originally Home's best export commodity does *not* appear directly as a worsening of Home's terms of trade. Instead, with the loss of this industry, Home becomes an importer of the first commodity, and its consumers gain to the extent that the price has been reduced from unity to $(1/a^*_{k+1})$. This is part of an overall 'terms-of-trade' effect for Home, the other part consisting of a price rise for all the other commodities imported by Home, the second bracketed term in (2). Here is where the 'profile of comparative advantage' possessed by Home is critical. Prices of all these commodities imported by Home have been raised by the proportion (a^*_k/a^*_{k+1}). This reflects the fact that by taking over production of the first commodity, the commodity in which Foreign possesses the least comparative advantage but must produce is no longer commodity k, but commodity $(k+1)$, in which Foreign has a greater comparative advantage. If the difference in comparative productivity in these two commodities is not very large, Foreign's wage rate will not increase by much, thus limiting the deterioration in Home's terms of trade.

The two-commodity case considered in Ruffin and Jones (2007) highlights the importance of the profile of comparative advantage. Suppose, as above, commodity units have arbitrarily been selected so that Home needs only one unit of labor to produce one unit of either commodity, and that Home has a comparative advantage in producing the first commodity (and a comparative disadvantage in producing the second). If there is an uncompensated transfer of Home's superior technology in producing the first commodity, and if as a consequence Home's labor force moves from being completely specialized in the first commodity to being completely specialized in the second, Home nonetheless gains by the transfer if Home's absolute advantage in producing the second is not much less than in

producing the first. This would be captured by inequality (3) being satisfied, which is the form taken by equation (2) for the two-commodity case:

$$(a_2^*)^2 > a_1^* \tag{3}$$

The comparison with the two-commodity case is also revealing in that whereas in the two-commodity case, the extent of Home's absolute advantage in producing the first commodity is crucial [see inequality (3)], this is not the case in expression (2), the criterion for gain in the worst-case scenario in the multicommodity case. What is crucial, instead, is the comparison between Home's comparative and absolute advantage in producing the k-th commodity and that of the new commodity now produced at Home, commodity $(k+1)$. As a consequence, although selecting the first commodity as the one whose technology is transferred sounds like it would inflict the most damage to Home real incomes, it is not different than transferring Home's superior technology for any of its original export items.

There is, however, a natural limit to possible gain for Home of unrequited transfers of its superior technology. Suppose it were to transfer its technological knowledge in *all* commodities to Foreign. The world would obviously gain, but could the Home country as well? The answer is an unequivocal *no*. For such a transfer puts Home back in the same position it was in when in autarky, which is inferior to its original pre-transfer, free trade position. However, as the Ruffin and Jones (2007) results indicate, Home might gain by a transfer of all its superior technology for every export commodity, while maintaining its superior technology for all its import commodities. An aggregative condition of inequality (3) provides the criterion.

As Prof. Paul Samuelson and others have frequently remarked, the doctrine of comparative advantage is not only extremely important and powerful, but it is also subtle and often quite difficult to understand. In the context of Samuelson's (2004) argument, it can show how globalization can hurt some countries, but as argued in Ruffin and Jones (2007) and Jones and Ruffin (2008) although relatively small shocks can harm some countries, larger shocks that serve to alter production patterns may in the end benefit countries who would be harmed if the pattern of production were not disturbed. In most developed countries, it is possible to point to commodities, such as TV sets or automobiles that years before were produced at Home but are now imported, with Home consumers not complaining.

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Pensions under Ageing Populations and the EU Stability and Growth Pact*

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Abstract

This article explores how the Stability and Growth Pact (SGP) may cope with the future costs of population ageing in the European Union. Clearly, population ageing has forced countries to reform their pension systems, and will continue to do so, both by reducing the generosity of pension arrangements and by switching to funding rather than relying on pure pay-as-you go pension provision. We study how such reforms affect the room for adhering to the SGP, but also how the SGP may induce or hamper the incentives for reform. We will refer to recent literature on ageing and pensions and on the SGP. We also calibrate a simple model for addressing intergenerational equity and discuss its implications for the SGP. (JEL codes: H11, H55, H60)

Keywords: Public pensions, population ageing, government budget deficit and debt, European Union stability and growth pact.

1 Introduction

This article addresses the link between two major macroeconomic policy issues in Europe: (i) coping with rising public expenditures caused by population ageing, and (ii) the adherence to the European Union's (EU's) fiscal rules, notably to the provisions on public finances in the Stability and Growth Pact (SGP) as revised in 2005. The analysis is concerned with the long-term sustainability of public finances. As this can, however, be achieved through many different combinations of spending and revenue policies over time, we narrow the focus and consider those policies that treat subsequent generations equally, taking into account their fertility, longevity, tax payments and the benefits they receive from the public

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pension system, and other expenditure programmes. Our benchmark calibration suggests that adhering to this principle requires the average EU government to run substantial surpluses for at least two future generations. Therefore, the SGP's current medium term objectives (MTOs) do not seem sufficiently ambitious. We further find that (partial) privatisation easily leads to a conflict with the SGP's reference values for deficits and debt.

The article is structured as follows. Section 2 discusses the content and implementation of the SGP, both before and after its recent reform, including the use of the long-term expenditure projections for the EU-25 for assessing long-term fiscal sustainability. Section 3 sets up a model to provide numerical illustrations of public debt, deficits and implicit liabilities under different pension and fiscal arrangements. It pays attention to a transition towards (partial) funding of pensions that might be required for intergenerational equity. Technicalities are kept to a minimum, while the Appendix available on http://www1.fee.uva.nl/toe/content/people/beetsma.shtm presents the full model. Section 4 discusses the implications of the analysis for pension reforms and the SGP, while Section 5 concludes the article.

2 The SGP and ageing-related public expenditures

2.1 The original SGP

While monetary policy in the euro area is delegated to the European Central Bank (ECB), fiscal policy remains in the hands of the national authorities, who should (according to the Treaty agreed upon in Maastricht in 1991) comply with the principle of sound public finances. To ensure this compliance, the Treaty prohibits central bank financing to governments, their privileged access to other financial institutions and the bail-out of debts of any public entity with the help of the European Community or its Member States. A bailout of a Member State in severe budgetary trouble by raising inflation to erode the real burden of its debt is also excluded by setting price stability as the primary objective of the ECB. This arsenal of measures geared to preventing divergences from sound public finances was complemented with an Excessive Deficit Procedure (EDP) with reference values for deficits (3 percent of GDP) and debt (60 percent of GDP) that can ultimately lead to the payment of fines by a Member State that does not correct its Excessive Deficit before the deadline imposed by the EU Council. Nevertheless, some countries (notably Germany) believed that all this would still not be sufficient guarantee for the ECB to be able to operate independently and achieve price stability. This fear resulted in the SGP in 1997.[1]

[1] For more details, see Eichengreen and Wyplosz (1998); Fischer et al. (2006) classify the various proposals to amend the Pact; prominent examples are Wyplosz (2005), von Hagen (2002), Fatas et al. (2003), Fitoussi (2002), and Blanchard and Giavazzi (2004).

One part of the SGP, the regulation 'on speeding up and clarifying the implementation of the excessive deficit procedure', makes the Treaty-based EDP operational by specifying the time schedule and various criteria applied in the procedure (the 'corrective arm'). The other part, the regulation 'on the strengthening of surveillance of budgetary positions and the surveillance and coordination of economic policies', aims at preventing excessive deficits by requiring countries to strive for a budget that is close to balance or in surplus in the medium run (the 'preventive arm'). The safety margin below the 3 percent of GDP deficit aims at allowing the automatic stabilisers to do their work, unless the economy falls into a very severe recession. As part of this regulation, euro area members must submit a 'Stability Programme' every year, in which they set out their budgetary path and the underpinning measures for the coming years. The other EU countries submit similar 'Convergence Programmes'. The Commission assesses the programmes and provides recommendations, after which the Council of Economics and Finance Ministers (ECOFIN Council) gives its opinion.

2.2 The revised SGP

The revision of the SGP was agreed upon at the ECOFIN Council and endorsed by the European Council in March 2005, after the SGP had been put on hold at the end of 2003 as a result of the failure to follow its formal procedure in the case of the Excessive Deficits of Germany and France.[2] The revision comprises several improvements and clarifications to short- and medium-term budget management in order to avoid pro-cyclical fiscal behaviour. Specifically, budgetary adjustment should be judged in terms of the cyclically adjusted balance, net of one-off items, and temporary measures. The revision also allows the deadlines for correcting Excessive Deficits to be revised and extended if unexpected adverse economic

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The proposals that focus on long-term sustainability are especially relevant for the present article: Pisani-Ferry (2002), Calmfors and Corsetti (2004), and Buiter and Grafe (2004).

[2] Apart from the fact that in many Member States deficits exceeded 3 percent, there was a particular issue that triggered the crisis in implementing the SGP in 2003. It was an issue of a Member State in Excessive Deficit (Germany) that had implemented the recommendations it had received, but exogenous factors had turned out to be more unfavourable than expected and the deficit therefore did not decline. The Commission considered that it was legally obliged to recommend moving to the next stage of the procedure (i.e. one step closer to potential sanctions), while Germany, supported by France, wanted to return to the previous recommendations and revise them (Korkman 2005, p. 117). This dispute caused a deadlock in the Council, as the required qualified majority was not found under the correct legal procedure to any decision. In the subsequent ruling, the Court of Justice of the European Communities (2004) considered (among other things) that the recommendations can indeed be modified later by the Council, on a fresh recommendation from the Commission (paragraph 92). After this clarification to the original SGP, the possibility of repeating the steps was made explicit in the revised SGP.

events occur. Public debt and sustainability receive greater emphasis. This is also the case for structural reforms, including pension reforms 'to safeguard the sustainability of public finances in the long run, to promote growth and to avoid imposing excessive burdens on future generations' (European Council 2005).

The MTO for budget balance at the end of the Stability and Converge Programme period was made country-specific, subject to possible revision in the case of major structural reforms, and in any case in every 4 years. For countries that already have adopted the euro or participate in Exchange Rate Mechanism (ERM)-II, the MTO ranges from a minimum of −1 percent of GDP for low-debt and high-potential-growth countries to balance or surplus for high-debt or low-potential-growth countries (ECOFIN Council 2005). As long as a country has not reached its MTO, it should reduce its cyclically adjusted deficit annually by at least 0.5 percent of GDP. The short-run costs of structural reforms, in general, are explicitly recognised for the definition of the adjustment path to the MTO.

These MTOs were first agreed upon in 2005, but it was explicitly noted that they were set for a transition period until the 'criteria and modalities for taking into account implicit liabilities [related to increasing expenditures in the light of ageing populations] are appropriately established and agreed by the Council' (ECOFIN Council 2005). Even though more time was needed, useful groundwork had already taken place in the context of producing commonly agreed long-term projections for public expenditures.

2.3 Demography and ageing-related expenditure projections

Pensions are largely unfunded in most EU countries. In the EU, thus far only the Netherlands, Denmark, and the United Kingdom have featured a substantial funded pension pillar.[3] If strictly applied, a pure pay-as-you-go (PAYG) pension system implies that contributions into the system exactly match the pension payments. Such a system thus affects neither the government's deficit nor its debt. However, the consequence of increasing expenditure under a pure PAYG system is that over the coming decades PAYG pension contributions (or other taxes) have to increase substantially. This raises some questions about the negative consequences of such tax hikes, including lower labour supply and tax evasion.

[3] Economic Policy Committee and European Commission (2006a, pp. 52–56), provides an overview of European pension systems; Economic Policy Committee and European Commission (2006b, pp. 28–31), contains a scheme of the pension reforms in the EU. See also, Whiteford and Whitehouse (2006). In Finland, the statutory pension system is 20–25 percent funded, and consists of investments mainly in assets other than Finnish government bonds. It is classified within the general government accounts; consequently (e.g. in 2006), while gross public debt was 39 percent, net debt was negative, at −24 percent of GDP (Ministry of Finance of Finland 2007).

These negative consequences of escalating ageing-related expenditures and the potentially serious impact on the government's deficit and debt were commonly recognised towards the end of 1990s. To prepare the ground for the necessary reforms, serious work on projecting these expenditures was started at the EU level in 1999, leading to the first comprehensive report in 2001 followed by the second one in 2006 (Economic Policy Committee and European Commission 2001, 2006a, b). The latter provides projections for population-ageing-related public expenditures in the EU Member States (EU-25 at the time) from 2004 to 2050 (henceforth referred to as 'EPC projections'). They are based on demographic projections, a commonly agreed-upon set of macroeconomic assumptions regarding the labour force, productivity growth and real interest rates, and the policies or policy rules prevailing in 2005.

In 2004, EU-25 pension expenditures were on average 10.6 percent of GDP, ranging from 4.7 percent of GDP in Ireland to 14.2 percent in Italy. The average increase in the EU-25 by 2050 is a relatively modest 2.2 percent-points of GDP. This is much less than the increase in the old-age dependency ratio which (other things equal) would imply an 8.1 percent-points increase in expenditure. The countervailing factors are a projected increase in the employment rate of prime-age workers and in the retirement age, and, notably, a decrease in the average pension relative to the average wage. The projected average expenditure increase of 2.2 percent-points of GDP also conceals large differences among the Member States, from a 5.9 percent-point decrease in Poland to a 12.9 percent-point increase in Cyprus.

Healthcare and long-term-care expenditures are projected to rise, on average, at roughly the same relative speed as the pensions. The dispersion across countries is smaller than for pensions, presumably partly because a common methodology was applied to projecting these costs.

Based on ageing-related expenditure projections, and taking into account current deficit and debt ratios, European Commission (2006, pp. 86–87) classifies the EU Member States into three groups with respect to risks to the sustainability of public finances: (i) 'high-risk': the Czech Republic, Greece, Cyprus, Hungary, Portugal, and Slovenia, where the projected increase in pension expenditure ranges from 5.6 percent to 12.9 percent-points of GDP; (ii) 'medium-risk': Belgium, Germany, Spain, France, Ireland, Italy, Luxembourg, Malta, Slovakia, and the United Kingdom, where the projected increase ranges from 0 percent to 7.4 percent-points of GDP; and (iii) 'low risk': Denmark, Estonia, Latvia, Lithuania, the Netherlands, Austria, Poland, Finland, and Sweden, where the projected change ranges from a decrease by 5.9 percent to an increase of 3.5 percent-points of GDP.

The EPC projections should be regarded with considerable caution. For example, the significant decreases in projected expenditures, notably in Poland, Estonia and Malta, and the very small increase for Italy, follow from the policy rules in force in 2005. There is serious doubt, however, about the *political sustainability* of those rules (and possibly also their interpretation). This doubt mainly concerns the indexation of pensions: the rule that is formally in place (e.g. price indexation only) and, therefore, assumed for the projection, may not be politically sustainable.[4]

The EPC projections do show, however, that ageing-related public expenditures pose a severe challenge to almost all EU Member States. The illustrations below refer to EU-average numbers; for further applications, we recommend looking carefully into the EPC projection for each Member State separately and considering all relevant details.

2.4 The revised SGP and pension system reforms

In anticipation of the rising costs of ageing, and to share more evenly among the generations the costs of providing old-age pensions, countries have started to introduce both systemic and parametric pension reforms. Regardless of whether pension reform is systemic or parametric, to the extent that it permanently reduces projected expenditure, it alleviates the concerns of long-term sustainability. However, a reform that replaces part of the public pension system by a private-sector-managed, fully funded tier will trigger a reduction in pension contributions paid to the first pillar at a time when the pensions of the current retirees still need to be financed. A stock of assets will be built up in the newly established funded pillar, but this will not be part of the government accounts as, according to the decision by Eurostat (2004), funded defined-contribution schemes should be recorded as part of the private sector.[5] To cope with the reform, the government may issue debt, making some of the implicit pension

[4] Poland is an illustrative example: in 2005 the indexation rule was changed to inflation only, abolishing the partial indexation to real wages. In line with the common methodology, the projections were based on this new rule, implying a significant reduction in projected replacement rates. However, the original indexation rule was restored in 2007 (Republic of Poland 2008). As even the restored rule can be regarded as conflicting with the basic principles of the Polish Notional Defined Contribution system, one may reasonably expect further changes to the indexation rule or occasional increases in pension payouts.

[5] This decision by Eurostat concerned the defined-contribution, funded pension systems that may be managed by the government. It considered that the fund's assets are ultimately owned by the participants, who bear the risk associated with the return on the assets. These systems should therefore be classified in the private sector. With regard to the defined-benefit schemes, an important criterion is the degree of funding. The Dutch occupational defined-benefit system is classified in the private sector (as it is fully funded), while the Finnish partially funded mandatory defined-benefit system falls within the general government (as the degree of funding is only about a quarter).

debt explicit. The problem here, however, is that the public deficit and debt increase, while the fall in implicit liabilities due to the reduction of future pension payments from the PAYG pillar is not recognised in the national accounts relevant for assessment of compliance with the SGP.[6]

The revision of the SGP addresses this potential conflict between the transition to a (partially) funded pension system outside the government accounts and the SGP rules. With regard to the preventive arm, it prescribes that the 'Member States implementing such reforms should be allowed to deviate from the adjustment path towards the MTO, or from the MTO itself. The deviation from the MTO should reflect the net cost of the reform to the publicly managed pillar, provided the deviation remains temporary and an appropriate safety margin to the reference value is preserved' (European Council 2005).

In the corrective arm, the leeway is specified prescribing that (regressive) 'consideration to the net cost of the reform will be given for the initial five years after a Member State has introduced a mandatory fully-funded system', so that during the 5 years '100, 80, 60, 40 and 20 percent of the net cost of the reform to the publicly managed pillar' will be taken into account (European Council 2005; for a detailed presentation, see European Commission 2007).

Note that while the allowed deviations from (the path to) the MTO and the reference deficit level as a share of the cost are falling over time and restricted to 5 years only, transition under pension reforms typically lasts for decades.

2.5 Intergenerational equity

For a few years now, the EU has used the commonly agreed projections for ageing-related expenditures to construct a quantitative indicator for long-term stability of public finances along the lines of Buiter (1985). The indicator is based on the *constant tax rate* that would fulfil the intertemporal budget constraint (ITBC) of the government, given the projected expenditures, and the need to service the current debt. This tax rate is compared with the current tax rate, and the difference between the two is called the 'sustainability gap'.[7]

However, for a given projected expenditure increase an infinite number of tax-rate paths exist that fulfil the ITBC of the government, while there

[6] Tabellini (2003) makes this point. Oksanen (2004) presents a numerical illustration of the effect of partial privatisation on the public deficit and debt.

[7] See, European Commission (2006); see also, Buiter and Grafe (2004). The *gap* derived from an infinite-horizon calculation is now more prominent, while a *gap* derived from a calculation until 2050 has also been used. The Board of Trustees of the US Social Security System (Board of Trustees 2007) uses the same method.

are no convincing reasons why the scenario with a *constant tax rate* should be chosen as the (dominant) benchmark (as is done when calculating the *sustainability gap*). There are several arguments for looking at a broader range of scenarios. First, subsequent generations generally differ from each other with regard to their fertility, longevity, retirement age, and pension benefits. Hence, to achieve intergenerational equity, one might envisage that they also pay different pension contributions and other taxes (Sinn 2000, 2004). Second, the expenditure projection based on current policies should not dominate the modalities for setting the MTOs, as for many EU Member States emphasis should obviously be put on designing reforms that reduce these expenditures (e.g. European Council 2005); in the process of designing a comprehensive policy package one could make alternative calculations for the MTOs conditional upon several reform options.

It is clear, as is also acknowledged by the European Commission (2006, pp. 21–22), that the SGP incorporates intergenerational equity neither explicitly nor systematically. One reason for this is that distributional issues are a matter of political preferences expressed and implemented at the national level—taking actions affecting the fundamental principles of national social security is even explicitly excluded from the competence of the EU (EU Treaty article 137; this is maintained in the Reform Treaty of 2007, which is pending for ratification). Another reason is the lack of data: since the EPC projections do not provide data by age cohort, they do not allow for a link between the costs and benefits of subsequent generations.

These or other considerations should not, however, be regarded as decisive obstacles to examining pensions and their financing from the angle of intergenerational burden sharing. Analysis and policy design at the EU level should benefit from an overall framework geared for this purpose. Below we set up a simple model and use numerical illustrations to explore compliance with the SGP of different policies dealing with future ageing costs, including those aimed at intergenerational equity.

3 The intergenerational distribution of costs under alternative fiscal rules

This section addresses explicitly the consequences, under population ageing, of different fiscal and pension arrangements for public deficits, public debt, implicit liabilities and the balance of contributions, and benefits per generation. The former two variables are of particular importance for assessing to what extent the arrangements comply with the SGP. The balance of contributions and benefits per cohort is the key for assessing

the size of potential economic distortions and the intergenerational distribution of the ageing burden. We illustrate the consequences of a fall in fertility and a rise in life expectancy.

3.1 Description of the pension model

The model that underlies the illustration is (with a slightly different notation) adapted from Oksanen (2005, 2006) and presented in more detail in the Appendix. In the model workers (or employers on their behalf) contribute to the pension system. Their per person fertility is f children. The retirees receive a public pension (and do not pay pension contributions or, for simplicity, other taxes). The pensions can be partly (or fully) financed out of current workers' contributions or they can be partly (or fully) financed out of the assets accumulated from contributions in the past. The two extreme cases are a pure PAYG system and a fully funded system. The discounted pension benefits to be received by the current workers are termed the 'implicit pension debt' (IPD, also called 'accrued-to-reference-date liability') of the public sector.

The consolidated public sector (government plus the pension system) owns (net) financial assets A_t in period t (public debt amounts to negative assets). Further, all taxes are levied on the wage bill.[8] The consolidated public sector budget constraint is

$$c_t w_t L_t + (\rho_t - 1)A_{t-1} = \pi_{t-1} w_t R_t + A_t - A_{t-1}, \qquad (1)$$

where c_t is the tax rate, w_t is the (gross) wage rate,[9] L_t is the 'effective' labour supply of workers in period t, ρ_t is the financial market interest-rate factor (the interest rate is $\rho_t - 1$), π_{t-1} is the pension accrual rate, and R_t is the 'effective' number of elderly. Here, $L_t = l_t \tilde{L}_t$, where $\tilde{L}_t$ is the number of new entrants to the labour force in period t, and l_t is the number of years spent in work in period t, divided by the number of years spent in work in period 0. We thus compare the labour input of a worker in each period with that in a single reference period. Further, since periods refer to generations here, and as the number of years during which a pension benefit is received generally differs from the number of years that individuals pay contributions to the pension system, we define σ_t as the number of years spent in retirement in period t divided by the number of years spent working in period $t-1$, i.e. $R_t = \sigma_t L_{t-1}$.

[8] For convenience, we label all primary revenues of the public sector as 'taxes', even though in our model they consist mostly of pension contributions. The reason is that primary revenues also include the taxes collected (from wages) to service the initial explicit debt of the government.

[9] From now on, 'wage' stands for 'gross wage'—that is, the wage before pension contributions are paid.

Finally, $\rho_t = (1+g_t)(1+\mu_t)$, where $1+g_t = (w_t/w_{t-1})(L_t/L_{t-1})$ is the wage-bill growth factor, and $\mu_t > 0$ is an exogenous mark-up of the financial market interest-rate factor on the wage-bill growth factor. Hence, μ_t is not influenced by the demographic shocks considered below.[10] The accrual rate as a share of the wage net of contributions, π^n_{t-1}, is set by policy. Using π^n_{t-1}, one then derives the appropriate accrual rate π_{t-1} as a share of the gross wage w_t (for the details of the calculation, see Appendix).

Dividing by the total wage bill in period t, we can rewrite (1) as follows:

$$c_t = \pi_{t-1}\left(\frac{l_{t-1}}{l_t}\right)\left(\frac{\sigma_t}{f_{t-1}}\right) + a_t - (1+\mu_t)a_{t-1}, \tag{2}$$

where $f_{t\ -1}$ is the fertility rate in period $t-1$ (hence, $\tilde{L}_t = f_{t-1}\tilde{L}_{t-1}$) and $a_t = A_t/(w_t L_t)$ are (net) assets as a share of the wage bill. Note that (2) is an identity that follows from the public budget constraint.

3.1.1 Pure PAYG and constant debt ratio

We first spell out the policy rule that keeps the financial position of the public sector unchanged (i.e. assets as a share of the total wage bill are kept constant at a level $\bar{a} = a_0 =$ the initial assets as a share of GDP). This implies the following tax rate:

$$c_t^{\text{pcd}} = \pi_{t-1}\left(\frac{l_{t-1}}{l_t}\right)\left(\frac{\sigma_t}{f_{t-1}}\right) - \mu_t\bar{a}, \tag{3}$$

where superscript 'pcd' is used to indicate 'PAYG with constant debt'. A reduction in the pension accrual rate, an increase in the length of the working life, a reduction in the number of years in retirement relative to working life length, and an increase in the fertility rate all imply a lower tax rate. The total tax rate consists of a component that covers the pension outlays and a second component that captures the cost of debt servicing so that a_t is kept constant. This implies that (under the assumption of positive wage-bill growth) the budget balance is in surplus (deficit) if government net assets are positive (negative).

3.1.2 A new policy rule: actuarial neutrality across generations

Now, we introduce the following *policy rule*: starting from the current period, for the (known or projected) demographic characteristics (fertility, retirement age, and longevity), and pension accrual pertaining to current

[10] Note that for setting up the accounting framework, the expression for the interest rate is merely an identity; for the main results below, however, we need to assume that μ_t is exogenous.

workers and the interest mark-up projected for the next period, the tax rate is set at a level that will be indefinitely sustainable under the hypothetical situation that no changes to these factors will occur in the future. This rule essentially stipulates that from now onwards (hypothetical), identical generations will be treated identically by the government. Note that we do *not* assume that these factors will remain unchanged indefinitely. Instead, our rule amounts to a particular determination of the tax rate from now onwards as a function of the demographic variables, pension policy parameters, and the interest mark-up. If and when one or more of these factors change for a new generation of workers, the same principle as just defined is applied again. For example, when the life expectancy of a new working generation is projected to increase, the tax rate on this generation's income is raised. We now derive the formula for setting the tax rate implied by *this rule*.

Where applicable, a superscript t indicates that the variable is based on the information available in period t. For example, μ_t^t denotes the interest mark-up in period t known in period t, while μ_{t+1}^t denotes the interest mark-up projected for period $t+1$ under the information available in period t.[11]

We define θ as the IPD as a share of the total wage bill. For the burden from the past (period $t-1$) and given the (known) parameter values in period t, it is

$$\theta_{t-1}^t = \frac{\mathrm{IPD}_{t-1}^t}{w_{t-1}L_{t-1}^{t-1}} = \frac{\pi_{t-1}\left(l_{t-1}^{t-1}/l_t^t\right)\sigma_t^t}{\left(1+\mu_t^t\right)f_{t-1}}, \tag{4}$$

while for period t, given the known parameter values and those projected for $t+1$, it is

$$\theta_t^t = \frac{\mathrm{IPD}_t^t}{w_t L_t^t} = \frac{\pi_t \sigma_{t+1}^t}{\left(1+\mu_{t+1}^t\right)f_t}. \tag{5}$$

Higher fertility f and longer working life l raise the total wage bill and, hence, reduce the IPD as a share of the wage bill. An increase in the pension accrual rate π or a (projected) increase in number of years in retirement relative to the length of the working life σ naturally raises it. An increase in the interest rate mark-up implies heavier discounting of future liabilities and thus has a depressing effect on θ.

[11] For clarity, we also attach a superscript to the length of the working life variable, l_t^t, to indicate that it is the value known in period t when the tax rate for workers in that period is determined. Variable θ below also carries a superscript as for each period it has both 'ex ante' and 'ex post' value; for a detailed explanation of our rule, see Appendix.

Using the expressions above, the tax rate implied by the new *policy rule* is found as (Appendix):

$$c_t^a = \mu_{t+1}^t \left[\left(\frac{1+\mu_t^t}{1+\mu_{t+1}^t} \right) \left(\theta_{t-1}^t - a_{t-1} \right) \right] + \theta_t^t. \tag{6}$$

Hence, each generation of workers first contributes to the public accounts to share the burden stemming from the past decisions on pensions and other expenditures and revenues by paying the interest mark-up on the sum of the implicit pension liabilities and the explicit public debt (possibly corrected for a change in the mark-up—see the first term on the right-hand side), and then pays the full present value of its own future pensions (the second term). An increase in the length of the working life $l_t^t > l_{t-1}^{t-1}$ implies that the IPD accumulated in the past is shouldered by more labour input, which implies a reduction in the contribution rate (notice that $\theta_{t-1}^t = (l_{t-1}^{t-1}/l_t^t)\,\theta_{t-1}^{t-1}$).

Now that we have shown these implications of our *policy rule* we label it as *actuarial neutrality across generations*: the burden of initial explicit and implicit public debt is shared equally between the current and future generations and each generation covers the actuarial value of its own future pensions. Like any actuarial calculation, the implementation of the *rule* is partly based on fixed policy parameters (e.g. the pension accrual rate and retirement age) and partly on projected values (longevity and interest rate).

The expression for the tax rate in Equation (6) is a general formula under *actuarial neutrality*. It is valid for any changes, permanent or temporary, in the demography, retirement age, generosity of pensions, and interest-rate margin in the subsequent periods. Under this *rule*, while respecting the rights of the current retirees regardless of what they paid for them, the balance of pension contributions and benefits of each generation is fully separated from the characteristics and pension policy choices of other generations starting from the moment at which this *rule* is first implemented. This result is quite robust, as it allows, for example, for a change in the (projected) interest-rate margin as long as the latter does not depend on the other factors in the formula.[12]

We emphasise that this *rule* is not based on a welfare evaluation across generations. This is an advantage: we do not need to compare welfare across generations with different fertility, longevity, and retirement

[12] To assess the plausibility of this assumption, note that under elementary growth theory, the interest rate should fall with a declining rate of growth of the economy and with increasing capital intensity. In the model here, this is indeed the case: for given μ_t^t and μ_{t+1}^t, the interest rate decreases with a fall of the wage-bill growth rate.

age—this would be difficult if not impossible. Yet, according to the *rule*, identical generations are treated equally by the government in terms of present values of payments to and benefits from the public coffer, and the *rule* then implies how the policy parameters need to be changed when successive generations differ in some respect. We view the *rule* and its implications as a natural benchmark for a neutral treatment of different generations by the government. It contrasts with pure PAYG pension financing, which generally produces systematic redistribution across generations.

Under our *rule*, furthermore, the sum of explicit public debt ($-a$) and implicit liabilities as a share of the wage bill (labelled the 'total debt ratio') evolves as follows:

$$\theta_t^t - a_t = \frac{1+\mu_t^t}{1+\mu_{t+1}^t}\left[\left(\frac{l_{t-1}^{t-1}}{l_t^t}\right)\theta_{t-1}^{t-1} - a_{t-1}\right]. \tag{7}$$

This equation thus implies that the total debt ratio remains constant if $\mu_t^t = \mu_{t+1}^t$ and $l_{t-1}^{t-1} = l_t^t$. An increase in the length of the working life or an increase in the interest mark-up implies a reduction in the total debt. Ceteris paribus, higher implicit liabilities (a higher θ_t^t) require higher pension contributions, which implies an offsetting reduction in the public debt. Note that (7) is applicable under any initial degree of funding, which then evolves as a function of factors in the formula for c_t^a. In particular, if the system were initially fully funded, it would remain so under the *actuarial neutrality rule*.

3.2 The calibration

Our numerical example is largely based on the following stylised calibration taken from Oksanen (2005). The unit period corresponds to 30 years, which is roughly the average childbearing age of women in Europe. It is also roughly the average age difference between a retired person (70 years) and a worker (40 years). Throughout, we assume that the annual growth rate of the nominal wage per worker is 3.28 percent, which stems from a unit real-wage growth rate of 1.75 percent and an inflation rate of 1.5 percent per annum. The interest-rate mark-up over the growth of the total wage bill equals 1.5 percent-points per annum.

The economy starts in period 0 in a steady state in which people work for 40 years and spend 18 years in retirement (hence, $\sigma_t = 0.45$). These numbers are thus used to scale pension contributions and pensions to correspond to realistic numbers, although the formal model works with the 30-year period. Fertility, moreover, initially preserves a constant population. Further, the unit pension is initially set at 55 percent of the wage after pension contributions (i.e. $\pi_{t-1}^n = 0.55$; Appendix), so as to make the

initial numbers comparable with those for 2004 in the EPC projections. Initial public debt is 60 percent of annual GDP.

Period 1 includes both a 20 percent fall in fertility (roughly corresponding to a fall from 2.1 children per woman, which is needed for full replacement, to 1.7, which is close to the current average in Europe) and an increase in longevity by 3 years (this corresponds to 1 year for each 10-year period). Period 2 includes a further increase in longevity by 3 years. This allows us to match quite closely the assumptions on the increase in longevity in the EPC projections for the EU average [an increase in life expectancy (at birth) for males (6.3 years) and for females (5.1 years) from 2004 to 2050].

3.3 The numerical results

We show the time paths of the most relevant variables under pure PAYG and various policies under *actuarial neutrality*. We consider two possible policy measures to contain the rising ageing burden: an increase in the retirement age and a reduction of the replacement rate; the tax rate is then residually determined by these measures and the policy rule implemented. For the case of *actuarial neutrality*, we also consider a (partial) privatisation of the public pension pillar, where the latter is partly replaced by a mandatory, funded private pillar. Most numbers are expressed in percentages of GDP, assuming for simplicity that the total wage bill (including pension contributions) is a constant 60 percent of GDP.

Table 1 displays the time paths of the tax rate and pension expenditures, the public debt, the IPD, the total debt, and the budget surplus (all as shares of GDP) under the pure PAYG rule. A negative value for the budget surplus/GDP ratio thus indicates a public deficit. Throughout, the debt and the budget surplus are expressed as ratios of annual GDP (Appendix; a new steady state is always achieved in period 3; the period-4 numbers are reported merely to confirm this; budget balances and public debt levels that violate the SGP are indicated with boldface characters). Table 2 reports the figures corresponding to Table 1 under *actuarial neutrality*, while Table 3 illustrates a partial privatisation of the public pension system under *actuarial neutrality*.

Panel 1 of Table 1 shows the results for the baseline PAYG scenario in which no policy changes are undertaken. The reduction in fertility and the two-step rise in longevity produce an increase in pension expenditure from an initial level of 11.9 percent of GDP to a new steady-state level of 17.5 percent of GDP. Taxes (the bulk of which consist of pension contributions) as a share of the total wage cost ('wage' for short) rise from the initial 21.7 percent to 31.1 percent in the new steady state. Given that the generosity of the pension benefits is untouched, the IPD rises as a share

Table 1 Public finances and pensions under pure PAYG

Period	0	1	2	3	4	Change
1. PAYG—baseline: net accrual rate 55%; fixed retirement age						
Pension expenditure/GDP (%)	11.9	11.9	15.9	17.5	17.5	5.6
Tax rate	21.7	21.7	28.4	31.1	31.1	9.4
Public debt/GDP (%)	60.0	60.0	60.0	60.0	60.0	0.0
IPD/GDP (%)	228.5	305.4	336.3	336.3	336.3	107.8
Total debt/GDP (%)	288.5	365.4	396.3	396.3	396.3	107.8
Budget surplus/GDP (%)	−1.9	−1.9	−1.5	−1.5	−1.5	0.4
2.1. PAYG—target net replacement rate 48%; fixed retirement age						
Pension expenditure/GDP (%)	11.9	11.9	14.4	15.9	15.9	4.0
Tax rate	21.7	21.7	25.8	28.3	28.3	6.6
Public debt/GDP (%)	60.0	60.0	60.0	60.0	60.0	0.0
IPD/GDP (%)	228.5	275.9	304.8	304.8	304.8	76.3
Total debt/GDP (%)	288.5	335.9	364.8	364.8	364.8	76.3
Budget surplus/GDP (%)	−1.9	−1.9	−1.5	−1.5	−1.5	0.4
2.2. PAYG—target net replacement rate 48%; increase in working life (40–41–42)						
Pension expenditure/GDP (%)	11.9	11.7	13.3	14.3	14.3	2.4
Tax rate	21.7	21.3	24.1	25.8	25.8	4.1
Public debt/GDP (%)	60.0	60.0	60.0	60.0	60.0	0.0
IPD/GDP (%)	228.5	255.9	275.4	275.4	275.4	46.9
Total debt/GDP (%)	288.5	315.9	335.4	335.4	335.4	46.9
Budget surplus/GDP (%)	−1.9	−2.0	−1.5	−1.5	−1.5	0.4

Notes: (i) The tax rate consists mainly of pension contributions and is expressed as a percentage of the total wage cost. (ii) The final column 'change' gives the percent-point change from period 0 to the new steady state, except for the budget surplus/GDP ratio, where it gives the percent-point change from period 0 to the lowest or highest level.

of GDP. This rise is produced both by the additional years in retirement and the fall in fertility. Permanently lower fertility means that the IPD as a share of GDP increases because the growth of the wage bill is permanently reduced implying that a given amount of future pension outlays is discounted at the lower rate. In panel 2.1, we consider a reduction in the pension accrual rate π^n_{t-1} as a share of the wage net of pension contributions from 55 percent to 48 percent. In panel 2.2, this is combined with a 'moderate' increase in the retirement age such that the working life in period 1 rises to 41 years and in period 2 to 42 years, i.e. it rises by one-third of the increase in life expectancy (Beetsma and Oksanen 2007, provides results also for a larger increase in retirement age for this and other tables). Naturally, an increase in the retirement age alleviates the rise in pension expenditures and the tax rate. In period 1, the tax rate falls because the contribution period has increased while the rise in longevity

Table 2 Public finances and pensions under actuarial neutrality

Period	0	1	2	3	4	Change
1. Actuarial neutrality—baseline: net accrual rate 55%; fixed retirement age						
Pension expenditure/GDP (%)	11.9	11.9	16.3	18.2	18.2	6.3
Tax rate	21.7	26.4	28.4	28.4	28.4	6.7
Public debt/GDP (%)	60.0	−25.1	−60.5	−60.5	−60.5	−120.5
IPD/GDP (%)	228.5	313.5	349.0	349.0	349.0	120.5
Total debt/GDP (%)	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP (%)	−1.9	2.5	2.3	1.5	1.5	4.4
2.1. Actuarial neutrality—accrual rate reduced to 48%; fixed retirement age						
Pension expenditure/GDP (%)	11.9	11.9	14.6	16.3	16.3	4.4
Tax rate	21.7	24.6	26.4	26.4	26.4	4.7
Public debt/GDP (%)	60.0	8.1	−24.4	−24.4	−24.4	−84.4
IPD/GDP (%)	228.5	280.3	312.9	312.9	312.9	84.4
Total debt/GDP (%)	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP (%)	−1.9	0.8	1.3	0.6	0.6	3.2
2.2. Actuarial neutrality—accrual rate reduced to 48%; increase in working life (40–41–42)						
Pension expenditure/GDP (%)	11.9	11.6	13.4	14.6	14.6	2.7
Tax rate	21.7	23.5	24.3	24.3	24.3	2.6
Public debt/GDP (%)	60.0	18.8	−4.3	−4.3	−4.3	−64.3
IPD/GDP (%)	228.5	264.1	280.9	280.9	280.9	52.4
Total debt/GDP (%)	288.5	282.9	276.6	276.6	276.6	−11.9
Budget surplus/GDP (%)	−1.9	0.2	0.6	0.1	0.1	2.5

Notes: see Table 1.

has not yet materialised (because it concerns those working in period 1 and thus the longevity rise materialises in period 2). The budget surplus is practically unaffected in all cases we consider. Moreover, the projected pension expenditure in panel 2.2 roughly corresponds to the EPC projection for EU-15.

Table 2 illustrates *actuarial neutrality* as an alternative policy rule.[13] The baseline assumes no change in the generosity of the benefits or in

[13] We can compare *actuarial neutrality* with the generational accounts developed by Kotlikoff and others (e.g. Kotlikoff 2002) that aim at revealing intergenerational imbalances by projecting public expenditure by generation under prevailing policies and calculating the net tax payments of current and future generations. We can also compare *actuarial neutrality* with Musgrave's (1986) 'fixed relative position' rule for determining a fair pension formula, referred to in recent discussions, e.g. by Esping-Andersen et al. (2002). Pensions are thus indexed to the wage rate after pension contributions, while a pure PAYG system is strictly preserved. Although the indexation rule is the same as in the illustrations here, the Musgrave rule deviates from *actuarial neutrality*, and under population ageing leads to an increasing burden for future generations.

Table 3 Public finances and pensions under actuarial neutrality: one-third privatisation

Period	0	1	2	3	4	change
1. Actuarial neutrality—55% accrual rate; fixed retirement age						
Pension expenditure/GDP (%)	11.9	11.9	10.9	12.1	12.1	0.2
Tax rate	21.7	20.6	21.9	21.9	21.9	0.2
Public debt/GDP (%)	60.0	**79.4**	55.8	55.8	55.8	−4.2
IPD/GDP (%)	228.5	209.0	232.7	232.7	232.7	4.2
Total debt/GDP (%)	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP (%)	−1.9	−2.9	−0.8	−1.4	−1.4	−1.0
2.1. Actuarial neutrality—accrual rate reduced to 48%; fixed retirement age						
Pension expenditure/GDP (%)	11.9	11.9	9.7	10.9	10.9	−1.0
Tax rate	21.7	19.4	20.6	20.6	20.6	−1.1
Public debt/GDP (%)	60.0	**101.6**	**79.9**	**79.9**	**79.9**	19.9
IPD/GDP (%)	228.5	186.9	208.6	208.6	208.6	−19.9
Total debt/GDP (%)	288.5	288.5	288.5	288.5	288.5	0.0
Budget surplus/GDP (%)	−1.9	**−4.0**	−1.5	−2.0	−2.0	−2.1
2.2. Actuarial neutrality—accrual rate reduced to 48%; increase in working life (40–41–42)						
Pension expenditure/GDP (%)	11.9	11.6	9.0	9.8	9.8	−2.1
Tax rate	21.7	18.6	19.1	19.1	19.1	−2.6
Public debt/GDP (%)	60.0	**106.8**	**91.4**	**91.4**	**91.4**	31.4
IPD/GDP (%)	228.5	176.1	187.3	187.3	187.3	−41.2
Total debt/GDP (%)	288.5	282.9	278.7	278.7	278.7	−9.8
Budget surplus/GDP (%)	−1.9	**−4.4**	−2.0	−2.2	−2.2	−2.5

Notes: see Table 1.

the retirement age. The fall in fertility (via a reduction in the discount rate) and the rise in life expectancy both raise the IPD as a share of GDP. In anticipation of this increase, taxes already rise in period 1 (the system now moves to partial funding). Hence, the rise in the implicit debt ratio is followed by an equivalent reduction in the (explicit) public debt ratio (or increase in the public asset ratio), and the deficit turns into a surplus from period 1 onwards in all panels. The surplus is largest in period 1, when the population is affected by two shocks simultaneously (the rise in workers' life expectancy and the fall in the fertility rate). A reduction in the accrual rate (panel 2.1) produces a smaller implicit debt/GDP ratio, thereby requiring smaller surpluses than under the baseline. This effect is further strengthened when the reduction in the accrual rate is combined with an increase in the retirement age. The expenditure increase of 2.7 percent-points of GDP in panel 2.2 in Table 2 roughly corresponds to the EPC projection for the EU.

All actuarially neutral scenarios clearly show that as long as the demographic change is permanent, the financial position of the government should also change permanently. Depleting the public assets once the ageing process has ended is therefore excluded, unless pension accrual is drastically reduced.

Table 3 considers the latter option induced by a partial privatisation (possibly in combination with other measures) in which implicit pension debt is swapped for (explicit) public debt. The partial privatisation is implemented with a one-third reduction in the accrual rate expressed as a share of the gross wage rate. Under *actuarial neutrality* taxes paid to the government fall immediately (the contributions to the newly established private second pillar come on top of these taxes). Obviously, as accrued pension rights are respected, public pension expenditure falls only gradually. Comparing the new steady state with period 0, the public debt/GDP ratio falls only slightly (panel 1). In period 1, it exceeds the 60 percent limit of the SGP, while the deficit ratio in that period remains just marginally below the 3 percent limit. Adding to this a reduction in the accrual rate leads to a further swap of debt in panels 2.1 and 2.2, where the deficit ratio violates the SGP in period 1 and so does the debt ratio from period 1 onwards.

A complete privatisation under *actuarial neutrality* would make all implicit debt explicit, leading to a gross violation of the SGP limits (for details, see Beetsma and Oksanen 2007, Table 5). This scenario is not mentioned here as a realistic one, but to note that a reform that shifts mandatory pensions entirely to private sector has a severe effect on the public finance figures, even though total pensions and taxes are not affected at all.

3.4 Other ageing-related expenditure

In order to obtain a picture of the overall budgetary consequences of ageing, one can extend the above approach to pensions also to other *ageing-related* expenditures. The most important categories are the *healthcare and long-term-care expenditures*. In 2004, they were, respectively, 6.4 percent and 0.9 percent of GDP in the EU-15, while their projected increase by 2050 amounts to 1.6 percent and 0.7 percent of GDP, respectively. Although we have employed these numbers in our calculations, they are highly uncertain, and the conclusions derived from them are only tentative, requiring a substantial amount of further work (e.g. Chapters 4 and 5 in Economic Policy Committee and the European Commission 2006a).

Who benefits from these expenditures and who provides the financing? A stylised fact is that roughly half of healthcare costs benefit the

working-age population (including their children), while the other half benefit the elderly, particularly those approaching their final years of life. As the bulk of public expenditure on long-term care is related to the elderly, we simply assume that they consume all of it.

An estimate must then be made of how an increase in longevity affects the volume of healthcare facilities and long-term-care services to be used by the elderly. One extreme assumption is that it increases proportionally with the number of people over, say, 60 years of age. The opposite extreme is that an increase in longevity raises these expenditures hardly at all, as the bulk of these are concentrated in the last few years before death.

As for the financing, we note that public health and long-term-care expenditures are normally covered by tax revenues that are paid also by the elderly. The way in which these expenditures are financed thus differs significantly from that of pension outlays, which are typically covered by pension contributions paid by workers, but not by pensioners.

Fortunately, the framework described above is derived from a more general model that we can apply also to other ageing-related expenditure items. One assumption that we need to make concerns the ratio between the level of taxable income of the elderly and that of the workers. We set this at 60 percent, keeping in mind the level of pensions as compared with wages in Europe (see the Appendix for the details).

We make the following assumptions: the system is initially (until period 0) in the steady state, initial public debt is set at zero,[14] and health-care and long-term-care spending for the elderly are initially financed out of current taxes.

Again, we spell out the effects of ageing on expenditures, on taxes on wages and income of the elderly, on debt, and on the deficit. We skip here the straightforward results for full financing from current taxes (the analogue to the pure PAYG pension system). Instead, the results discussed below are all based on the same new *rule* as for pensions: after any change, the tax rate is set at a level that is financially sustainable as long as there is no new shock, and *mutatis mutandis*, revised when such a shock arrives. We also compute for each period the implicit debt, which is defined as the capital value of these expenditures benefiting the elderly in the following period.

Note that the *policy rule* does not in all cases result in perfect neutrality across generations, as it did for pensions. The reason is the assumption that the same tax rate is applied to the incomes of both workers

[14] This is assumed without loss of generality as the outcomes for the public budget under this calibration will later be combined with those obtained above for the pension model. The consolidated public sector then starts with 60 percent initial debt, the reference value in the Treaty and the SGP.

Table 4 General model applied to healthcare- and long-term-care expenditure

Period	0	1	2	3	4	Change
Expenditure/GDP (%)	7.3	7.3	9.1	9.6	9.6	2.3
Tax rate	10.0	11.3	11.5	11.5	11.5	1.5
Public debt/GDP (%)	0.0	−27.4	−34.8	−34.8	−34.8	−34.8
Net ID/GDP (%)	52.8	76.4	82.0	82.0	82.0	29.2
Total debt/GDP (%)	52.8	49.0	47.2	47.2	47.2	−5.6
Budget surplus/GDP (%)	0.0	1.4	1.0	0.9	0.9	1.4

Moderate increase elderly/net contributors ratio and 4% increase in expenditure per 30 years.
Notes: ID, implicit debt. Further, see Table 1.

and pensioners. For example, if the working-age generation were to start consuming a higher amount of healthcare services than the previous generation did, then policymakers should immediately increase the tax rate. The current elderly will then also pay higher taxes, although they will get nothing in return. Thus, under these assumptions the succeeding generations cannot be treated completely separately.

We consider one scenario (Table 4). It assumes that the time spent as a net user of these services increases by 2 years in both periods 1 and 2, while longevity increases by three plus three years, leading to a 'moderate increase' in the ratio of the elderly to net contributors. In addition, we assume for periods 1 and 2, a pro rata 4 percent increase in expenditures for both the younger generation and the elderly for each 30-year period. The implied long-run expenditure increase of 2.3 percent-points of GDP roughly corresponds to the EPC projection for the EU average. Our assumptions imply a stepwise frontloading of tax collection leading to an eventual reduction of the public debt by 35 percent of GDP and a budget surplus of 1.4 percent of GDP in period 1 and 0.9 percent in the new steady state. Government debt falls because the tax rate immediately jumps to a higher level as soon as the projected expenditure increase is recognised, while the increase itself will materialise only later.[15]

The full consequences of ageing for the public budget under the *policy rule* introduced in this article can be calculated by summing the budgetary effects associated with the pension outlays and those associated with healthcare and long-term-care expenditures reported in Table 4. Table 5 provides an example, combining pensions under *actuarial neutrality*,

[15] In itself, this effect reduces spending in period 1 relative to period 0. It virtually cancels against the effect of the exogenous spending trend, implying that the overall spending/GDP ratios of periods 0 and 1 are almost equal.

Table 5 Overall financial implications of ageing

Period	0	1	2	3	4	Change
Expenditure/GDP (%)	19.2	18.9	22.5	24.3	24.3	5.1
Tax rate	31.7	34.8	35.7	35.7	35.7	4.0
Public debt/GDP (%)	60.0	−8.6	−39.2	−39.2	−39.2	−99.2
Net ID/GDP (%)	281.3	340.5	362.9	362.9	362.9	81.6
Total debt/GDP (%)	341.3	331.9	323.8	323.8	323.8	−17.5
Budget surplus/GDP (%)	−1.9	1.6	1.6	1.0	1.0	3.5

Notes: see Tables 1 and 4.

a moderate retirement-age increase and a net accrual rate reduction to 48 percent (panel 2.2 in Table 2) and our scenario for healthcare and long-term-care expenditures. The total debt ratio declines relatively little. The conventionally measured government deficit moves from the initial 1.9 percent of GDP deficit to a surplus of 1.6 percent over 60 years, while explicit debt declines by almost 100 percent of GDP over two generations. These are large numbers that deserve careful assessment.

3.5 Limitations and extensions of our framework

Our analysis obviously makes a number of simplifying assumptions. First, our results are based on a model in which successive generations follow one another after each 30-year period (i.e. all members of a given generation are born at the same instant). Reality is quite different, and we can only interpret the results representing neutrality for an average-aged worker and an average-aged retiree. As the same tax rate is set for all workers in a given year, and as the demographic change is gradual, there is no way to reach perfect *actuarial neutrality* for every yearly age cohort. Our results can be generalised for annual data, however, and the unavoidable deviations from perfect neutrality could be estimated (for an application see Oksanen 2003).

Another extension involves addressing the consequences of forecasting errors. For example, suppose that the actual longevity increase for the next period turns out to have been underestimated—something that has frequently happened in reality. Under PAYG, the tax rate on workers in the next period rises to cover the larger amount of pension outlays. Explicit debt remains constant and the consequences of the mistake are thus borne by the workers in the period in which it materialises. Under *actuarial neutrality*, the increase in the tax rate caused by the mistake is limited to the interest on the unexpected increase in the total public debt. The consequences of the mistake are thus spread out over all working generations

as of the period when the forecasting error is discovered.[16] This is an intrinsic feature of an actuarially neutral system: it implicitly allows for intergenerational risk-sharing by spreading the costs of *unexpected* longevity shocks over all current and future workers, while it, by construction, also takes care of generational neutrality with respect to an *expected* longevity increase.

As mentioned above, our *rule* can be applied to the average-aged worker having 30 years to become an average-aged retiree. Hence, the result is mainly determined by known factors and the projections of future demographic variables and the interest rate over the next 30 years. Those projections gradually change over time and our *rule* can be continually updated to take these changes into account. Thus, the effects of the uncertainty about demographic and economic projections further into the future are kept under control.

Finally, we have ignored public investment. This is reasonable if we can assume that the public capital stock is properly maintained and expanded in line with economic growth. However, if major investment projects are undertaken or planned, they should be recognised as part of the net assets to be left to future generations. The same should be the case for government disinvestment (i.e. the sale of its real assets).

4 Implications of *actuarial neutrality* for pension reforms and the SGP

4.1 Implications for designing pension reforms

Our framework highlights the IPD and makes the distinction between pension rights accrued to date and those to be accrued in future. Accrued rights are assumed to be well defined and respected. This does not correspond to reality. If a pension reform plan is presented without due assurances, the elderly, who have already accrued most of their pension rights, may fear that they will lose these rights and therefore block an otherwise sensible reform plan. Distinguishing accrued rights from those to be accrued in the future may help here. If an agreement is reached on the accrued rights, then current pensioners and older workers may be able to lift their concerns and accept reforms that set new rules for (less generous) future rights and their financing. The agreed reform option

[16] This is seen from Equations (4)–(6) above: an error in the longevity estimate for period t means that its realised value σ_t^t in Equation (4) is different from its value σ_t^{t-1} projected in $t-1$. The σ_t^t in Equation (4) enters the tax rate Equation (6) via θ_{t-1}^t in the first term for the interest on the total debt. For example, if longevity was underestimated, all workers from t onwards will shoulder the same additional burden caused by the forecasting error that made the workers in period $t-1$ pay too low taxes.

(for example, a partial privatisation as studied above) could then gradually replace the old system. The advantages from clarifying the accrued rights could also be regarded as a responsibility of the government in order to enhance the private long-term saving decisions of individuals.[17]

4.2 Measurement and treatment of the IPD and the SGP

Obviously, the estimation of the IPD defined as accrued-to-date pension liabilities is a non-straightforward matter. In the 1990s, there was some interest in estimating these liabilities (e.g. van den Noord and Herd 1993), but no systematic update has taken place since then.

The IPD as defined here can be compared with the *open-system pension liabilities*, defined as the present value of projected pension expenditure minus revenue up to infinity. The *sustainability-gap* indicator corresponds to the constant tax rate matching this liability.[18] Thus, just like the *sustainability-gap* indicator, the projection for *open-system liabilities* is not sufficient for assessing intergenerational equity: it does neither contain the data by age cohort, nor does it distinguish between rights accrued to reference date and those to be accrued in the future.

There is a debate as to how much effort should be put into estimating the (accrued-to-date) IPD, and how the latter should be related to the explicit public debt. First, under most public pension systems in Europe, implicit pension rights are not backed by explicit well-defined commitments. For example, frequently there is ambiguity about inflation indexation. Second, there is a fear that the official publication of an implicit-liabilities estimate may give those liabilities an explicit character, and thereby make it more difficult to renege on them. For this reason, Coeuré and Pisani-Ferry (2005) argue quite fiercely against including implicit liabilities in their measure of the net balance position of the government. This worry could be handled by adding to the official publication of implicit liabilities a statement that the figures are based on current policy and that no legal rights can be extracted from them. Moreover, baseline figures for implicit liabilities could be complemented by projections based on alternative assumptions, for example about indexation. This would give those baseline figures a less definitive character.

These considerations will become important as the international statistical community is about to finalise its proposals to set up, in the next System of National Accounts (SNA)/European System of Accounts (ESA)

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[17] The political economy of pension reform is studied in Razin et al. (2002) and Galasso (2006).

[18] European Commission (2006, Chapter I and Annex I), and European Commission (2007, Section 2.3); see also, Buti and Nogueira Martins (2006) and Blanchet and Ouvrard (2006).

revision, new supplementary accounts for accrued public pension liabilities [see Advisory Expert Group on National Accounts (AEG) 2007; also European Commission 2007, Part II, Section 2.3]. These figures will help in constructing actuarially neutral benchmarks for public pension policy.[19]

4.3 Implications for the SGP

The newly established MTOs for the next few years, ranging from −1 percent of GDP to balance or surplus, if persistently followed, imply a reduction in the public debt and, hence, guarantee quite safely the sustainability of the (explicit) public debt. However, the question is whether it is (politically) feasible for governments to implement those MTOs in the long run in view of the increase in ageing-related expenditures. This seemed to concern the ECOFIN Council (2006), when it noted that reaching the MTOs in the 2005 programmes based on the revised SGP guidelines would be an important step, but not a sufficient one. In particular, the Council called 'for further structural reforms and/or budgetary consolidation, in line with the three-pronged strategy to ensure sustainability decided by the Stockholm European Council in 2001, i.e. (i) reducing debt at a fast pace; (ii) raising employment rates and productivity; and, (iii) reviewing and, where appropriate, reforming pension, health care and long-term care systems.' The summary example (Table 5) based on our tax-setting *rule* aiming at neutrality across generations implied a reduction of 100 percent in the government debt ratio and a 1.6 percent surplus over a 60-year period. From this perspective, the current MTOs for the EU on average do not seem ambitious enough, given the expenditure projections used. This conclusion is strengthened by a serious risk that the expenditure projections regarding healthcare and long-term care will be exceeded (after all, in the past couple of decades, these expenditures have risen much faster than is now projected for the coming decades; see Economic Policy Committee and European Commission 2006a, pp. 121 and 127).

A clear implication of our *policy rule* is that if the accumulation of funds for pre-funding future pensions belongs to the general government sector, this should be fully reflected in the targets for the public debt and the deficit. Otherwise, the pension-system surplus will likely be squandered by a deficit in other public policy areas.[20]

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[19] The way the IPD enters in our policy rule should remove Franco's (1995) concern that it should not be used without qualification as a stand-alone indicator of the future pension burden (also European Commission 2007, p. 99 and Blanchet and Ouvrard 2006).

[20] The accumulation of funds in the public pension system should thus show up as a positive item for the budget balance and a reduction in net debt. If the public pension system is organised as a separate entity, then the question arises as to where it should invest. Some authors argue that if pension funds (private or public) invest in government

Finally, the results from the illustrations of the (partial) privatisation of the public pension system clearly indicate that a conflict with the SGP rules may arise, although how serious this becomes will depend on several factors. In our stylised examples for one-third privatisation and 60 percent of GDP initial public debt (Table 3), there is a serious risk that the SGP will be violated.[21] Lower initial debt gives more room for adjustment. Also, the budget surplus target would be larger under a policy of frontloading taxes to finance the future increase in the costs of healthcare and long-term care. This would help to offset the negative effect on the budget balance of pension system privatisation.

5 Concluding remarks

This article has explored how the SGP may cope with the future costs of population ageing in the EU. In anticipation, countries have started to, or plan to, reform their pension systems—both by reducing the generosity of pension arrangements and increasing the retirement age, and by switching from pure PAYG pension provision to pre-funding, including reduction of public debt and partial privatisation. This article has investigated how such reforms relate to the SGP.

Although the SGP, especially after its revision in 2005, clearly aims to ease the financial burden on future generations, it does not incorporate intergenerational equity explicitly and systematically. The simple *rule* studied in this article labelled as *actuarial neutrality* means that generations that are identical in terms of demography (longevity and fertility) and retirement age should face the same tax rate for the same level of benefits. We show that there exists a wide range of alternative pension arrangements that comply with this benchmark. Our results provide further rationale and precision for the ambitious policy line widely expressed by the EU finance ministers (e.g. ECOFIN Council 2006) and others. They also show that a pure PAYG rule does not, in general, comply with

bonds, they are in effect pure PAYG (e.g. Barr 2004, p.114). Of course, this requires that the government always issues new debt (i.e. increases the deficit) to accommodate such investment. Whether or not this happens depends on rules and policies. From the perspective of intergenerational equity, investment by a public (private) pension fund in government debt is neutral if net public debt is reduced (kept constant) in response to this investment. Bosworth and Burtless (2004) find that this requirement has been met at the state level in the United States, while in OECD countries (from 1970 to 2000) 60–100 percent of public pension saving at the national level was offset by larger deficits in other budgetary accounts.

[21] Note here that the reference scenario is not a pure PAYG mono-pillar system, but a mono-pillar that is first reformed to implement *actuarial neutrality*. The latter would lead to a reduction of the public debt, while the one-third privatisation would turn that around to an increase (compare, for example, panels 2.2 in Tables 2 and 3, respectively).

actuarial neutrality, but tends to shift an increasing burden to future generations.

Our results are derived from a partial equilibrium analysis that ignores the behavioural responses of private-sector agents. It is clear, however, that the demographic and pension system variables would dominate the results even if the model would comprise some endogenous private-sector reactions. Qualitatively speaking, and in terms of orders of magnitude, we would expect our results to be unaffected by such extensions.

For the many countries in which ageing-related expenditure is projected to increase considerably under current policies, emphasis should be on considering policy changes that will help contain the increase. The MTO for budget balance should then be set on the basis of the reformed rules. However, the EPC projection for a Member State close to the EU average might be a relevant starting point for setting targets for the debt and deficit. This average increase in pensions already incorporates a significant reduction in the replacement rate and an increase in retirement age, and yet, as a result of the ongoing change in the age structure of the population, expenditures increase. Our stylised example above, which mimics those figures and also takes into account the projected increase in healthcare expenditure (Table 5), shows that our *neutrality rule* then implies that the budget target should be a significant surplus for several decades. It thus does not seem sufficiently ambitious to set the MTOs under the revised SGP provisionally in the range from -1 percent of GDP to balance or surplus.

While the revised SGP now recognises the problem with the transitional cost of (partial) privatisation of pensions, the leeway over the 3 percent of GDP deficit ceiling is quite limited. Our results show the inevitable downside of this: a partial privatisation performed on a fully actuarially neutral basis of a reformed and sound mono-pillar pension system may not easily be accommodated under the current rules. If, for example, one-third of the IPD is swapped for explicit public debt, then the government budget balance should be allowed to deteriorate by 4–5 percent-points of GDP relative to the otherwise similar mono-pillar system. The risk of breaching the 3 percent deficit ceiling therefore becomes imminent. Hence, while there might be sound economic reasons for privatisation (e.g. a reduction in the distortionary effects of the pension system on the labour market), it is clear that under otherwise similar policies a country that maintains a mono-pillar system can be much more comfortable with the SGP rules than a country that contemplates and implements a partial privatisation of the system. More concretely, a significant privatisation may lead to an Excessive Deficit and prevent the Member State from adopting the euro. For this reason, the reforms to establish a fully funded second pillar may

be abandoned or delayed. This is hardly in the spirit of the EU budgetary rules as they were originally drafted.

A remedy to this consequence of the current rules would entail a change to the Protocol on the EDP annexed to the EU Treaty. When the SGP was revised in 2005, no changes were made to the Treaty, including the Protocol on the EDP, presumably because of the concern that the EDP as a budgetary anchor would be undermined. However, if serious plans for significant privatisation would be considered by some Member State, the solution could be a limited clause (requiring a unanimous decision of the EU Council) that the surplus in the second pillar be included in the government budget balance for the purposes of the EDP.

Experience with the budgetary rules as inserted in the Maastricht Treaty in 1991 and their enforcement under the SGP show that it is difficult to avoid the tension between the economic rationale behind complex issues and the simplicity required by the political process. Improving the implementation of the legal rules is therefore an ongoing process. The framework in the present article provides some clarification regarding the issues to be tackled, and the ongoing work of pension actuaries and statisticians to gather estimates on implicit pension liabilities will greatly help in analysing the issues and designing economically sound reforms.

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The Life-course Perspective and Social Policies: An Overview of the Issues

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Abstract

A number of trends are changing the nature of social risks and increase the importance of human capital, adaptability, and flexibility. This article discusses the usefulness of a life-course perspective in developing proactive social policies that better fit the changing life cycles of individuals who combine formal work with other activities on transitional labor markets. It pays special attention to the accumulation and maintenance of human capital over the life course and stresses that reconciliation of work and family goes beyond child care facilities and parental leave, and involves the entire life course. In particular, longer and deeper involvement in paid employment allows people to exploit their longer life to reconcile the two ambitions of, first, investing in the next generation as a parent and, second, pursuing a fulfilling career in paid work in which one keeps learning. Greater flexibility of working time over the life course requires more individual responsibility for financing leave. Moreover, rather than shielding older insiders through employment protection, labor market institutions should enable parents of young children to easily enter and remain in the labor market. Finally, more activating social assistance and in-work benefits should replace the passive income support for breadwinners that results in high minimum wage floors. (JEL codes: H30, J10, J20)

Keywords: Life course, human capital, work and family, fertility, longevity, social risks, labor market, retirement.

1 Introduction

Life courses are becoming more heterogeneous in terms of the distribution of time over working, caring, learning, and resting. As a consequence of the feminization of work, workers increasingly combine a career in the formal labor market with family obligations. Moreover, in transitional labor markets, workers move between periods of full-time work to periods of voluntary (part-time) absence from the labor market to enjoy leisure, educate themselves, set up a business, or care for children or frail relatives.

These developments are changing the nature of social risks at a time when traditional institutions for insuring social risks are under pressure. In particular, firms can offer less job security to their employees in a dynamic economy with constant innovation and creative destruction. At the same time, governments find that insuring human capital through

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ex post income replacements becomes increasingly costly in terms of harming the incentives to accumulate and maintain that capital.

This article discusses the usefulness of a life-course perspective in developing proactive approaches to social policy that better fit the changing nature of social risks over the life cycle. We pay special attention to the accumulation and maintenance of human capital over the life course as well as reconciliation of work and family. Human capital becomes more and more the key to personal fulfillment, stable personal relationships and social inclusion on a micro level, and to high levels of employment and labor productivity on a macro level. Human capital is produced not only in schools but also in families and firms. Reconciliation of work (including workplace learning in firms) and family (including informal care for young children) is therefore essential for safeguarding durable labor supply and an adaptable labor force generating substantial productivity growth. This article stresses that the reconciliation of work and family goes beyond child care facilities and parental leave during the family phase, and involves the entire life course.

Section 2 considers a number of trends that are changing the nature of social risks and call for a life course perspective. These trends point to an increased importance of human capital, adaptability, and flexibility. The most important components of human capital—the ability to learn, emotional resilience, and the capacity to work well with others—are shaped early in life. Section 2 also considers a number of challenges that endanger the level and quality of human capital at a time when corporations and governments are withdrawing from their traditional roles as insurers of human capital risks.

To investigate the role of social policy, Section 3 investigates the market and institutional failures that damage human capital accumulation and hamper flexibility and adaptability over the life cycle. Traditional social policies, such as compressed wage scales and job protection, are becoming increasingly counterproductive in generating security. This calls for institutional innovation in developing new proactive approaches to social protection over the life cycle. Section 4 employs the life course perspective to describe various elements of such approaches. Section 5 concludes by focusing on the political economy of reform.

2 Trends and challenges

2.1 Trends

2.1.1 Female human capital stronger

Female labor force participation has increased strongly in almost all OECD countries over the last few decades (Figure 1). A major factor is

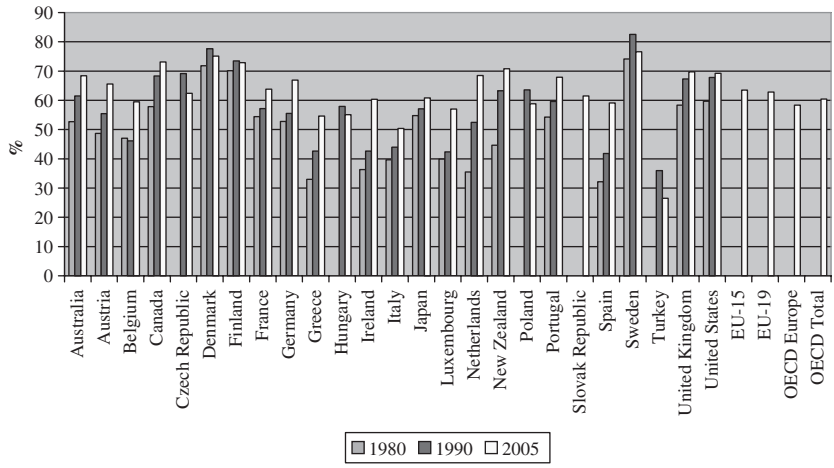

Figure 1 Female labor force participation in percentages, 1980–2005 (persons aged 15–64 years)
Source: OECD (2002, 2006), *Employment Outlook 2002 & 2006*, Paris, Statistical annex, Table B, p. 250. European Union Labor Force Survey. Before 1990: OECD, *Labor Force Statistics*.

the increased supply of female human capital as a result of better-educated women, improved birth control, better household appliances, and changing female aspirations (Golden and Katz 2002). At the same time, increasing employment shares of the service sector and technological developments have boosted the demand for female labor by facilitating part-time work and by raising the demand for communication and creative skills at the expense of raw muscle power in the industrial sector (Golden 2006). The increased potential earnings of women in the formal labor market reduce the scope for specialization in home production between male and female partners and encourage more gender equality (Jones et al. 2003). As a direct consequence, both male and female employees increasingly combine a career in the formal labor market with family obligations (Table 1). About half of the working European workforce combines paid work with unpaid work of at least 12 hours a week (Groot and Breedveld 2004). Moreover, life courses become increasingly heterogeneous in terms of the distribution of time over working, caring, learning, and resting, as people are more and more able to construct their own choice biographies.

In Eastern European countries, in contrast, women's participation rates have not increased, as the transition weakened the labor market position of young women and reduced family-related supports and benefits.

Table 1 Time spent on four different obligations in hours per week working population EU-15, 2003

	Men					Women				
	Total of all obligations	Paid work	Household and looking after children	Voluntary work	Education	Total of all obligations	Paid work	Household and looking after children	Voluntary work	Education
EU total	58.4	42.6	13.3	0.8	1.7	59.5	34.7	22.6	0.8	1.8
Finland	55.1	40.8	10.5	1.5	2.4	59.9	37.3	18.3	1.3	2.6
Sweden	56.9	40.4	13.6	2.0	1.2	59.1	37.0	18.9	1.6	1.6
Denmark	57.2	40.8	13.3	1.7	1.2	62.5	36.5	22.4	1.1	2.3
Germany (West)	59.1	42.2	13.3	0.7	2.2	57.2	32.1	22.3	0.8	1.8
Germany (East)	60.6	42.9	13.1	0.5	3.2	59.6	35.4	21.8	0.4	2.2
The Netherlands	54.9	39.8	11.6	1.4	1.9	53.4	27.4	23.8	1.8	1.2
Great Britain	57.5	42.2	13.7	0.6	1.6	55.4	28.6	25.9	0.6	1.3
Northern Ireland	54.5	41.1	11.5	0.8	1.2	61.2	32.7	24.6	1.0	2.4
Ireland	56.2	43.7	11.0	0.7	1.0	59.6	33.7	23.8	1.3	2.6
Belgium	59.5	42.3	13.7	0.8	1.3	60.7	36.4	21.5	0.6	1.2
Luxembourg	66.0	43.2	19.0	2.4	1.9	69.4	32.9	32.0	3.5	2.3
Austria	60.3	46.2	11.5	1.3	1.8	62.2	37.7	22.2	0.9	1.4
France	52.7	40.0	10.4	0.9	0.9	55.5	35.9	18.2	0.6	1.6
Portugal	54.1	45.1	8.4	0.4	0.4	64.6	41.9	21.4	0.3	1.0
Spain	59.0	44.0	13.4	0.1	1.7	67.9	39.9	23.8	0.2	3.1
Italy	66.0	45.0	18.0	0.8	1.8	66.3	39.5	25.3	1.1	2.0
Greece	61.5	46.9	13.0	1.0	2.0	69.8	41.2	26.8	1.3	1.7

Source: Eurobarometer 60.3.

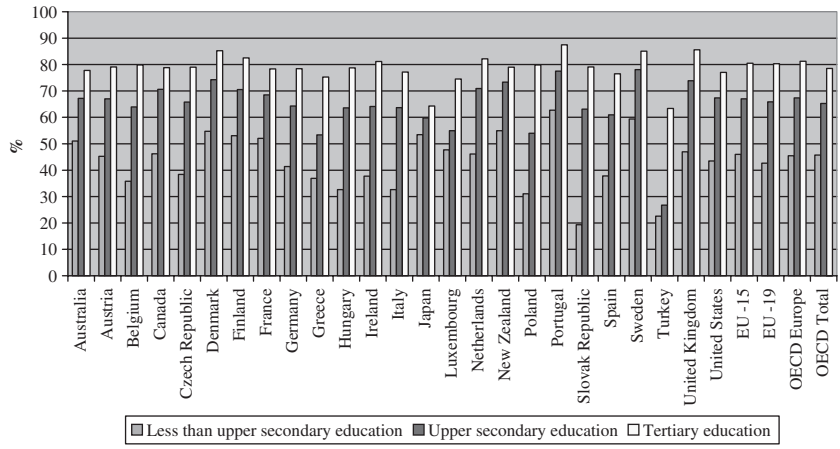

Figure 2 Female employment rates by educational attainment, 2004 (persons aged 25–64 years)
Source: OECD (2006), *Employment Outlook 2006*, Paris, Statistical annex, Table D, pp. 260–2.

Moreover, in contrast to most other European countries, the traditional male breadwinner model remains the preferred model in several Eastern European countries.

Large cross-country differences in the levels of female participation exist, especially for low-skilled women. Whereas participation ratios of high-skilled women (with tertiary education) exceed 75 percent in all EU countries, participation ratios of low-skilled women (with less than upper secondary education) vary substantially from above 50 percent in Nordic countries and France to close to 35 percent in Southern and Eastern Europe (Figure 2).[1] Although the presence of young children depresses the participation rates of women, employment rates of both mothers with young children and other women rise strongly with the educational level, even though high-skilled mothers opt for part-time work much more often than their childless peers (Table 2). Indeed, highly educated women appear to combine work and family by reducing their working time rather than by exiting employment, thus remaining in touch with the labor market. These data bear out the close complementarity between human capital (as measured by the level of education), on the one hand, and the employment level, on the other hand.

[1] Portugal is an exception in Southern Europe. These participation ratios are based on participation in the formal sector and thus do not include the participation of low-skilled women in the informal, gray economy (for example, by providing cleaning services).

Table 2 Female employment rate and the presence of children, 2000 (persons aged 25–54)

	Total		No children		One child		Two or more children	
	Employment rate	Gender gap[a]	Employment rate	Gender gap	Employment rate	Gender gap	Employment rate	Gender gap
Australia	66.8	20.0	68.4	16.1	55.3	33.3	43.2	47.5
Austria	73.5	16.2	76.0	10.5	75.6	18.5	65.7	29.0
Belgium	67.8	20.1	65.6	17.4	71.8	23.5	69.3	24.7
Canada	74.0	11.8	76.5	6.0	74.9	14.9	68.2	23.6
Czech Republic	73.7	15.6	80.8	5.4	72.3	21.2	59.4	33.5
Denmark (1998)	80.5	7.7	78.5	7.7	88.1	3.5	77.2	12.9
Finland (1997)	77.6	7.0	79.2	0.1	78.5	11.8	73.5	19.7
France	69.6	17.7	73.5	9.6	74.1	18.7	58.8	32.9
Germany	71.1	16.3	77.3	7.2	70.4	21.2	56.3	35.6
Greece	52.6	35.9	53.1	31.1	53.9	40.3	50.3	45.4
Hungary	61.7	16.0						
Ireland	53.1	29.0	65.8	14.1	51.0	33.2	40.8	43.2
Italy	50.7	33.9	52.8	26.2	52.1	40.9	42.4	49.9
Japan (1999)	62.7	31.6						
Luxembourg	63.0	29.8	68.7	21.3	65.8	30.4	50.1	46.1
The Netherlands	70.9	21.4	75.3	15.6	69.9	24.3	63.3	30.8
New Zealand (2001)	70.6	17.0	80.7	5.7	66.9	20.2	58.9	30.9
Poland	72.0	9.6						
Portugal	73.9	16.4	72.6	13.4	78.5	16.6	70.3	24.8
Slovak Republic	64.8	13.7						
Spain	50.6	34.8	54.6	26.0	47.6	44.7	43.3	48.6
Sweden	81.7	4.1	81.9	−0.4	80.6	9.8	81.8	9.4
Turkey								
United Kingdom	73.1	14.4	79.9	5.4	72.9	17.1	62.3	28.2
United States (1999)	74.1	14.8	78.6	7.2	75.6	17.4	64.7	29.0
Unweighted average	69.0	18.6	73.7	11.8	70.6	22.9	61.9	32.3

Source: OECD, 2002, *Employment Outlook 2002*, Paris, Table 2.4, p. 77.

[a]Gender gap: percentage point difference between the employment rates for men and women.

2.1.2 Human capital more important

The importance of the educational level as a crucial determinant of female labor participation points to human capital as the key to a successful career in a modern knowledge-intensive economy. Indeed, several studies indicate that the skill premium has increased as human capital has become scarcer (Autor and Katz 1999). The additional demand for skills on account of rapid technological change outstrips the additional supply of skills as a result of a better educated workforce.

At the same time, work and career are increasingly important for personal fulfillment and development, lifelong learning, the maintenance of social networks and (mental and physical) health. This holds true not only for men but also increasingly for women. Indeed, well-educated women aspire to the independence and fulfillment that paid employment brings. Access to employment, and thus workplace learning, prevents not only social exclusion but also depreciation of skills as a result of rapid technological change.

2.1.3 Longer life and rapid innovation call for lifelong learning

Increased longevity implies that human capital has become more durable. Average life expectancy at birth has increased by about 2.5 years per decennium since 1950 in the OECD countries. Life expectancy at age 65, which is more relevant for the costs of pensions, rose on average by 1 year per decennium. At the same time, knowledge and specific skills age faster on account of creative destruction associated with fierce competition and rapid innovation. The combination of a longer life combined with faster obsolescence of skills and the increased importance of human capital implies more need for lifelong learning. This lifelong learning involves not only schooling and training but also learning by doing and internal and external job mobility. These latter ways of learning are likely to be more important for low-skilled and older workers, who tend to learn more easily on the work floor than in the classroom.

2.1.4 An adaptable labor force enhances the legitimacy of competition

Also the creative destruction associated with a competitive, innovative economy requires greater adaptability and employability of the workforce to prevent a competitive market economy from losing its social legitimacy. By absorbing the idiosyncratic shocks associated with creative destruction, an entrepreneurial workforce empowered with sufficient skills safeguards the legitimacy of a dynamic market, thereby boosting productivity growth. Moreover, an adaptable labor force can embrace risk, thereby raising the supply of risk-taking capital for additional R&D and risk-taking

entrepreneurs who experiment and challenge existing firms. More generally, in a continuously changing and highly competitive environment of a modern economy, intellectual flexibility, emotional resilience, and the capacity to work well with others are at a premium.

2.1.5 Noncognitive skills are becoming more important and are shaped early in life

Adaptability and the ability to learn are important components of human capital. The same holds true for noncognitive skills (such as social and communication skills facilitating stable relationships, self-discipline, self-control, and self-esteem, perseverance and other virtues, emotional security, time preference, motivation to learn, openness to change) and values stressing creativity, personal growth, responsibility, and readiness to meet challenges. These skills and values, which enhance adaptability and the ability to learn throughout the adult life, are shaped early in life, mainly in families.[2] Early child development therefore gains in importance in helping individuals accumulate key skills for successful careers in paid work and for stable, supportive personal relationships in two-parent families, thereby easing the stresses of life (CEA 1997). In order to lay the basis for lifelong learning through child development in families, while at the same time maintaining the marketable skills of parents, workers should be able to reconcile work with family obligations. Indeed, work contributes importantly toward maintaining skills because an important part of skill formation occurs on the workfloor through on-the-job training.

2.1.6 Aging makes human capital more valuable

Aging raises the importance of human capital. Increased funding of pensions raises capital–labor ratios, thereby depressing returns around the world and at the same time raising wages (Boersch-Supan 2005). Moreover, if commodities and services are not perfectly tradable, shifts in the real exchange rate and real wages imply that the return on pension saving fall—even in a small open economy that is perfectly integrated in world financial markets. Intuitively, as the older, inactive generations become larger in number compared with the active working generation, a tight labor market raises real wages, thereby depressing the real value of the capital that the older generations have accumulated. Aging thus makes human capital more valuable. Accordingly, investment in human capital becomes more attractive compared to that in other capital. Aging thus increases the need to not only save more in the form of financial capital

[2] See Heckman (2000) and Cunha et al. (2005) for the theory and evidence on human capital formation over the life cycle and the key role of the family as the producer of skills.

but also invest more in human capital. In particular, high levels of human capital and employment ensure that the additional financial savings that result from more funding do not result in low rates of return.

2.2 Challenges

We can identify several challenges involving the need to create more room for investments in human capital, particularly those that foster the adaptability of parents and their children.

2.2.1 Maintaining the intergenerational contract

A first challenge is to maintain social cohesion in the face of a population that is aging on account of increased longevity and declining fertility. In particular, aging threatens the intergenerational contract according to which each generation invests in the human capital of the next and is taken care of at the end of its life by the generations in which it has invested. Hence, each generation cares twice (once for the previous and once for the next generation) and is taken care of twice (as a child and in old age). Within a family context, women are the traditional brokers of the intergenerational contract, providing most of the informal care to children and aged relatives.[3] The higher potential earnings of women in the formal labor market have increased the opportunity costs of these activities at a time when most elderly have fewer younger relatives who can care for them, as a result of shrinking family size. Moreover, the middle-aged face a heavy tax burden as the large baby-boom generation starts to take advantage of pay-as-you-go (PAYG) pensions and health care provisions. This threatens the sustainability of the public intergenerational contract according to which the middle-aged must care not only for the very old but also for the very young.

2.2.2 Stopping the vicious circle of early retirement and rapid depreciation of human capital

The so-called work age paradox exacerbates this threat. Whereas life expectancy increases and people enjoy better health at 65 years of age than ever before in history, the effective retirement age, in Europe especially, has fallen substantially below 65 years. Biological aging and social aging have thus moved in the opposite direction. As a direct consequence, the expected retirement span has increased substantially, while the

[3] Time surveys indicate that women in couples still provide the bulk of informal care and work within the household (Table 1). Even women in full-time work spend about twice as much time on these activities as their male partners do (see also OECD 2001a). Women older than 50 provide a lot of informal care to aged relatives.

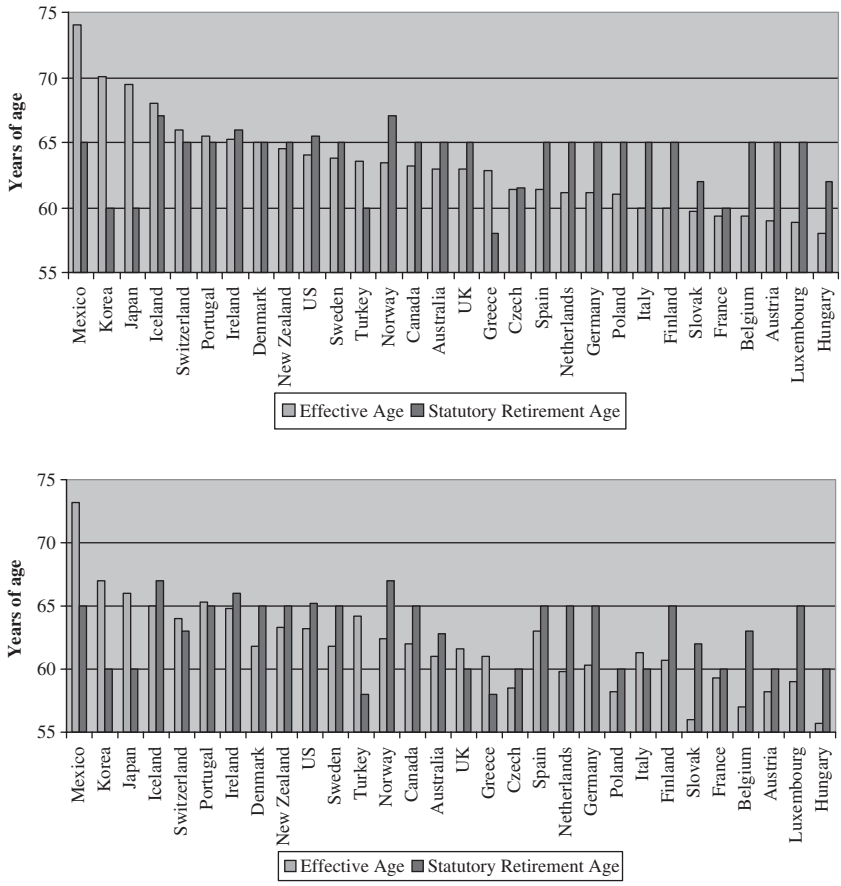

Figure 3 The effective age of retirement versus the statutory retirement age of men (top graph) and women, 1999–2004. The effective age of retirement refers to the average at which persons aged 40 and over left the labor force during the period 1999–2004. The Statutory Retirement Age refers to the earliest age in 2004 at which workers are entitled to a full old-age public pension irrespective of contributions and work history.
Source: OECD estimates based on the European Union Labor Force Survey and other national labor force surveys.

working life is being compressed. Indeed, many OECD countries depreciate their human capital quickly (Figure 3). Across the OECD, the number of years that men can expect to spend in retirement has increased from an average of 11 years in 1970 to 18 years in 2004. For women, the corresponding numbers are 14 and 23 years (Figure 4).

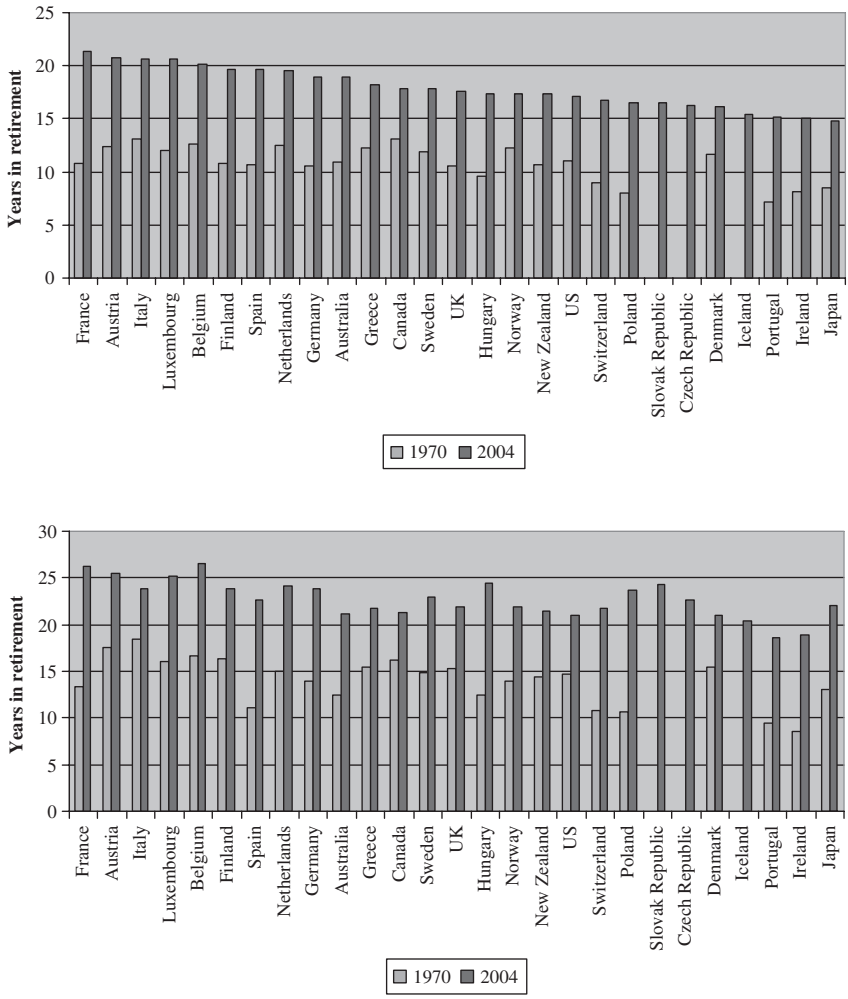

Figure 4 Expected years in retirement of men (top graph) and women, 1970 and 2004. The data refer to life expectancy at the average effective age of retirement. *Source*: OECD estimates. See also OECD (2006).

2.2.3 Maintaining investments in younger generations

With increased longevity, earlier retirement, and the compression of the working life, the aging European continent risks becoming entangled in a vicious circle of early retirement and lower fertility in which politically strong older generations favor generous passive

Table 3 Fertility, 1980–2004, and mean age of women giving birth to the first child, 1980–2003

	Total fertility rate				Mean age of women at childbearing first child (years)			
	1980	1990	2001	2004	1980	1992	1998	2003
Austria	1.7	1.4	1.3	1.4	26.30	27.30	28.00	28.80
Belgium	1.7	1.6	1.6	1.6	26.60	28.09		
Canada	1.7	1.7	1.5	1.5		28.40		
Czech Republic	2.1	1.9	1.1	1.2		24.82	26.64	28.10
Denmark	1.5	1.7	1.7	1.8	26.80	28.77	29.52	30.10
Finland	1.6	1.8	1.7	1.8	27.70	28.95	29.55	29.80
France	2.0	1.8	1.9	1.9	26.80			
Germany	1.4	1.5	1.4	1.4	26.40	27.93[a]	28.58[a]	29.10[a]
Greece	2.2	1.4	1.3	1.3	26.10	27.55	28.70	29.40[b]
Hungary	1.9	1.8	1.3	1.3		25.80	26.86	28.00
Ireland	3.2	2.1	2.0	1.9	29.90	30.01	30.30	30.60
Italy	1.6	1.3	1.2	1.3	27.40	29.21	30.30[c]	
Luxembourg	1.5	1.6	1.7	1.7	27.50	28.58	29.25	29.90
The Netherlands	1.6	1.6	1.7	1.7	27.70	29.67	30.25	30.40
Poland	2.3	2.0	1.3	1.2		26.38	27.19	27.90
Portugal	2.2	1.6	1.5	1.4	27.10	27.60	28.40	29.00
Slovak Republic	2.3	2.1	1.2	1.2		25.13	26.39[c]	27.30
Spain	2.2	1.4	1.3	1.3	28.20	29.25	30.55	30.80[b]
Sweden	1.7	2.1	1.6	1.8	27.60	28.87	29.73	30.30
Turkey	4.4	3.0	2.5	2.2				
United Kingdom	1.8	1.8	1.6	1.8	26.90	27.84	28.32	28.80
United States	1.8	2.1	2.1	2.1				

Sources: OECD Social indicators database; Eurostat.

[a]Including former East Germany.

[b]2002.

[c]1999.

spending on pensions and health care at the expense of investments in the human capital of younger generations. The decline in fertility in various European countries implies that current generations are investing less in future generations (Table 3).[4] The opportunity costs of raising

[4] Actual fertility levels are not a good measure of the true level of fertility because they are sensitive to changes in the timing of births. Also completed fertility, which measures the average numbers of live births at the end of the childbearing years, indicates that fertility has dropped below replacement levels in almost all European countries (Schoenmaeckers and Lodewijckx 1999).

children in terms of foregone career possibilities seem excessive for many high-skilled women, who opt for a career in paid work rather than raising children.[5] Low-skilled women, in contrast, make the opposite choice. Indeed, highly educated women feature the lowest fertility rates, while more than a quarter of high-skilled women remain childless (Schoenmaeckers and Lodewijckx 1999). Moreover, countries featuring the largest increases in female participation rates tend to show relatively large declines in fertility rates (see Chart 4.1 in OECD 2001a). The low fertility rates of high-skilled women have adverse consequences for the future quality of human capital, because the skill level of children tends to be closely related to that of their parents (Plug and Vijverberg 2003).

Families face difficulties in reconciling work with rearing children. About half of the working population in the EU would prefer to reduce their working hours with a corresponding cut in pay (EFILWC 2003). Moreover, European women would like to bear more children than they actually have. In some countries, the difference between desired and actual number of children is as large as –0.7 (Schoenmaeckers and Lodewijckx 1999). When considering options for combining work with other activities, European workers consider flexible working times and time bank arrangements to save overtime as the most promising options (Table 4).

2.2.4 Insuring human capital while protecting the incentives to maintain human capital

Various developments increase the dangers of moral hazard and hence make human capital risks less insurable. As the economy shifts from blue-collar work in industrial sectors to white-collar work in service sectors and knowledge-intensive activities, mental causes of sickness and disability become more prominent. These types of sickness and disability can be less easily verified than physical disabilities. Moreover, an increasing number of workers now moves between periods of full-time work to periods of voluntary absence from the labor market to enjoy leisure, educate themselves, set up a business, or care for children or frail relatives. In such a transitional labor market with a growing diversity of life courses,

[5] Recent research shows that the gender gap in wages is to a large extent a 'family gap'. In the United Kingdom, for example, the gender wage gap (that cannot be explained by other observable factors) for men and women without children is 10 percent, but increases to >30 percent for those with children and stays at 25 percent for those whose children have grown up (Paul 2006). Similar consequences of motherhood are found for hours worked, with little shrinking of the work gap when children have grown up. Rather than a time when many mothers return to work, school entry of the child is in fact a time of high labor market turnover—with mothers both moving into and out of work and changing their working patterns. Indeed, substantial gender wage and work gaps persist 30 years after birth. Motherhood thus substantially harms the human capital of women, especially for high-skilled women (Anderson et al. 2002).

Table 4 Opinions on importance and availability of different options for combining paid and unpaid work, percentage of working population, EU-15 2003

Which of these options are important to you personally for combining paid work with other activities	Importance			Available	Difference important/ available
	Men and women	Men	Women	Men and women	Men and women
Working more or less hours if needed	59	58	60	44	14
Saving up overtime to take as extra time off	38	38	39	29	10
Carrying over holidays to next year	32	32	31	24	7
Early retirement	25	27	23	9	16
Taking extra paid time off to look after relatives	25	22	28	12	12
Early retirement but with the option of still working part-time	24	23	25	7	17
Taking extra pay instead of holiday	23	25	21	14	9
Taking unpaid leave	21	20	22	19	2
Taking extra paid time off for study	19	18	19	11	8
Childcare facilities at your workplace	15	11	21	4	11
Teleworking	15	16	14	8	7
Taking a sabbatical, career break	15	14	16	7	8
Do not know	7	47	6		
Others	4	4	4		

Source: Eurobarometer 60.3.

it becomes more difficult to separate voluntary periods of inactivity from involuntary unemployment. At the same time, individuals can increasingly affect the probability that they become unemployed or sick by either investing in their own employability or changing the way in which they organize their life. In other words, the dividing line blurs between the contingencies that people are responsible for (the so-called manufactured or voluntary risks) and those for which they are not (the so-called external risks). More and more periods in which people experience a cut in income

are in part 'manufactured', increasing the risk of moral hazard in social insurances that protect people against these losses in income.

These changes in the nature of and the responsibility for social risks make it more costly to insure human capital through ex post income replacements in terms of harming the incentives to accumulate and maintain that capital. At the same time, a more dynamic world economy and the decline of the extended family as an insurance device have increased the demand for such insurance as people experience more substantial economic insecurity.

2.2.5 Empowering workers to become less dependent on corporations

Also corporations can offer people less job security. Fewer and fewer employees work for 40 years for the same company. More intense competition implies that companies exhibit shorter life spans. In a dynamic economy, constant innovation results in substantial creative destruction. Firms can thus offer less security to their employees. Within firms, employees have to update knowledge and qualifications regularly as they move between different jobs on the internal labor market. These developments point again to the importance of continuously maintaining and updating skills in order to guarantee income security. Making workers less dependent on their employer requires more employable workers through more general human capital.

2.2.6 Protecting social cohesion

The labor market position of unskilled workers (including many unskilled migrants) weakens as a result of technological and other developments. Together with the relatively high minimum-wage floors in European labor markets, this produces structural unemployment yielding social exclusion of the unskilled. These minimum-wage floors are compatible with high levels of employment for vulnerable groups only if expensive and intrusive active labor market policies assist disadvantaged adults in entering the labor market and if early intervention programs help disadvantaged children to accumulate sufficient skills. By reducing the budgetary room for such activating and preventive policies, the large call of the elderly on public resources threatens not only intergenerational but also intragenerational solidarity protecting disadvantaged adults who lack human and social capital.

2.3 A life course perspective

2.3.1 Reconcile career and family in longer life

A modern knowledge-intensive economy requires longer periods of learning so that young adults start their working lives later. At the same time,

older workers terminate their working careers earlier as effective retirement ages decline or stagnate, even though life expectancy increases. People thus concentrate work effort increasingly in the relatively short life season in which they also raise children (Table 5). At the same time, many parents wish to look after their children, especially immediately after childbirth. The key challenge is to accommodate these preferences by allowing parents to strengthen family life while also maintaining their human capital through continued attachment to the labor force so that they can enjoy long, fulfilling careers.

2.3.2 From dividing tasks in the breadwinner model to combining work and family

The traditional breadwinner model relies on a strong division of labor between men and women. In the face of an eroding comparative advantage of men in paid work, young generations increasingly combine various activities by engaging simultaneously in learning, working, caring, and relaxing. The relative importance of these activities varies during the life course, depending on family obligations, and on idiosyncratic and macroeconomic shocks.

2.3.3 Spring and fall complement summer and winter

In the modern longer life course, adults spend considerable time in households without young children as a result of delays in family formation and parenthood, as well as in death. Indeed, in the 'spring' of the modern life course (or early adulthood phase or 'playtime of life'), young adults first experiment with relationships and jobs before they take responsibility for raising children during the 'summer': the family season when adults bear the responsibility for raising minors. After their children have grown up, adults typically spend considerable time in good health in the 'fall' season of their life course (or the active senior phase) before they enter 'winter': the last phase of life in which people suffer from serious health problems. The modern life course is most apparent in Northern Europe. In this region, many people in the age brackets between 20 and 30 and between 50 and 60 live as singles or as couples without children. In Southern Europe, in contrast, the extended family is still dominant in these age-groups. Figure 5 illustrates these different household patterns over the life course for Denmark (representing Northern Europe) and Spain (representing Southern Europe).[6]

The summer season in the modern life course is quite hot. The costs of living are high while time is scarce, as parents invest not only

[6] Kalle et al. (2002) provide these data for 12 other EU countries.

Table 5 Changes in lifetime allocation of labor and leisure, 1965–2000 (percentage deviations)[a]

	Period	Men			Women		
		Childhood and education	Length of working life	Length of retirement	Childhood and education	Length of working life	Length of retirement
Australia	1970–2000	−0.7	−5.5	6.3	−1.8	−1.9	3.7
Belgium	1990–2000	−0.3	−1.8	2.0	0.9	2.1	−3.0
Canada	1980–2000	−0.2	−3.1	3.3	−0.5	−1.9	2.4
Denmark	1990–2000	0.1	−7.1	7.1	2.6	−8.6	6.0
Finland	1970–2000	0.2	−3.9	3.8	−0.2	−2.7	2.9
France	1970–2000	0.8	−6.8	6.1	−1.6	−4.4	6.0
Germany	1975–2000	2.0	−6.5	4.6	0.2	−4.9	4.7
Greece	1990–2000	1.0	−1.0	0.0	1.3	0.4	−1.7
Ireland	1985–2000	0.6	−1.1	0.4	0.7	−3.5	2.8
Japan	1970–2000	−0.3	−3.4	3.6	0.4	−3.8	3.4
Luxembourg	1990–2000	1.5	−4.6	3.1	7.0	−8.6	1.6
The Netherlands	1975–2000	−0.3	−2.1	2.4	−0.3	−3.2	3.5
New Zealand	1990–2000	0.2	−0.9	0.7	3.2	−5.7	2.5
Portugal	1980–2000	1.8	−5.6	3.8	0.1	−5.2	5.1
Spain	1980–2000	1.8	−4.4	2.6	1.7	−6.1	4.4
Sweden	1970–2000	0.2	−3.8	3.6	−2.9	−0.7	3.6
Turkey	1995–2000	−0.2	−11.0	11.1	−0.8	−7.2	7.9
United Kingdom	1990–2000	0.3	−3.9	3.6	−2.5	0.6	1.9
United States	1965–2000	−0.4	−4.3	4.7	−2.4	−0.3	2.7
OECD average	1990–2000	0.2	−3.3	3.1	0.0	−2.3	2.3

Source: Burniaux et al. (2004).

[a]Changes in lifetime allocation of labor and leisure across OECD countries, normalized over (several periods) a 10-year period.

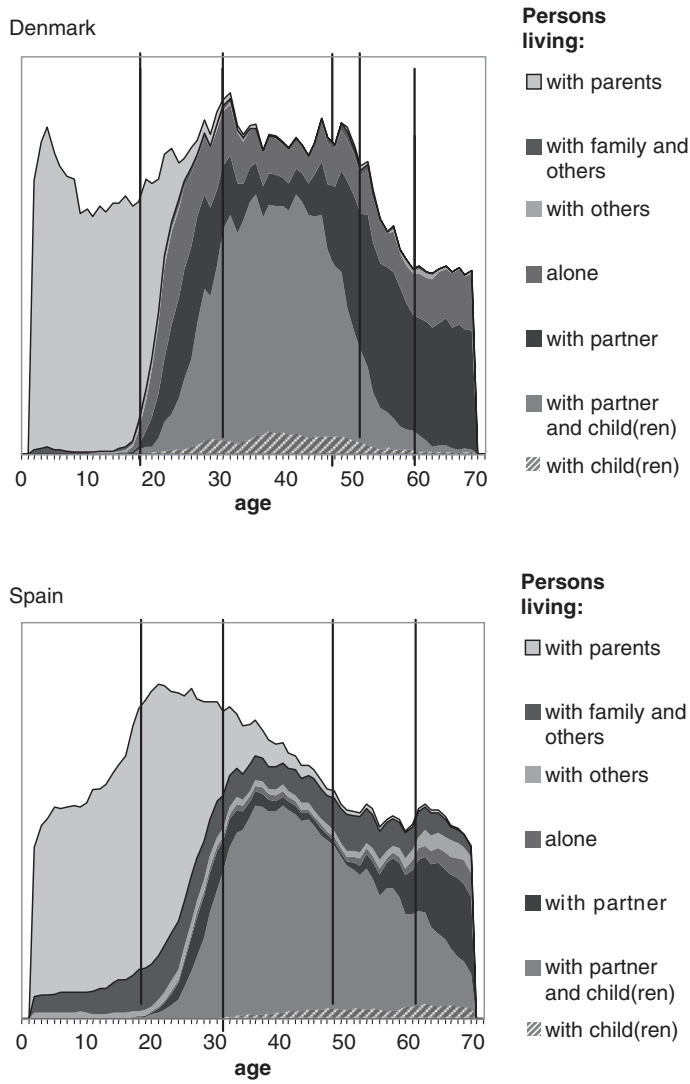

Figure 5 Age and household composition, 1996
Source: Kalle et al. (2002).

in their children but also in their careers. During this so-called 'rush-hour of life', people may experience 'combination stress'. Compared to other European household types, families with children residing at home are least satisfied with living conditions, including their work (or main activity),

income, housing, and leisure time (Avramov 2002). Time pressure can result in broken relationships and burn out. Especially single-parent households face both a 'time crunch' and a 'money bind'. In the spring and the fall, in contrast, the climate is more moderate. Adults thus do not have to care for young children and enjoy relatively high purchasing power.

3 Market and institution failures: the need for institutional innovation

To explore the role of social policy, this section investigates relevant market and institutional failures in the accumulation of human capital over the life cycle.

3.1 Market failures

3.1.1 Liquidity constraints

Agents cannot borrow against the future value of human capital because of adverse selection and moral hazard. Indeed, financial institutions cannot use human capital as collateral to ensure that loans are paid back. Liquidity constraints discourage parents from investing in the human capital of themselves and their children, and tends to increase the time pressure on young parents (Apps and Rees 2004).

Capital market imperfections also prevent agents from smoothing consumption over time in the face of various shocks. This stimulates precautionary saving because the presence of a financial buffer helps agents to optimally diversify temporary risks over time. Indeed, precautionary motives rather than saving for retirement tend to be the main reason why young households save (Cocco et al. 2005).

3.1.2 Externalities of children

By socializing the intergenerational contract, PAYG pension and health insurance systems insure against childlessness. Children who have been reared by others support the elderly without children. By bearing children, parents thus generate positive external effects for the childless. This provides an argument for public support of children through family support and publicly funded primary education and child care (Sinn 2000). This public support should increase with the opportunity costs of raising children (due to, e.g. loss of career opportunities and higher costs of raising children in a complex society), the social benefits of investing in the noncognitive skills of young children, and the PAYG benefits provided

to the elderly.[7] The case for public support for households with children is stronger if these households cannot finance investments in children because they face capital market imperfections, including liquidity constraints. Table 6 reveals how much governments spend on family services and benefits compared to pension spending and other spending on the elderly.

In the case of grants to families, the traditional arguments based on consumer sovereignty in favor of cash grants over in-kind subsidies are modified because children do not have a say in how parents spend cash grants. In order to ensure that the public resources benefit the children, the government may thus want to provide benefits in kind. Indeed, the key market failure is that children cannot choose their parents, are not able to buy services from them, and cannot ensure against being born in a disadvantaged family (Cunha et al. 2005).

As regards externalities of parental leave on children, Ruhm (2000) and Tanaka (2005) find on the basis of panel data for 16 European countries [and in the case of Tanaka (2005) also for Japan and the United States] that job-protected paid parental leave enhances pediatric health. Parental time thus is an important investment in the human capital of young children. Care responsibilities can be outsourced, for example, through formal child care. However, some more personal dimensions involving emotional attachment and care are difficult to contract out, especially in the beginning of a child's life (Plantenga 2005). Blau (1999) and Cunha et al. (2005) find that the features of the home environment are especially important in shaping the cognitive and noncognitive abilities and talents of young children.

The relationship between maternal employment and the cognitive development of children has been studied for the United States, which features only limited statutory maternity leave and publicly funded child care. These studies find that maternal employment tends to hurt the child's development during a child's first year. As regards the impact on the mother's employment on older children, the evidence is less conclusive and depends on the nature of the work performed by the mother and the child-care and school arrangements[8] (Blau and Currie 2004). Ruhm (2002) finds that children appear to perform better when their mothers work part-time rather than full-time during their second and third years of life.

[7] These latter external effects of children are measured by the net tax burden on unborn generations computed by so-called generational accounting (Auerbach et al. 1999). These measures account for all public spending and taxation. For a survey of the literature of the effects of family policies (such as parental leave, child benefits, and subsidized child-care) on fertility, see Björklund (2007).

[8] To illustrate, adolescents tend to suffer as a result of maternal employment if they are left unsupervised after school.

Table 6 Public spending on families and on the elderly, 1998[a]

	Public spending on families (1)= (2)+(3)	Cash benefits (2)	Family services (3)	Public spending on elderly (4) =(5)+(6)	Old-age cash (5)	Services for the elderly (6)	Spending on families versus spending on elderly (7) = (1):(4)
Australia	*2.60*	2.19	0.41	5.06	4.30	0.76	0.51
Austria	*3.03*	1.92	1.11	10.86	9.94	0.92	0.28
Belgium	*2.22*	2.06	0.16	7.50	7.37	0.13	0.30
Canada	*0.76*	0.76		5.10	5.10		0.15
Czech Republic	*1.61*	1.61		6.85	6.37	0.48	0.24
Denmark	*3.77*	1.54	2.23	9.77	6.82	2.95	0.39
Finland	*3.36*	1.92	1.44	8.53	6.99	1.54	0.39
France	*2.69*	1.46	1.23	11.25	10.59	0.66	0.24
Germany	*2.73*	1.93	0.80	11.21	10.46	0.75	0.24
Greece	*1.91*	1.18	0.73	10.49	10.22	0.27	0.18
Ireland	*1.74*	1.58	0.16	2.90	2.54	0.36	0.60
Italy	*0.88*	0.58	0.30	13.01	12.84	0.17	0.07
Japan	*0.47*	0.21	0.26	5.98	5.67	0.31	0.08
Luxembourg	*2.81*	2.40	0.41	8.53	8.02	0.51	0.33
The Netherlands	*1.21*	0.81	0.40	7.51	6.21	1.30	0.16
New Zealand	*2.65*	2.55	0.10	5.47	5.47	0.00	0.48
Poland	*0.93*	0.93		8.25	7.97	0.28	0.11
Portugal	*0.98*	0.65	0.33	6.58	6.31	0.27	0.15
Slovak Republic	*2.19*	2.10	0.09	5.62	5.20	0.42	0.39
Spain	*0.40*	0.29	0.11	8.41	8.12	0.29	0.05
Sweden	*3.31*	1.63	1.68	11.17	7.46	3.71	0.30
Turkey	*0.98*	0.91	0.07	4.31	4.22	0.09	0.23
United Kingdom	*2.22*	1.73	0.49	10.58	9.77	0.81	0.21
United States	*0.51*	0.22	0.29	5.20	5.15	0.05	0.10

Source: Own calculations using the OECD Statistical database.

[a]Cash amount for a two-earner family with two children as a percentage of GDP. A blank means that there is no scheme.

An additional 20 hours/week of mother's employment during the first three years of life harms the reading and mathematics performance of five- and six-year olds by about 0.10 standard deviation.

3.1.3 Externalities of human capital formation

Welfare states protect the living standard of citizens who lack sufficient human and social capital to maintain a minimum standard of living. The implicit income insurance provided by the intragenerational social contract harms the incentives to accumulate human capital, supply labor, and form stable personal relationships. This provides arguments for public early intervention in case of disadvantaged groups and dysfunctional families (Haveman and Wolfe 1995) and public support for basic education more generally (Bovenberg and Jacobs 2005).[9] These instruments can help to ensure that citizens enter adult life with sufficient human capital and interpersonal skills. These citizens thus do not have to rely on social assistance but are productive enough to earn the minimum standard of living. The welfare state insuring against a lack of human capital makes human capital (including a work ethic) a merit good that yields positive externalities in terms of lower welfare payments for society at large.

Learning is a dynamic process exhibiting increasing returns to scale: learning begets learning, as skills acquired early in life facilitate further learning (Knudsen et al. 2006). Empirical evidence indeed suggests that learning is most effective when it begins at a young age: marginal returns on schooling are highest for the young (CEA 1997). For elderly workers whose skills have become obsolete and who lack marketable skills, in contrast, in-work benefits rather than public training programs are typically the most efficient way to attach them to the labor market and to build human capital through learning-by-doing in private firms (Heckman 2000). Indeed, adults prefer to learn through learning-by-doing in a work setting. Heckman et al. (1998) estimate that postschool learning in firms accounts for almost half of all skill formation in modern economies. Indeed, lifelong learning is implemented primarily outside the formal education system in firms.

A related market failure involves the impact of the tax system on work. Redistributive taxation harms labor supply, which yields underinvestment in human capital. It also encourages individuals to substitute time away

[9] Also other market imperfections, such as monopsony power of employers, a compressed wage structure, liquidity constraints and the lack of contractibility of training, may prevent the efficient sharing of costs and benefits of training and thus result in underprovision of training (see OECD 2003, Chapter 5, Section 2). Liquidity constraints may hurt training especially for low-skilled workers. Low-skilled workers may lack funds also to invest in the human capital of children (e.g. by reducing working time).

from taxed formal work into untaxed home production (Sandmo 1990). This is an argument in favor of subsidizing child care. Blau and Currie (2004), however, argue that the best available evidence suggests that the effects of childcare subsidies on labor force participation tend to be rather small, as formal care crowds out informal care.

3.1.4 Adverse selection in labor markets

Privately negotiated labor contracts may yield inefficient solutions due to adverse selection. To illustrate, firms may not voluntarily offer socially optimal leave schemes, if low-risk individuals who are not likely to take advantage of these schemes signal their status to employers by agreeing to contracts providing little or no leave (Aghion and Hermalin 1990). Government mandates forcing firms to offer leave schemes (e.g. parental schemes) combat this adverse selection. The same holds true for collectively negotiated mandates applying to a whole industry. These mandates may encourage the development of more inclusive and flexible workplace cultures in which workers who temporarily work shorter and more flexible hours remain employable and can enjoy fulfilling careers. This, in turn, is likely to strengthen social norms facilitating the combination of work and family obligations.[10]

Most of the recent evidence suggests that public parental leave mandates increase female employment, but that lengthy entitlements depress the relative wages of women. Based on a panel of nine European countries, Ruhm (1998), for example, finds that job-protected leave paid by the government raises female participation by about 3 percent. Apparently, women enter the labor force in order to qualify for leave benefits, while job-protected leave accelerates the return to work of young mothers. Brief leave entitlements (three months) do not affect women's earnings, but lengthier leave (nine months and longer) depresses relative wages by about 3 percent. Indeed, with longer leave entitlements, employers face higher rescheduling costs in replacing young mothers during leave, especially in countries that restrict temporary fixed-term contracts. Moreover, a woman bearing multiple children depreciates her human capital by being away from her job for several years.

3.1.5 Lack of foresight

Behavioral economics is gathering more and more evidence that individuals suffer from myopic behavior and that they have difficulty planning for the future. To illustrate, many individuals believe that they should be

[10] For how changes in work patterns can change preferences and social norms, see Lindbeck (1997).

saving more for retirement but are unable to do so (Laibson et al. 1998). People apparently lack the self-control that is required to implement a savings plan. Individuals may thus experience an unanticipated drop in consumption when their incomes decline as a result of retirement or the birth of children.

A convenient way to model this behavior is hyperbolic discounting. With this type of discounting, nearby events are discounted more heavily than events that are still far away. These preferences imply time-inconsistent behavior and cause individuals to seek ways to commit themselves by restricting their discretion to reverse earlier decisions. Hyperbolic discounting can explain why women may understate the importance of remaining attached to the labor force in terms of protecting their future earning capabilities.

3.2 Institutional failures

Early retirement ...

Various schemes encouraging early retirement have resulted in workplace cultures that fail to maintain human capital. Various schemes facilitating early exit from the labor force have also produced an early retirement culture setting in motion a vicious circle: workers retire early because their skills are obsolete, while human capital is not maintained because people can retire early and thus feature only a short time horizon and a low utilization rate of human capital. Indeed, cross-country data show a strongly positive correlation between spending on training and the effective retirement age (OECD 2006). In Europe, additional leisure time after retirement is not used actively but rather for home-centered leisure activities—and watching TV in particular (Avramov and Maskova 2003).

The waste of human capital as a result of early retirement originates in the erroneous belief that early retirement reduces unemployment because the amount of work is fixed: the so-called 'lump-of-labor fallacy'. In fact, early retirement has contributed to unemployment by putting a heavy financial burden on companies and families with young children.[11] Moreover, early retirement has nurtured working place cultures in which careers must be made during the time when people bear family responsibilities for young children, thereby creating time pressures in the family season of life in the age range between 30 and 45. By thus preventing men from taking on more household duties and caring for children, these cultures have fostered gender inequalities in employment and earnings patterns.

[11] Indeed, countries with the lowest participation rates (and thus labor supply) feature the highest unemployment rates (Burniaux et al. 2004; OECD 2006).

Indeed, fathers often cite workplace cultures as the key reason why they are not more involved with their families (EFILWC 2003). This explains why the European countries with the lowest effective retirement age also feature the lowest female participation and fertility rates. In this connection, early retirement has also worsened liquidity constraints in early adulthood by transferring resources away from this early phase in the adult life cycle to the active senior phase of the life course.

. . . and Lack of wage flexibility

An important factor explaining the low effective retirement age in Europe is the lack of wage flexibility for elderly workers, which reduces labor demand and thus results in a weak labor market position of these workers. Since many social benefits (provided by unemployment and disability insurance, for example) are directly linked to previously earned wages through fixed replacement rates, elderly workers who have experienced a decline in their earning potential are hard pressed to find a job that is acceptable to them, and therefore reduce their search intensities.

Wage rigidity explains the increase in structural, long-term inactivity in Europe following adverse macro-economic shocks and in the face of more idiosyncratic shocks to earning potentials of individual workers due to more creative destruction. Whereas European displaced workers experience smaller income losses than their American colleagues, they face smaller reemployment probabilities, resulting in further rapid depreciation of their human capital rather than restoration of old levels through on-the-job learning (Lunqvist and Sargent 1998).

Another factor weakening the demand for older workers is the implicit labor contract according to which workers are underpaid when young and overpaid later on. This contract can encourage young workers to invest in firm-specific human capital and promote workers' effort and cooperation. At the same time, however, it ties older workers with golden chains to their employer. Moreover, it makes older workers dependent on the survival of the firm they work for and discourages entrepreneurship. These workers thus experience a lack of security associated with 'fear of falling' in a dynamic economy in which creative destruction causes companies to exhibit shorter life spans. Indeed, the implicit contract creates a gap between the *insiders* who are lucky enough to work for a surviving firm and the *outsiders* whose firms have not survived.

Another drawback of the implicit contract is that it requires a mandatory retirement age at which workers are laid off (Lazear 1979). Hence, the speed and extent of phased retirement cannot act as a buffer for absorbing aggregate financial market and aggregate longevity risks. In an actuarially neutral pension system, working one year longer (and thus receiving annuities one year later) tends to raise their pension by about 8 percent.

The speed and timing of retirement is thus a powerful instrument for absorbing risks.

Employment protection

Social insurance systems in various European countries protect breadwinners against income shocks through employment protection legislation and social insurance linked to previous earnings. These systems shielded families against poverty at a time when the earning potential of women was low and men could look forward to a continuously increasing wage profile in a single-track full-time career. In modern economies that rely on creative destruction and feature a large potential labor supply of female skilled workers who aim for careers in paid work, these systems protecting insiders are increasingly costly in terms of wasting the human capital of outsiders, tying older incumbents to the fortunes of their employer, and discouraging these insiders from moving into new jobs that better fit their life season. Paradoxically, workers seem to feel more secure in those European countries in which employment protection is lowest (Cahuc and Kramarz 2004). One reason is that employment protection discourages not only firing but also hiring, thereby reducing the turnover in the labor market and thus the jobs that are opening up for new entrants to the labor market and those that want to get out of their current jobs. Rather than the difficulty of being laid off from the current job, the ease with which a worker can find a new job is becoming increasingly important in determining the sentiment of security in a transitional labor market.

In addition to preserving the status quo when innovation requires new work practices, employment protection discriminates against outsiders by slowing down turnover in the labor market. The lower probability of finding a good job in a dual labor market depresses the labor supply of secondary workers and raises the opportunity costs of bearing children for young, highly educated women. In countries with strict employment legislation in which workers hold permanent highly protected jobs, women face both higher unemployment risk and the prospect of lower future wage growth (through foregone experience and delayed wage growth) if they temporarily (or on a part-time basis) exit the labor market during the childbearing years. Indeed, worsened future career prospects rather than foregone earnings during the relatively short period spent with the baby account for the bulk of the opportunity costs (in terms of lower lifetime income) of becoming a mother (or of sharing household work and caring for a child as a father). Thus, whereas the literature has traditionally focused on maternity benefits and childcare as the key toward reconciling work and family life, an inclusive labor market is at least as important because in such labor markets young workers do not have to engage

in costly rent seeking to acquire highly protected jobs when they build a family.[12]

On the basis of a panel of OECD countries for the last 35 years, Adsera (2004a) shows that countries with labor market institutions facilitating women's exit and entry in the labor market combine high fertility rates with high female labor supply. This third factor of rigid labor markets protecting insiders at the expense of younger workers explains why the cross-country correlation between fertility and female labor force participation, which has traditionally been negative (conforming to the theoretical predictions), became positive in the mid-eighties (Da Rocha and Fuster 2006). In particular, fertility dropped in Southern European countries (with traditionally low female participation rates) when structural unemployment rose. In the same vein, Kugler and Pica (2003) find that employment protection in Italy raises employment for men, who are more likely to be insiders, at the expense of women, who are likely to be outsiders. Indeed, employment protection substantially depresses the hiring of young women.

Bertola et al. (2002) show that employment protection and wage compression price women as well as young and elderly men out of employment and into other states (the informal economy, homemaking, education, and retirement).[13] By discouraging the employment of young adults and the elderly, these labor market institutions thus contribute to the compression of the working life. Moreover, young adults stay in full-time education longer than would be optimal. As a direct consequence, social adulthood and the responsibility for supporting oneself is increasingly postponed beyond the age of biological maturation.

Using aggregate evidence for 12 European countries, Becker et al. (2004) find that low job security of children compared to their parents prevents young people from leaving the parental home and starting their own family. In particular, if the 20- to 30-year olds would have secure rather than insecure jobs, co-residence rates of children with their parents would decline by 13 percentage points. For parents aged 50–59, co-residence rates with their children rise by 9 percentage points if they have secure rather than insecure jobs.

Housing market: insiders versus outsiders

Young households often face difficulties entering not only the labor market but also the housing market. To illustrate, rent control protecting

[12] Using the European Community Household panel for 13 European countries, Adsera (2004b) finds that, compared to maternity benefits, flexible labor markets that do not penalize part-time work are more effective in stimulating fertility.

[13] OECD (2006, Chapter 3) also shows a significant negative relationship between employment protection and the employment rate of the population aged 50–64 across OECD countries.

incumbent renters typically reduces the rental housing supply for new entrants and results in the rationing of rental properties. As a direct consequence, workers find it difficult to move around. This hurts their job prospects and, more generally, the flexibility of the labor market.

Tax incentives that are not targeted at new entrants may drive up house prices. High house prices reallocate resources from young households who have not entered the housing market toward older incumbents. Imperfect capital markets that prevent young households with insecure jobs from taking out mortgages add to the strain experienced by young people. The difficulty of entering the labor and housing markets discourages young people from starting a family. This lengthens the period of social adolescence, thereby postponing the establishment of a durable relationship and parenthood.

Internal flexibility of firms

Workplace practices and cultures in many countries are still oriented toward the full-time male breadwinner who can devote all of his time and energy to his career. Senior male management and unions (often dominated by older male workers) sometimes lack leadership in introducing family-friendly workplace measures. These measures include flexible leave policies (parental leave, emergency leave to care for sick elderly relatives or children); flexible working hours (e.g. school holiday adjusted working hours; part-time work; flexi time); flexible working arrangements (like teleworking); support with childcare and eldercare; and provision of training during or after leave, so that the allocation of work over the life cycle is better adjusted to the biological clock of women.[14] Even if some of these facilities are present, workers sometimes fail to take advantage of them because they fear that doing so would harm their careers (Groot and Breedveld 2004).[15] Indeed, employers may perceive women who take time off for childbirth as less committed to their career than male breadwinners, and are therefore less likely to invest in female career opportunities. This produces a vicious circle, as many women do not pursue a career in view of a limited likelihood of advancement.

Empirical evidence suggests that the career effects of taking parental leave differ substantially across countries, reflecting different workplace cultures. To illustrate, Kunze (2003) finds that taking parental leave substantially reduces future wage growth in Germany. In Sweden, in contrast,

[14] Some countries are more successful than others in more fully reintegrating mothers into the labor market when their children have grown older (Klammer 2005).

[15] Employee surveys suggest that workers especially value flexible working hours and short-duration leave schemes (see OECD, 2001a, Table 14). For an overview of indicators of these arrangements, see OECD (2001a, Table 4.8). Access to part-time work boosts female labor force participation (see OECD 2003, Chart 3.3).

women do not experience much smaller wage growth after taking parental leave (Albrecht et al. 1999). Apparently, since taking parental leave is so common in Sweden, it does not signal anything about career commitment. Whereas the Swedish labor market for women is thus the outcome of a pooling equilibrium, the corresponding German market is better described by a separating equilibrium.

High wage floors

Welfare payments and minimum wages in many countries are based on a breadwinner having to care for a dependent adult and young children. The need to provide an income for two adults results in high minimum wage floors and compresses the wage scale. Moreover, the limited wage flexibility at the bottom of the labor market puts the unskilled out of work, resulting in social exclusion and further loss of skills and morale. Indeed, high minimum wages act as a tax on employers who employ low-skilled labor. The absence of a low-wage sector prevents families (and also the elderly) from contracting out household services (cleaning and housekeeping, small repairs around the house, child minding, old-age care).[16] Women thus reduce their labor supply as households face more difficulties in reconciling work and family life.

The idea that a minimum wage should be sufficient to provide for a dependent adult and young children is increasingly inappropriate for two reasons (see also Section 2). First of all, the potential earnings of the secondary earner have increased because of the stronger labor market position of women. Second, in the modern longer life course, adults spend considerable time in households without young children. In the spring and fall of the modern life course, adults thus do not have to care for young children and therefore can make do with lower incomes and social protection. In any case, a higher minimum-wage floor raises the human capital requirements of those entering the labor force. If agents do not have sufficient capabilities to earn the minimum wage, they risk ending up in welfare schemes.

Equity versus efficiency

Redistribution from rich to poor and social insurance against income losses are basic functions of the welfare state. In modern welfare states, however, a large part of the taxes levied to finance social transfers merely redistributes resources from one stage in an individual's life cycle to another. Hussénius and Selén (1994) estimated that for the average citizen

[16] High-skilled households and low-skilled agents can get around the minimum-wage floors by contracting household services on the black market, where social protection and quality of service are (very) limited. Moreover, this raises moral issues, as unskilled workers complement social assistance benefits with additional labor income in the informal sector.

in the early 1990s only about 24 percent of the taxes levied to finance social insurance in Sweden accomplished interpersonal redistribution. Pettersson and Pettersson (2003) recently updated and refined the estimates by Hussénius and Selén, estimating lifetime incomes with the aid of a dynamic micro-simulation model and including the value of important public services, such as education, health care, and care for the elderly in a comprehensive measure of lifetime income. With this extended concept of income, Pettersson and Pettersson found that only 18 percent of the taxes levied to finance social insurance transfers and social services in Sweden can be categorized as interpersonal redistribution. Falkingham and Harding (1996) found a degree of interpersonal redistribution of almost 50 percent in Australia and about 30 percent in Great Britain. For Ireland and Italy, O'Donoghue (2001) estimated a degree of interpersonal redistribution of 45 percent and 24 percent, respectively. Sørensen et al. (2006) found that the degree of interpersonal redistribution in Denmark amounts to 26 percent across all taxpayers.

These studies show that a considerable part of the tax bill does not redistribute lifetime income from the lifetime rich to the lifetime poor, but is essentially income that the taxpayer transfers to himself over his own life course. In the absence of an actuarial link between (social security) taxes paid and social transfers received, taxes and transfers inevitably distort labor supply. Moreover, transfer programs often create moral hazard, as taxpayers have no incentive to reduce their reliance on transfers.

In a transitional labor market with a growing diversity of life courses, individuals increasingly experience periods of voluntary inactivity during their life course (to enjoy leisure, educate themselves, set up a business, or care for children or frail relatives). As noted above, the danger of moral hazard increases in such an environment. Moreover, annual incomes (on which many transfers and taxes are based) become an increasingly poor indicator of lifetime needs. Indeed, more efficient capital markets allow individuals to smooth their consumption over their life courses themselves without the help of the welfare state.

4 Policy recommendations

The trends and challenges outlined in Section 2 and the market and institutional failures in Section 3 call for social innovation. Traditional social policies, such as high minimum wages and job protection, are increasingly counterproductive in generating social protection. At a time when corporations and governments are withdrawing from their traditional roles as insurers of human capital risks, new institutions should be created to

offer workers more durable social protection and lasting security. Indeed, a more dynamic world economy and a decline of the extended family and the firm as insurance devices have raised the demand for new ways to absorb social risks over the life cycle. These new institutions should operate in a transitional labor market in which human capital is the key determinant of macroeconomic performance and personal fulfillment. Each country, depending on its history, institutional framework, industrial sector, and worker's preferences, will opt for different solutions. As most countries face similar challenges, however, we can outline some common policy conclusions for the OECD countries. These policy conclusions apply to most countries, albeit not to the same extent.

4.1 A longer working life

Raising retirement age in line with increased longevity

A higher effective retirement age is crucial for a number of reasons. First of all, it raises the return on human capital by lengthening the horizon for investments in human capital. Indeed, raising the retirement age in line with longevity capitalizes the benefits of increased longevity in terms of more durable human capital. Increased longevity is then turned into an economic opportunity rather than a financial threat. In fact, one can argue that all ages that are used to measure old age should be linked to longevity so that one in fact measures old age from the end rather than the beginning of life. In this way, society ensures that social aging and biological aging do not diverge further and people age actively rather than passively. Moreover, fulfilling work that provides stimulus and companionship prevents social exclusion of the elderly, while better-maintained human capital allows the elderly to bear more risk. Indeed, in many countries, tomorrow's elderly can be expected to be healthier, wealthier, and better educated than ever before.

Measuring age appropriately stabilizes pension systems, as increased longevity puts financial stress on not only PAYG schemes but also funded pension schemes if retirement ages are not raised in line with life expectancy. Indeed, funded pension schemes are particularly vulnerable to increased longevity. The reason for this is that the longer life spent in retirement calls for more financial saving, which depresses the return on capital and thus hurts funded pension schemes. Indeed, aging calls for more accumulation, better maintenance, and more intense use of human capital in addition to fiscal discipline and additional private saving. With better maintained human capital, effective retirement ages can be raised in line with longevity, thereby protecting long-run labor supply.

Linking retirement ages to longevity also enables the government to issue longevity bonds so that insurance companies and pension funds

are better able to provide retirement security to retired generations. This is because linking the age at which citizens first receive their public pension to life expectancy reduces the exposure of the government balance sheet to longevity risk. Hence, it becomes less unattractive for the government to acquire more longevity risk on behalf of younger and future generations. Indeed, these generations are best able to absorb these risks through a longer working life associated with more human capital investment.

The rule of automatically linking public pensions and tax privileges to life expectancy avoids the political costs of discretionary decisions to limit eligibility to public pensions and tax benefits if longevity increases further. Agreeing on a risk-sharing rule *ex ante* also reduces the political risks associated with collective discretionary decision making. Moreover, it allows individuals and firms to adapt gradually to a longer working life by better maintaining human capital and adjusting the organization of work to the needs of older workers. An increase in spending on disability pensions and unemployment benefits is thus avoided.

Decompressing the working life

Another benefit of a higher effective retirement age is that it allows people to exploit their longer life to reconcile the two ambitions of, first, investing in the next generation as a parent and, second, pursuing a fulfilling career in paid work in which one keeps learning and applying new technologies. A longer active working life better fits the biological clock of women; whereas some men of about 45–50 years of age already look forward to their retirement, women in the same age-group would like to return to work, as their children are leaving the household. Indeed, a better reconciliation of work and family goes beyond childcare facilities and parental leave schemes during the family phase, but involves the way the entire life course is organized.

By decompressing the working life, a longer working life facilitates greater flexibility in employment patterns over the life course by loosening the link between age and career progression. This reduces career pressure at the biologically determined time when parents care for young children, thereby promoting gender equality, fertility, and child development. Parents of young children can continue to invest in the human capital of their children without having to depreciate their own human capital. Rearing children and reducing work effort somewhat, or taking a career break during the family season thus becomes less costly in terms of depreciated human capital of the parents.[17] In this way, increased longevity can help to bring fertility back closer to replacement levels so that countries do not get entangled in a vicious circle of early retirement and lower fertility

[17] A longer working life also helps to spread human capital risks, such as a spell of unemployment, over a longer working career.

in which politically stronger older generations favor generous passive spending on pensions and healthcare at the expense of investments in the human capital of younger generations.

More generally, a longer working life reduces the need to transfer resources from the summer season of life to the fall season either through intergenerational transfers (such as PAYG pension systems) or through the allocation of resources over the life cycle (for example, through forced pension saving). This reduces the time and income squeeze in the hot summer of the modern life course and helps to relieve the liquidity constraints in this life season. Resources are used to proactively maintain and invest in human capital rather than to reactively provide additional transfer income as a compensation for the premature depreciation of human capital.

A higher and more flexible effective retirement age requires actuarially fair systems ...

More adaptability and employability facilitating a longer effective working life requires people to bear more individual responsibility for the maintenance of their own human capital, thereby stimulating lifelong learning in firms through on-the-job training, jobs that demand continuous learning and job rotation.[18] To that end, retirement schemes should be actuarially fair. This gives workers also more individual choice about when and how to retire. Indeed, actual retirement ages should be flexible and adjust to individual circumstances and preferences. To illustrate, blue-collar workers who started to work early and exhibit lower life expectancy than others may want to retire earlier.[19]

....tighter eligibility criteria for passive unemployment and disability benefits,..

As another way to stimulate the maintenance of human capital, the eligibility criteria for passive unemployment and disability benefits facilitating early retirement and rapid depreciation of human capital should be tightened and should not depend directly on age. Moreover, by no longer allowing firms to shift the costs of reorganizations onto public disability or unemployment schemes, governments encourage firms and social partners to invest more in older workers (instead of getting rid of them) and to adapt work and workplace cultures to the needs of older workers. Indeed, for some types of social insurance (such as disability and

[18] See OECD (2006) for a comprehensive three-pronged approach to increasing effective retirement ages: getting labor supply incentives right; raising demand for older workers by changing employment practices; and promoting employability.

[19] Actuarially fair retirement systems that link pension benefits to longevity, not only on a macro level but also on the level of a homogeneous group of workers, can facilitate retirement ages that are better tailored to the health of workers. Indeed, life expectancy typically differs substantially across various socioeconomic groups, with low-skilled workers featuring lower life expectancy than high-skilled workers.

unemployment insurance), large firms can become the insurer of the first period of inactivity.

. . . and flexible wage setting and employment practices
A more flexible labor market for elderly workers ensures that additional demand for older workers matches additional supply generated by improved labor supply incentives. Together with less employment protection, wages that are more closely related to labor productivity (for example, by diminishing the role of seniority-based pay increments and rigid worker classification systems) reduce the need for mandatory retirement. Hence, workers can use the speed and time of retirement as an instrument to buffer risk. In time, as the elderly become better educated, their human capital is better maintained during the life course and individuals anticipate the possibility of a declining wage, rewarding older workers on the basis of their marginal productivity can become socially acceptable.

More generally, if workers are no longer paid more than their productivity when old, the labor market position of older workers becomes stronger so that they enjoy more discretion to adjust working conditions to their specific needs. More flexible retirement patterns (e.g. part-time and gradual retirement) and more opportunities to change jobs and work patterns (so that older workers become less dependent on their current job and their talents can be better used) then become possible.[20] The flexibility to change one's working conditions to better suit changing needs and to find new challenges in fulfilling work can help to extend fulfilling working lives. The positive effect of flexibility on labor market attachment holds true also for women between the ages of 50 and 70, who often provide informal care to aging, fragile relatives, and friends. This informal care is likely to remain important in the future, due to shrinking family sizes and budgetary pressures on formal care provided by the public sector.

4.2 More flexibility of working time over the life course

More flexibility of working time over the life course protects labor supply
More flexibility in allocating working time over the life course can prevent stress and excessive time squeeze when workers bear substantial family responsibilities. Moreover, it helps women, who still carry most of the family obligations (Table 1), to remain attached to the labor force. Their human capital is thus maintained better, thereby strengthening their labor market position and raising their labor force participation when the children have grown up. The opportunity to alter one's working

[20] The health of the elderly seems to benefit from being engaged in a variety of activities (Avramov and Maskova 2003).

patterns to better fit changing private circumstances is thus an important instrument to protect the labor supply of not only older workers but also young parents. Greater flexibility in employment and career patterns can also encourage men to take up more family responsibilities in middle age. Indeed, Europeans show a keen interest in more flexible working-time regimes (see EFILWC 2003 and Table 4].

Savings accounts provide more individual discretion over working times .... More individual discretion in allocating working time (i.e. time sovereignty) over the life course requires more individual responsibility for financing periods of (part-time) leave. This ensures that more flexibility in selecting work times results in more rather than less hours worked over the life course as a whole. In this connection, tax-favored savings accounts for financing (part-time) parental leave can supplement minimum public income provisions (such as child and childcare benefits and publicly financed parental leave schemes) to protect purchasing power during the summer of the family season without resulting in excessive consumption of leave time and childcare and in large budgetary costs. In this way, tax incentives help internalize the externalities of children at relatively low cost, while at the same time stimulating the labor supply of younger workers in the spring season of life. Savings accounts that are the property of the individual worker also strengthen the position of the worker vis-à-vis the employer and thus contribute to the emancipation of workers. Whereas the employer creates flexible work arrangements and career paths, the worker can offer to finance (part of) the actual leave taken.

To further protect overall labor supply over the life cycle, personal savings accounts can be integrated with tax-favored (early) retirement accounts. In particular, individuals can be allowed to withdraw funds from these accounts before retirement—for example, to care for children or to update skills.[21] Hence, rather than taking leave only at the end of the working life to facilitate the rapid depreciation of human capital through passive social insurance (and early retirement) benefits, individuals can use the funds already in the stressful and expensive family season of life to invest in the human capital of their children or their own human capital so as to prevent the obsolescence of skills. In this way, individuals save for old-age risks in the form of not only financial but also human capital; by investing in human capital earlier in life, individuals are able to work longer.

By helping agents to take more responsibility for drops in income, savings accounts can stimulate not only a more flexible working life but also a more flexible labor market and better management of human resources.

[21] The government may want to subsidize some withdrawals if these withdrawals are used to finance care activities with positive externalities.

In particular, individuals can self-insure a larger part of the shocks to the value of their human capital by using personal savings accounts. For example, older workers can draw on the account to retire gradually or supplement a reduction in the hourly wage at an advanced age. This facilitates wage flexibility of older workers, thereby strengthening their labor market position.

4.3 Workplace cultures aimed at employability and flexibility

More flexible and inclusive workplace cultures aimed at employability . . .
Social partners should nurture more inclusive, flexible workplace cultures that reconcile the needs of individual employees who balance work with family obligations with the needs of employers to respond flexibly to fluctuations in demand in increasingly competitive markets. In order to remain competitive in an aging labor market and to promote themselves as good places to work, firms should attune work conditions to the needs of employees who want to remain employable despite substantial family obligations and rapid innovation and creative destruction. They should aim to create workplaces in which workers develop and maintain their talents, skills, and health. Moreover, firms should help their workers to think and plan ahead how they can remain productive in fulfilling work when they grow older (e.g. by taking education leave in mid career). Reducing excessive stress or physical strain at an early stage can help to extend working lives. Proactive thinking aimed at preventing human capital risks later in life is called for in aging societies in which human resources become increasingly scarce and early retirement schemes are being phased out.

. . .with wage flexibility
Employees should accept more wage flexibility, internal flexibility in work practices, less employment protection for full-time male breadwinners, and more personal responsibility for financing leave and their own personal development (including early retirement and the costs of training). Rather than engaging in general, rigid working-time reductions, social partners should allow more flexible working times tailored to the needs of individual workers and firms. This may require changes in the way work is structured. The necessary changes in cultures and organizations aimed at better managing human resources will happen only gradually, as many companies still base their working conditions on a male breadwinner who is freed from other duties and can retire early.

4.4 More inclusive labor and housing markets

Protection through flexibility to enter and to adjust
To allow young adults to build a family, European labor markets should become more inclusive so that workers do not have to be continuously

employed full time in order to enjoy a successful career. Rather than shielding insiders through employment protection, labor market institutions should enable parents of young children, secondary workers, and young people to easily enter and remain in the labor market (e.g. through job-protected parental leave) and to adjust their working conditions to changes in family conditions. This helps to reduce the opportunity costs in terms of foregone career prospects of becoming a mother and of sharing household work for fathers. Various privileges for full-time male breadwinners should be replaced by facilities that allow parents to raise young children while maintaining their own employability. Employability is the best employment protection.

Portable arrangements diversify firm-specific risks

Basing their security on employability and portable savings, retirement and social insurance schemes rather than on employment protection helps workers to better diversify their human and financial capital; emancipated workers become less dependent on the firm for which they work. Endowed with sufficient human and financial capital, adaptable individuals are empowered to embrace the nonverifiable, idiosyncratic risks associated with creative destruction in a dynamic competitive world economy and a transitional labor market. Moreover, workers enjoy greater flexibility in adjusting working conditions to changing needs during their life courses and in finding fresh challenges from which they can continue to learn. Indeed, frequent job rotation and labor market transitions in a flexible labor market contribute to lifelong learning.

Decompressing the working life by shortening social adolescence

A more inclusive labor market can help reverse the trend toward a compression of the working life and postponement of social adulthood by facilitating the first entry into the labor market. Condensing the period of full-time education, combining learning with work at an earlier state, and spreading learning more over the life cycle by integrating it better with work could also be helpful in shortening the period of social adolescence, decompressing the working life, and bringing forward parenthood.[22] Activating social policies should induce young adults to build up their human capital through education, work, or both. Indeed, some form of education (possibly combined with work) could be compulsory until a young adult has achieved some minimum qualification.

[22] For early school leavers with few skills, the obligation to either work and/or learn can help to inculcate a work ethic and generate human capital.

Role of housing

Also a well-functioning housing market can reduce the stress that young adults experience in the early reproductive stage of their lives. Moreover, tax facilities for home ownership may have to be targeted better at the youngest entrants into the housing market. Equity in housing can also help the old to supplement their pension—for example, to pay for their medical expenditures and other consumption needs. Financial innovation (for example, through reverse mortgages) may be needed to turn home equity into an income stream.

4.5 From breadwinner support to in-work benefits for parents

In-work benefits and mutual obligations strengthen labor market position of low skilled . . .

Lower minimum-wage floors boost the supply of reliable household services for families and the elderly, while at the same time improving the employment prospects of low-skilled women in the formal labor market. To accomplish this while protecting the income position of vulnerable households, more activating social assistance should be combined with in-work benefits (including child care benefits) for parents caring for young children. In particular, social assistance based on mutual obligations should be conditional on each adult (including low-skilled women) being available to the labor market—possibly on a part-time basis while parents care for young children who are not yet of school age.[23] Work and search obligations should thus be credibly enforced for both lone mothers and secondary earners within a two-adult household. In this way, parents would realize that living on passive long-term social benefits (supplemented by black-market activities) is not an option. They are thus encouraged to maintain their marketable skills so that they are able to re-enter the labor market in a full-time job when their children are older. This would boost labor supply.

. . . by decoupling income policy from the allocative role of wages

With less wage compression, in-work benefits can be better targeted at low-skilled workers with children whose productivity is insufficient to earn a minimum standard of living, without the phasing-out of these in-work benefits resulting in very high marginal tax rates higher up the income scale. By moving away from breadwinner support (in which the breadwinner needs to earn sufficient wage income to provide for a dependent adult and children) toward targeted in-work benefits for families with young children, governments decouple income policy from the allocative role of wages. This creates more low-wage jobs in the formal sector.

[23] Box 3.5 in OECD (2003) contains some valuable suggestions on how this could be done.

Subsidized childcare can protect human capital

Subsidized (or publicly provided) childcare for households with low earnings helps women (including single mothers) to escape poverty, and alleviates liquidity constraints during the summer season of life. At the same time, school times should be attuned to the needs of working parents, with affordable after-school care for children of working parents with low labor incomes. Subsidies for high-quality childcare internalize the externalities of child development and alleviate the distortions of the tax system on female participation and human capital accumulation in the formal sector and the production of labor-intensive goods and services in the untaxed household sector. In view of their higher rates of labor force participation, high-skilled women tend to benefit most from general childcare subsidies. Targeting childcare subsidies and child benefits (and other family benefits) at low-income households alleviates poverty, but yields high marginal tax rates and thus disincentives to increase the earnings of the secondary earner in the phase-out range.[24] Hence, governments face a difficult trade-off between poverty alleviation and gender equality. The same trade-off bedevils the choice between household income or individual income as a base for redistribution.

Early intervention in disadvantaged families

Activating policies facilitate social integration of low-skilled migrants and their children, especially if work obligations for women are combined with programs supporting the development of young children. Indeed, early intervention in dysfunctional families is the key to preventing social exclusion, raising the participation rates of unskilled men and women alike, and encouraging durable two-parent families. A proactive social policy aims at creating equal opportunities at the start of life through an equal distribution of human capital. Early interventions aimed at enriching the family environments of disadvantaged children can carry a high economic return in terms of raising school performance in adolescence and boosting wages and labor force participation in adulthood (Cunha et al. 2005). At early ages, therefore, a trade-off between equity (targeting the most disadvantaged children) and efficiency (targeting training at those individuals who yield the highest return on learning) is absent. Once skills have been formed at later ages, returns on schooling are the largest for the most able, so that a trade-off between equity and efficiency exists. Accordingly, social policy can become more efficient by redirecting skill investments in disadvantaged groups from adults to young children.

[24] Targeting may also stimulate the breaking up of families. The associated damage to the role of the family as an institution for buffering risk and providing mutual care reduces the effectiveness of targeting in alleviating poverty.

4.6 Shift public support from the old to the young

The aging of the population is due to increased longevity and lower fertility. Whereas both funded and PAYG pension systems are vulnerable to increased longevity, PAYG pension schemes are especially vulnerable to lower fertility because they rely on human capital of the young to finance the pensions of older generations. As generations invest less in the human capital of the next generations by reducing fertility, they should invest more in financial capital. Hence, lower fertility calls for gradually shifting from PAYG financing to funded pension schemes (Sinn 2000). In this way, public support is gradually shifted away from the fall and winter seasons of life toward the spring and summer seasons.[25] This is consistent with a gradual move from a reactive social policy that provides passive income support to those who have depreciated their human capital to a proactive social policy that helps people to build up and manage human talents better. Stimulating private saving for retirement by shifting public PAYG benefits from the old to young parents is thus not only the appropriate response to declining fertility but also helps to halt the decline in fertility and to internalize the positive externalities of additional children in PAYG pension systems (van Groezen et al. 2003).

Countries with large PAYG systems should consider focusing the public scheme on poverty alleviation by gradually reducing earnings-related PAYG benefits for those earning higher incomes. This would yield a better balanced portfolio between funded and PAYG schemes, as workers with middle- and higher incomes substitute private, funded pensions for public PAYG benefits (see also OECD 2001b, Chapter 6). Reducing PAYG benefits for, and increasing the tax payments by, the more affluent elderly is consistent with the trend toward a more heterogeneous older population. When PAYG schemes were established, the economic depression of the 1930s and the second world war had impoverished the older generation. Since poverty was thus concentrated among the elderly, poverty alleviation called for transfers from the younger to the older generation. At present, in contrast, age is generally no longer a good indicator of poverty, as many elderly have accumulated substantial financial wealth and more risks have shifted to the beginning of the life cycle. Hence, information on age should increasingly be supplemented by other

[25] Whereas increased saving and more public support for young parents at the expense of the elderly is the appropriate response to lower fertility, increased longevity calls primarily for a higher retirement age and more investment in human capital.

information (particularly on incomes and family status) to identify those most in need of income support.[26]

The currently retired generation has not been able to anticipate lower public PAYG benefits. Moreover, this generation cannot adjust easily because it has already depreciated its human capital. Accordingly, a strong case can be made for changing the rules of the game (i.e. reducing PAYG benefits and increasing taxes on the elderly) only gradually.[27] Extensive grandfathering provisions protecting those who are currently old are expensive, however, and would eliminate benefits in terms of enhanced fiscal sustainability. Indeed, grandfathering implies that younger generations have to pay not only for their own private benefits but also for the public benefits of the currently old. The government thus faces a trade-off between flexibility and stability. To enhance confidence and trust in a stable social contract while at the same time facilitating timely adjustments, governments should announce as early as possible any prospective changes in the social contract. This would allow the large baby-boom generations to anticipate reduced public transfers in retirement by starting to build up more funded pensions.

4.7 Individual accounts in social insurance

Self-insurance ...

Social security can in part be based on mandatory contributions to individual accounts.[28] These accounts can in fact be viewed as a self-insurance device against human capital risk over the life cycle (due not only to old age, but also to unemployment and obsolescence of human capital during the working life). Agents become stakeholders in their own social security. If individuals bear more financial responsibility for the maintenance of their own employability, they face better incentives to work and train than under regular social insurance. By allowing people to shift the payment of deductibles in social insurance to the periods in which these costs can be more easily afforded, the schemes continue to offer security even though human capital risks have become less easily insurable.

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[26] Dang et al. (2006) argue that social spending (taxation) can be reallocated from the old (young) to the young (old) without compromising the objective of preventing old-age poverty.

[27] Relative PAYG benefits can be reduced gradually by indexing benefits to prices rather than wages.

[28] See Orszag and Snower (1997) and Stiglitz and Yun (2002), who propose replacing part of unemployment insurance with mandatory individual savings accounts. These savings accounts can also be in the form of so-called notional accounts. The implied PAYG financing avoids a costly transition.

. . . with liquidity insurance and life-time income protection . . .

The government in effect provides liquidity insurance and alleviates capital market imperfections by allowing individuals to make withdrawals from the accounts even if the account balance is negative. Moreover, the government can protect the lifetime poor by bailing out individuals who end up with a negative account balance at the end of their working lives. In this way, the government provides insurance against catastrophic shocks that substantially harm lifetime incomes. Redistribution is thus targeted more closely at the lifetime poor who are suffering a combination of low-wage incomes and frequent adverse shocks during their lives.

. . . yields more efficient insurance . . .

The accounts, in fact, combine a number of risks that occur during different periods of an individual's life in a single insurance contract with a deductible that is conditioned on the aggregate loss during the life course. Gollier and Schlesinger (1995) show that an umbrella insurance policy that adjusts the deductible on each separate loss to the outcome of the other risks in the form of a straight deductible based on the aggregate loss provides the best protection against large aggregate losses for a given insurance budget. Compared to separate insurance policies, the umbrella insurance contract provides better protection in the worst-case scenario of a succession of adverse shocks during the life course in exchange for less protection in other cases.

. . . but requires compulsion and active labor market policies, . . .

Lifetime redistribution as well as liquidity and lifetime income insurance still give rise to some moral hazard; agents have an incentive to minimize their contributions and maximize their withdrawals. The government must therefore regulate withdrawals so that they can be made only for prespecified purposes. Especially the lifetime poor will continue to face high marginal tax rates as a direct consequence of the lifetime income guarantee. Hence, the government should focus its active labor market policies (including workfare) on this group and employ instruments other than financial incentives to activate the lifetime poor. Savings must also be mandatory—at least until a specific upper limit is reached. In addition to moral hazard, lack of self-control and myopia are other reasons for making saving mandatory. Compulsory savings accounts in effect extend mandatory saving aimed at retirement to precautionary saving aimed at social insurance for individuals of working age.

Instead of forcing people to save, the government can encourage individuals to save by providing tax benefits for saving. The advantage is that individuals can then tailor their saving better to their individual needs. The main disadvantage involves the budgetary costs for the government, which may be quite high if the tax benefits cannot be targeted at marginal saving

and thus suffer from substantial deadweight. An attractive alternative to both mandatory saving and tax privileges may be defaults. These defaults induce people to save unless they opt out. Recent empirical research shows that defaults are quite powerful in affecting financial behavior.

. . . uncorrelated shocks and inclusive labor markets, . . .

The potential of individual accounts in improving the trade-off between insurance and incentives depends crucially on the extent to which individuals face correlated shocks during their lifetimes. The potential welfare gains of individual savings accounts are large if various income shocks are uncorrelated across time and among each other. In that case, annual income is a poor indicator of lifetime income, and income shocks are in fact only small in the context of an entire lifetime. If shocks are strongly positively correlated, in contrast, risks do not become much smaller in a lifetime context (compared to an annual context). Risks then remain catastrophic, even when viewed over the entire life course. For each type of human capital risk, another combination between insurance and self-insurance through saving is optimal, depending on the magnitude of the risk in terms of the potential drop in lifetime income and the potential danger of moral hazard because of endogeneity and nonverifiability of the insured risk. Self-insurance should be relatively important for non-catastrophic risks that people can affect through nonverifiable actions (Stiglitz and Yun 2002). Hence, individual accounts become more attractive in fast-moving transitional labor markets in which people experience short involuntary unemployment spells in addition to voluntary periods of absence from the labor market. The opposite is true in the presence of dual labor markets in which insiders enjoy high incomes throughout their lives while disadvantaged outsiders must make do with insecure jobs and tend to suffer from frequent and long-lasting unemployment.

. . . and equal distribution of human capital

Mandatory individual savings accounts can thus be a useful component of an overall social policy package that includes policies aimed at creating equal opportunities at the start of life through an equal distribution of human capital and early intervention. It should also provide some form of lifetime income guarantee. By using information on lifetime incomes, redistribution implicit in such an income guarantee can occur at lower efficiency costs. Moreover, actuarially fair links between contributions and expected benefits alleviate the labor market distortions associated with social insurance for middle- and high incomes. Finally, by facilitating consumption smoothing through saving schemes offering liquidity insurance, the government increases the scope for self-insurance, thereby combating moral hazard in social insurance. Through all of these channels,

savings accounts support social policy by reducing the costs that are associated with an effective mix of redistribution, social insurance, and consumption smoothing.

5 Conclusions

The policy conclusions imply transforming passive benefits compensating the loss of human capital into preventive, proactive social policies that build and maintain human capital. Another common thread in these conclusions is the importance of flexibility in wages and work practices. As workers increasingly combine their work with other activities (caring, resting, and learning), new social protection institutions should facilitate various transitions and changing combinations of activities during the life course. Among other things, an adaptable labor force provides the legitimacy for competitive open markets and the creative destruction associated with rapid innovation and growth. Moreover, substantial human capital contributes to a high level of labor force participation as the basis for ensuring solidarity with vulnerable elderly, children, and disadvantaged adults of working age.

The required reforms confront politicians with a major challenge because these reforms often run against vested interests and the perceived short-term interests of powerful insiders. Moreover, transforming passive, reactive social policies into more proactive policies yields a transitional problem similar to that associated with a shift from a PAYG to a funded pension system. In particular, society still has to pay for passive benefits to the currently old generations; these generations have typically depreciated their human capital because they have not profited from more proactive social policies. At the same time, the human capital investments in the young generations, which reduce social spending and increase tax revenues only with a lag, must be financed. The combination of passive old-age benefits and proactive spending aimed at especially the human capital of younger generations can create fiscal pressures and gives rise to difficult political choices.

As people gain more discretion to construct their own biographies, they become more responsible for their life courses. A challenge in this respect is to better prepare people for more responsibility for their employability, social insurance, and financial planning. Schools, employers, and unions can play an important role in helping people acquire the necessary financial competences and life and work skills. This may also make voters more aware of the fundamental trade-offs in social policy, thereby enhancing the quality of the political debate and policymaking (Boeri and Tabellini 2005).

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Prospects for Growth in the Euro Area

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Abstract

We review the recent performance of the Euro area economy, focusing in detail on the separate roles played by labour input, capital input and total factor productivity (TFP). After a long period of catching up with US levels of labour productivity, Euro area productivity growth has, since the mid-1990s, fallen significantly behind. We show that this recent divergence has accelerated since 2000, and that this is mainly due to the poor rate of Euro area TFP growth. Based on prevailing trends, we estimate that potential output growth in the Euro area currently may be running as low as 1.7 percent per year. In addition, if TFP growth stays at recent levels, the output growth rate will decline further due to weaker capital deepening. To consider future Euro area prospects for growth, we examine a set of alternative scenarios, each of which posits a potential increase in a determinant of output growth. One of these scenarios focuses on the potential effects of greater labour market deregulation. (JEL codes: O10, O47, O52, J11)

Keywords: Euro area, growth, total factor productivity.

1 Introduction

For much of the post-War period, the rate of economic growth in Europe was similar to that observed in the US. This process came to a halt during the mid-1990s. Since then, the US economy has grown substantially faster than that of Western Europe: US GDP has grown at an average rate of 3.2 percent per year compared with 2.2 percent in the Euro area. This difference in growth performance has generated considerable debate about how to boost the growth rate of the European economy and has had an important influence on the policy focus of national governments, the European Commission and the European Central Bank (ECB). For national governments and the Commission, there has been an increased focus on the need for deregulation of product and labour markets. This reform agenda has been formalized in the Lisbon Agenda set of policy proposals and discussed in high-profile publications such as the 2003 *Sapir Report* (Sapir et al. 2004).

In relation to monetary policy, the ECBs constitution calls for it to promote economic growth provided this does not undermine its primary goal of price stability. Indeed, the ECB has become a key participant in public

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debates about the need for structural reforms to boost the potential capacity for growth in the Euro area. Discussions of this issue have, for instance, regularly featured in the official statements accompanying the decisions of the ECB Governing Council and in the public statements of the ECB President.[1] Of course, another reason the ECB needs to keep track of the potential growth rate of the Euro area economy is because it also needs to have some measure of the "speed limit" at which the economy can operate over a sustained period of time without generating inflationary pressures.

With these considerations in mind, this paper reviews the performance of the Euro area economy over the period 1970:Q1–2006:Q4 and provides an assessment of its medium-term potential for growth. We also discuss the role that structural reform policies may be able to play in boosting the potential growth rate. Our review of the evidence suggests a number of reasons to be somewhat downbeat about the current potential for economic growth in the Euro area. Growth in labour productivity (defined as output per hour worked) was higher than in the US until the mid-1990s, but has steadily declined over time since then, averaging only 1.0 percent per year over the period 2001:Q1–2006:Q4 compared with 1.9 percent for the US. We also focus in detail on the separate roles played by labour input, capital input and total factor productivity (TFP) in determining economic growth. These calculations provide further evidence of a deteriorating performance: We calculate average TFP growth for the Euro area over 2001:Q1–2006:Q4 of only 0.4 percent per year, compared with 1.4 percent for the US over the same period.

Based on a detailed examination of recent trends, we argue that the potential growth rate of output per hour in the Euro area appears to be about 1.1 percent per year. Combined with the recent growth rate of 0.6 percent per year in hours worked, this suggests that the growth rate of Euro area GDP in the near-term may be as low as 1.7 percent per year. This is far below the 3 percent target set as part of the Lisbon strategy. In addition, our calculations suggest that the US economy's current trend growth rate achieves this 3 percent target.[2]

More worryingly, we document that the composition of recent growth implies that, if current trends continue, then the potential growth rate of the Euro area is likely to decline further. This is because recent growth has relied mainly on increases in capital and labour inputs, with negligible improvements in TFP. Our estimates of the present trend growth rate are

[1] For example, see Jean-Claude Trichet: Testimony before the Committee on Economic and Monetary Affairs of the European Parliament, 23rd May 2005. Available online at: www.bis.org/review/r050530b.pdf (last accessed July 2008).

[2] Our calculations for the US are somewhere between the "base case" and "optimistic" scenario presented a few years ago by Jorgenson, Ho and Stiroh (2003).

based on taking the current prevailing growth in capital input as given. However, a key insight from growth theory originating with Solow (1956) is that growth in capital is endogenous and depends on sustained improvements in technological efficiency. We show that the current trend growth rate of TFP is consistent with a long-run (steady-state) growth rate of output per hour of only 0.8 percent per year.[3] Even if this was combined with an optimistic assumption about long-run hours growth, it implies that unless there is a turnaround in TFP growth, the long-run growth rate of Euro area GDP will be just 1.4 percent.

Our relatively negative assessment contrasts somewhat with the more positive conclusions of Olivier Blanchard (2004) who argues that Europeans have tended, since the 1970s, to take additional leisure time as the reward for a faster level of productivity growth, so a focus on overall GDP growth or GDP per capita figures tends to understate the true positive extent of European economic performance. Blanchard's analysis, however, was largely based on data through 2000, and the period since then has seen a substantial weakening in European productivity growth. Indeed, we calculate that the gap between the levels of US and European labour productivity has widened from about 9 percent in 2000 to about 14 percent in early 2006.

In the final part of the article, we discuss the effects on GDP growth and productivity of structural reform programs designed to boost labour input and capital investment. We simulate the effects of a labour market reform package that closes about half of the gaps between the Euro area and US in participation rates unemployment rates and average workweeks. While we find that such a package would boost growth above 2 percent for a period of time, it would only do so at the expense of a significant worsening of productivity growth and would not change the poor long-run growth prognosis implied by recent trends in TFP growth. We also find that even a substantial increase in the capital investment share of GDP is unlikely to boost the medium-run growth rate above 2 percent in the absence of any improvement in the trend rate of TFP growth.

In addition, the evidence suggests that obtaining these positive reform outcomes may not be so easy. The limited amount of labour market reform seen already has not had much effect on labour market performance: hours worked per capita are about the same today as they were ten and 20 years ago. Furthermore, the share of nominal GDP accounted for by capital investment has been moving down over time despite a wide range of product market deregulation measures. Overall, our analysis suggests that

[3] This is an important source of difference between our projections and those in a recent ECB study by Musso and Westermann (2005). Their study is more optimistic about current trend growth rate of output per hour in the Euro area; they also assume that the rate of capital deepening will not change in the future, while we project this to decline.

policies aimed at improving TFP growth will be crucial if the Euro area is to return to higher levels of economic growth over the next decade.

The contents of the rest of the article are as follows. Section 2 reviews the growth performance of the Euro area and compares it with the US, focusing on GDP growth, labour productivity and hours worked. Section 3 presents evidence on TFP and investment. Section 4 examines the likely growth potential over the medium and long run of the Euro area economy if current trends prevail. Section 5 then considers a set of scenarios involving policies aimed at boosting the growth rate over the coming years. In particular, we focus on the effects of policies aimed at labour market deregulation and boosting capital investment. Section 6 concludes with a discussion of the outlook for Euro area TFP growth.

2 Review of growth performance

2.1 Output and productivity growth

Figure 1 provides a long-run perspective on the relative performances of the US and Euro area economies, illustrating their records of GDP growth, growth in hours worked and growth in labour productivity (defined as output per hour) between 1970:Q1 and 2006:Q4. Recent data for the Euro area come from Eurostat. Because most of the Eurostat series only go back to the early 1990s, we extended the database back using the same growth rates as the corresponding series in the ECB's Area-Wide Model (AWM) dataset described in Fagan, Henry and Mestre (2001). Data for the US are drawn from the websites of the Bureau of Labour Statistics and the Bureau of Economics Analysis: the details behind the construction of these data sets are provided in an Appendix A.

Figure 1A shows that, since 1970, GDP Growth in the US has generally exceeded that in the Euro area. However, for most of this period, this higher growth rate has reflected a faster growth rate of hours worked (Figure 1B). Indeed, up until the mid-1990s, the growth rate of labour productivity in the Euro area consistently exceeded that in the US (Figure 1C). This pattern is often explained as the result of Europe's potential for "catching-up" with the US, as it learned to adopt US technologies and thus close the substantial gap in labour productivity levels, which had prevailed during the immediate post-War period. The catch-up story has also been used to explain the fact that European productivity growth has eased off over time, as the gap between productivity levels was closed.[4]

[4] Blanchard (2004) and Dew-Becker and Gordon (2006) both emphasize the catch-up story as an explanation for Europe's superior productivity performance and its subsequent slowdown.

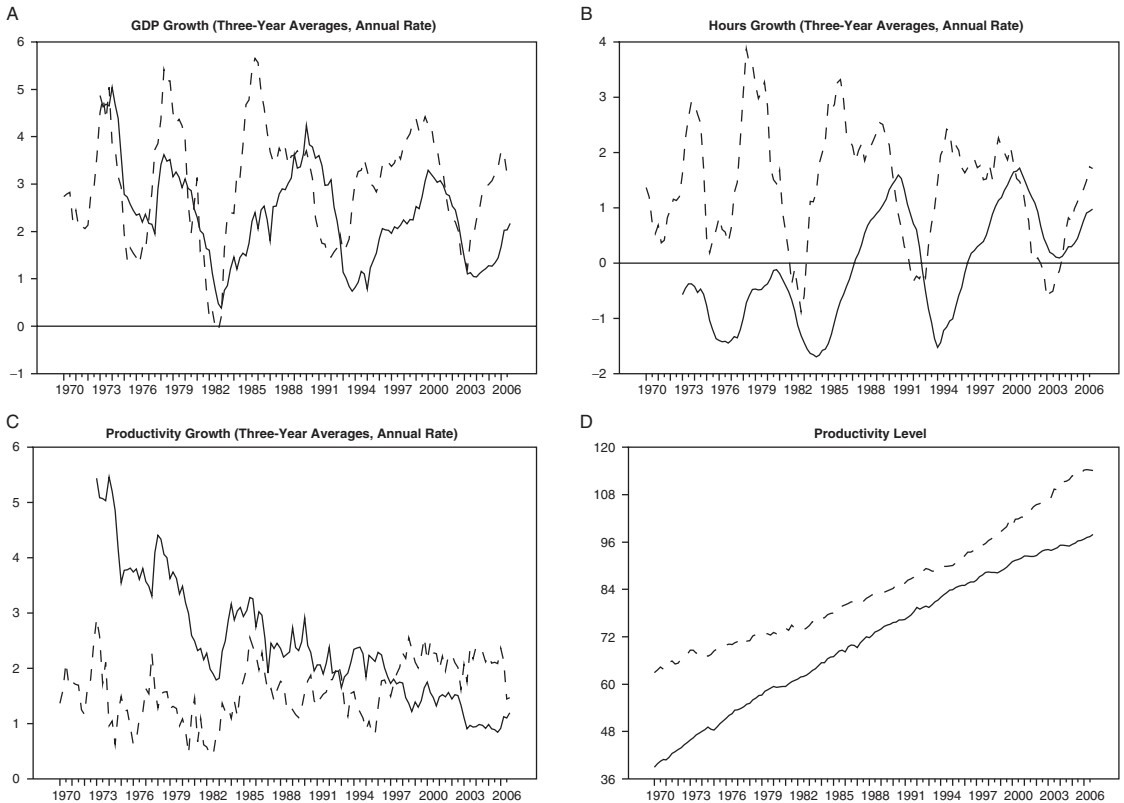

Figure 1 Comparison of Euro area and US economic performance (solid lines = Euro area).

When considered in the light of the "catch-up" story, the period since the mid-1990s has represented something of a puzzle. Not only has European productivity ceased catching up, but also productivity has decelerated even as the US has undergone a period of productivity growth stronger than any seen since the golden economic age of the 1960s. Indeed, using figures from the Groningen Centre for Growth and Development to obtain estimates of Purchasing Power Parity consistent *levels* of labour productivity, it is apparent that a substantial gap has re-emerged between US and Euro area productivity.[5] After reaching almost parity with US by the mid-1990s with a gap of 4 percent in 1995, we estimate that this gap stands at about 14 percent in 2006:Q4 (Figure 1D). However, unlike the last time a gap of this magnitude prevailed (circa 1982) Europe is still falling behind in terms of productivity: for reference, Euro area productivity growth in the first half of the 1980s was running at an average rate of 2.4 percent per year, compared with 1.0 percent over the 6 years ending in 2006:Q4. In contrast, as of yet, there is no sign of the Euro area starting to close the productivity gap or even catching up with the growth rate of US productivity.

2.2 Labour market developments

Figure 2 provides a perspective on the behaviour of hours worked in the US and the Euro area. Total hours worked can be defined as the product of four elements: population times, labour force participation rate times, employment rate times and hours worked per employee. The figure provides evidence on how the US economy has generated stronger hours growth through each of these four factors.

Population growth has been consistently higher in the US than in the Euro area, averaging about 1.4 percent per year compared with 0.4 percent for the Euro area. This gap has reflected both higher rates of immigration and a higher birth rate. In recent years, the rate of population growth in the Euro area has moved up to about 0.6 percent, largely due to increased rates of immigration, most notably from Eastern European countries that have joined the European Union.

Labour force participation (defined here as the ratio of the labour force to total population) was slightly higher in the Euro area than the US in the early 1970s, but fell behind during the 1970s and 1980s. This difference in performance reflected a smaller increase in labour participation among working age individuals and a larger increase in non-working-age relative to working age population in Europe (this latter factor reflecting a weaker birth rate and less immigration). Participation rates in both the US and Euro area have essentially flattened out in recent years, with the long

[5] These calculations were derived from the Groningen Centre's Total Economy Database.

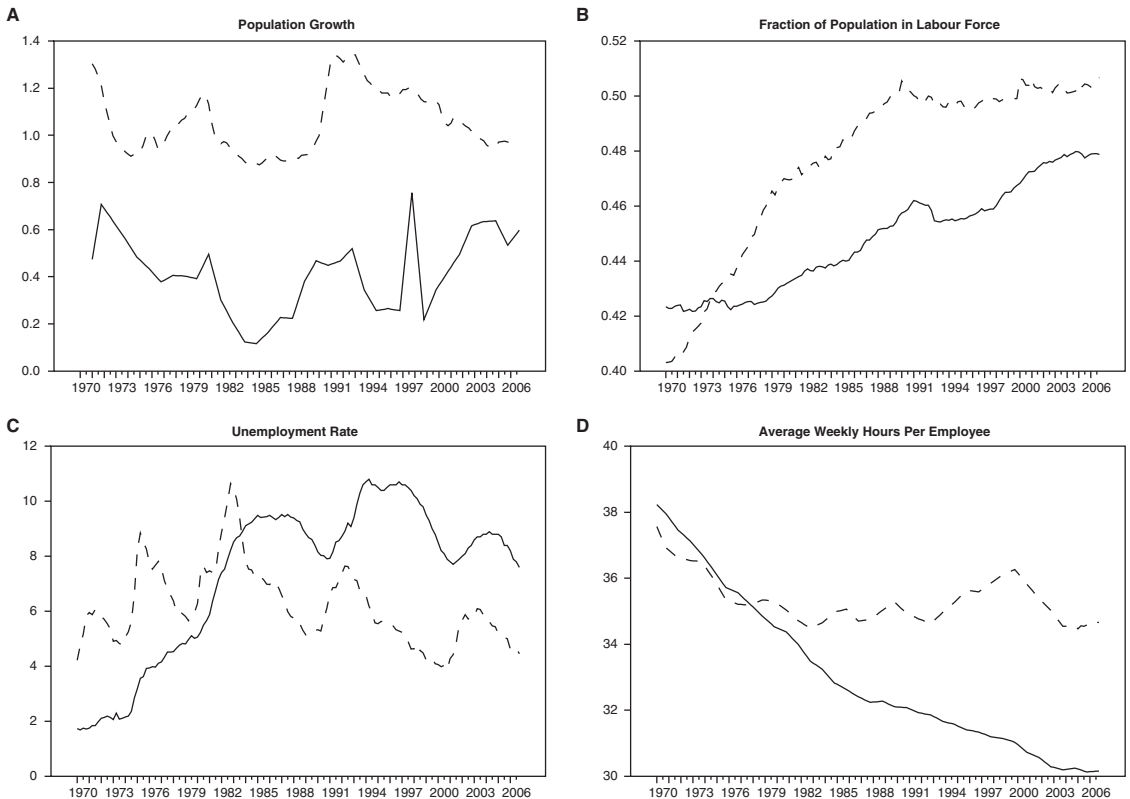

Figure 2 Comparing Euro area and US labour market outcomes (solid lines = Euro area).

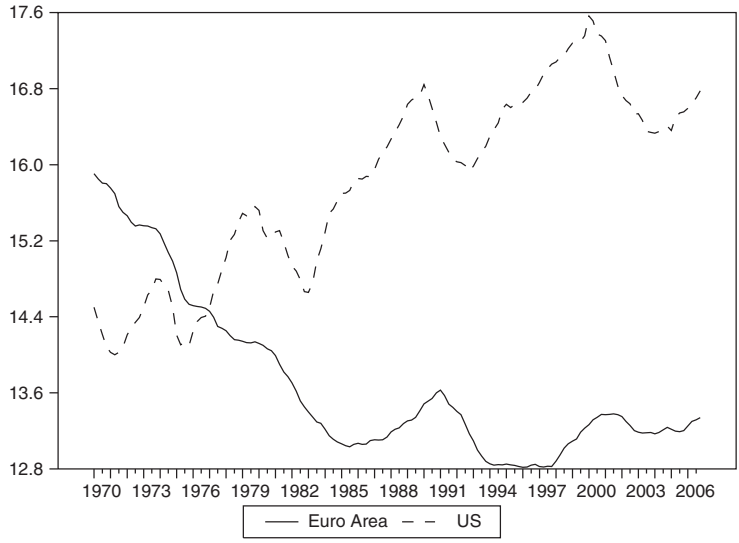

Figure 3 Per capita weekly hours worked.

upward trend due to higher female participation rates having apparently run its course.

Unemployment rates are another area where European and US performances have diverged. European unemployment was negligible in the early 1970s but climbed steadily until the mid-1990s. After retreating somewhat in the late 1990s, unemployment rates in the Euro area have remained relatively steady at a high rate of about 8–9 percent during the current decade.

Average workweeks (i.e. the average hours worked per week for each person employed) represent perhaps the most dramatic difference between US and European labour market developments. While European and US average workweeks were similar in the early 1970s, the Euro area workweek has declined significantly to below 30 hours worked per week, while the US workweek fell off a little in the 1970s but has remained at about 36 hours per week since then. Alesina, Glaeser and Sacerdote (2005) note that differences in vacation time account for most of the gap that has opened between European and US workweeks.

Figure 3 illustrates the behaviour since 1970 of hours worked per capita in the US and Euro area. This series summarizes the combined effects of these last three factors (the participation rate, unemployment rate and average workweek). Table 1 also provides an accounting decomposition of growth in hours worked over various periods into its four components. Figure 3 shows that from the 1970s to the mid-1980s Euro area hours worked per capita declined steeply, with increasing unemployment and, more

Table 1: Decomposition of average labour growth rates

	Euro area				
Period	Total	*Pop.*	*P.Rate*	*Emp.Rate*	*Workweek*
1970:1–2006:4	−0.1	0.4	0.3	−0.2	−0.6
1970:1–1980:1	−0.7	0.5	0.2	−0.3	−1.0
1980:1–1990:1	−0.2	0.3	0.6	−0.3	0.7
1990:1–2000:1	0.2	0.4	0.2	−0.0	−0.4
2000:1–2006:4	0.6	0.6	0.3	0.1	−0.4
1996:1–2006:2	0.9	0.5	0.4	0.3	−0.3
1996:1–2001:1	1.3	0.4	0.7	0.6	−0.4
2001:1–2006:4	0.5	0.6	0.2	0.0	−0.2
US					
1970:1–2006:4	1.4	1.4	0.2	−0.0	−0.2
1970:1–1980:1	1.8	2.0	0.5	−0.2	−0.6
1980:1–1990:1	1.7	1.2	0.4	0.1	−0.1
1990:1–2000:1	1.4	1.1	0.1	0.1	0.0
2000:1–2006:4	0.6	1.2	−0.2	−0.1	−0.4
1996:1–2006:4	1.2	1.3	−0.0	0.1	−0.1
1996:1–2001:1	1.8	1.4	0.2	0.3	−0.1
2001:1–2006:4	0.8	1.2	−0.2	−0.0	−0.2

Note: *Pop.* refers to population, *P.* is the participation rate, *Emp.* is employment and *Workweek* is average hours worked by employees.

importantly, a sharply declining workweek offsetting the effects of an increasing participation rate. Since then, Euro area per capita hours have been roughly flat at about 13 hours worked per week per person. In contrast, US hours per capita started off behind Europe in the early 1970s and then trended upwards through the late 1980s, with the strong upward trend in participation offsetting a weaker decline in the average workweek. The period since the late 1980s has seen US hours per capita fluctuate around 17 hours per Week.

The behaviour of hours worked per capita in Europe over the past decade must be viewed as somewhat disappointing. This is because this relatively unchanged outcome has occurred against a background in which there is broad agreement that the European labour market is over-regulated and in which various steps have been taken in the direction of deregulation. For instance, measures to encourage temporary contracts have been more widely introduced, tax credit systems that provide better incentives to work in low-paid jobs have become more widespread and tax rates on labour have declined. However, despite these measures, there has been little change in participation rates, unemployment rates or average workweeks since 2000.

Table 2 Decomposition of average labour growth rates (%) for select Euro area countries

Country	Total	*Pop.*	*P.Rate*	*Emp.Rate*	*Workweek*
1983:1–2000:4					
Belgium	0.8	0.3	0.5	−0.3	−0.3
Germany	−0.1	0.25	0.4	−0.1	−0.7
France	−0.0	0.6	0.0	−0.2	−0.5
Greece	0.8	0.9	0.4	−0.2	−0.2
Ireland	1.8	1.3	0.5	0.7	−0.7
Italy	−0.1	0.2	0.1	−0.2	−0.2
Luxembourg	0.9	1.0	0.3	0.1	−0.4
The Netherlands	2.0	0.7	1.4	0.6	−0.7
2001:1–2006:4					
Belgium	0.4	0.5	0.3	−0.3	−0.1
Germany	0.0	−0.2	1.0	−0.4	−0.4
France	0.5	0.8	0.2	0.2	−0.7
Greece	1.4	0.2	0.8	0.5	0.1
Ireland	2.7	2.3	1.0	−0.0	−0.6
Italy	1.1	0.0	−0.8	0.8	−0.4
Luxembourg	0.3	1.1	0.6	0.4	−1.0
The Netherlands	0.5	0.4	0.5	−0.2	−0.3

Cross-country analysis

In Table 2, we replicate the accounting decomposition of Table 1 for a select group of Euro area countries.[6] The results are presented for two sub-periods 1983–2000 and 2000–06. From the table, a number of patterns are worth noting:

- Unsurprisingly, the patterns we uncovered for the Euro area—little net growth in hours over the 1980s and 1990s and then a minor improvement in the 1990s—correspond largely to the pattern reported for the larger economies such as France, Germany and Italy.
- The factor that our aggregate analysis suggested played the most important role in reducing hours worked—the decline in the average workweek—turns out to be a very widespread development. All the countries presented here experienced declines in the average work week over both of these sub-periods with France, Ireland and Luxembourg experiencing the largest decline.

[6] The countries were chosen on the basis of data availability over the period 1983–2006.

- In contrast, there are some interesting variations across countries in the roles played by changes in the participation rate and the employment rate. Both Ireland and the Netherlands have sustained significant increases in participation rates, with the Dutch rise thought to be linked to improved active labour market policies. More generally, Garibaldi and Mauro (2002) demonstrate a link across OECD countries between employment growth and labour market reforms.

3 Capital investment and TFP

In addition to labour input, capital investment is another important factor determining labour productivity. For this reason, it is generally considered that one can get a better picture of how well an economy uses its resources by focusing on TFP, which is defined as the efficiency with which it combines its labour and capital inputs to produce its output. Here, we present evidence on Euro area and US TFP growth based on a simple growth accounting exercise.

3.1 Growth accounting

Our starting point is the standard assumption that output is produced according to a Cobb–Douglas production function

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

where, Y_t is real GDP, K_t is capital input, L_t is labour input (defined as hours worked) and A_t is TFP. Output growth can then be written as

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{A}_t}{A_t} + \alpha\frac{\dot{K}_t}{K_t} + (1-\alpha)\frac{\dot{L}_t}{L_t} \tag{2}$$

So, with data on output growth capital growth and labour growth in hand, this equation can be used to calculate TFP growth.

Our empirical calculations use the standard value of $\alpha = 1/3$ for all cases.[7] For the US, our data on capital are based on estimates of the total stock of fixed assets provided by the Bureau of Economic Analysis, which are available through 2004. A simple interpolation method was used to create quarterly data, and stock estimates though 2006:Q4 were generated by growing out the stock according to a perpetual

[7] An alternative is to use the labour share of income to calibrate the parameter $1-a$. However, for both the US and Euro area, this value has averaged about two-thirds, in line with our assumptions. In addition, we should note that our calculations can be considered accurate for any neoclassical production function, provided our estimate of the elasticity with respect to labour input is well captured by our two-thirds assumption.

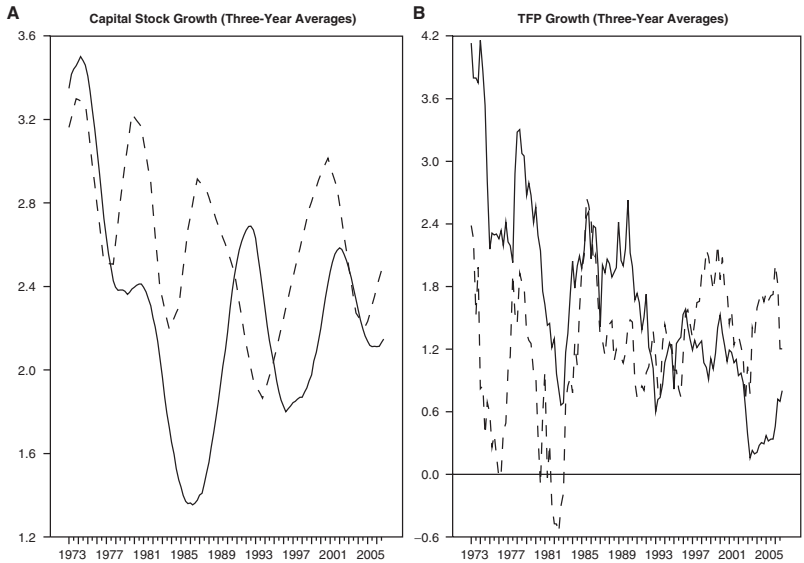

Figure 4 Capital and TFP growth (solid lines = Euro area).

inventory formula using the 2004 estimate of the average depreciation rate of the stock. For the Euro area, no official estimates of the capital stock exist, so our estimates are based on an initial assumption that capital in 1970 was at the steady-state value implied by the Solow growth model (this is discussed in greater detail in the Appendix A) and subsequently calculated based on the assumption that capital depreciates at 6 percent per year. Our results, however, are not particularly sensitive to either this initial assumption or the assumed depreciation rate.

Figure 4 shows that capital input has generally grown faster in the US than in the Euro area. In particular, the figure highlights the strong growth in the capital stock during the mid to late-1990s when the US went through a period of very strong growth in investment. Over the whole period examined, one of the implications of the stronger US capital growth is that the TFP growth record of the Euro area relative to the US has been even stronger than its positive labour productivity growth record. Indeed, the figure shows that TFP growth in the Euro area exceeded the comparable series for the US over almost every 3-year period from the early 1970s until 1992. The period since, however, has shown US TFP growth moving ahead. In particular, the period since 2000 has seen the gap between Euro area and US TFP growth widen, with the Euro area appearing to have settled down at a very low growth rate of about 0.5 percent per year.

Table 3 presents more detailed results from a growth accounting exercise, which allocates output growth according to its three components.

Table 3 Decomposition of Euro area and US output growth rates (%)

	Euro area				US			
Period	Δy	Δa	Δk	Δl	Δy	Δa	Δk	Δl
1970:1–2006:4	2.4	1.7	0.8	−0.0	3.0	1.2	0.9	0.9
1970:1–1980:1	3.5	3.0	1.0	−0.5	3.3	1.1	1.0	1.2
1980:1–1990:1	2.2	1.7	0.6	−0.1	3.1	1.1	0.9	1.1
1990:1–2000:1	2.1	1.2	0.7	0.1	3.1	1.4	0.8	0.9
2000:1–2006:4	1.7	0.5	0.8	0.4	2.5	1.4	0.8	0.4
1996:1–2006:4	2.2	0.9	0.7	0.6	3.2	1.5	0.9	0.8
1996:1–2001:1	2.9	1.4	0.7	0.8	3.8	1.6	1.0	1.2
2001:1–2006:4	1.5	0.4	0.7	0.4	2.7	1.4	0.8	0.5

The table confirms the improvement over time in the TFP performance of the US economy and its superior growth of capital and labour inputs, as well as the steady decline in European TFP growth. Table 4 provides an alternative accounting breakdown, describing the determination of labour productivity growth as a function of TFP growth and "capital deepening" (growth in capital per unit of labour). In other words, it provides the figures behind the identity

$$\frac{\dot{Y}_t}{Y_t} - \frac{\dot{L}_t}{L_t} = \frac{\dot{A}_t}{A_t} + \alpha\left(\frac{\dot{K}_t}{K_t} - \frac{\dot{L}_t}{L_t}\right) \tag{3}$$

These figures show that both capital deepening and TFP growth have moved downwards over time in the Euro area, while the opposite has occurred in the US. The decline in TFP growth has been even sharper than the decline in capital deepening. As we will discuss in the next section, however, capital deepening should not be considered a completely independent source of productivity growth because it depends on TFP growth over the long run.

3.2 Cross-country analysis

Table 5 reports results from repeating our calculations for the same range of countries presented in Table 2. It reports average annual TFP growth for the sub-periods 1983–2000 and 2000–06. From the table, a number of patterns are worth noting:

- The most striking pattern is that our finding at the aggregate Euro-area level of a slowdown in TFP growth over this period

Table 4 Decomposition of Euro area and US output per worker growth rates (%)

	Euro area			US		
Period	$\Delta y-\Delta l$	Δa	$\Delta k-\Delta l$	$\Delta y-\Delta l$	Δa	$\Delta a-\Delta l$
1970:1-2006:4	2.5	1.7	0.8	1.6	1.2	0.4
1970:1-1980:1	4.2	3.0	1.2	1.5	1.1	0.4
1980:1-1990:1	2.4	1.7	0.7	1.4	1.1	0.3
1990:1–2000:1	1.9	1.2	0.7	1.7	1.4	0.3
2000:1–2006:4	1.1	0.5	0.5	2.0	1.4	0.6
1996:1–2006:4	1.3	0.9	0.4	1.9	1.5	0.4
1996:1–2001:1	1.7	1.4	0.3	2.0	1.6	0.4
2001:1–2006:4	1.0	0.4	0.6	1.9	1.4	0.5

Table 5 Annual TFP growth rates (%) for select Euro area countries

Country	1983:1–2000:4	2000:1–2006:4
Belgium	1.0	0.5
Germany	1.7	0.4
France	1.7	0.5
Greece	1.2	2.1
Ireland	3.3	1.2
Italy	1.7	−0.6
Luxembourg	4.2	2.0
The Netherlands	1.2	0.4

is repeated for each of these countries with the single exception of Greece.

- Unsurprisingly given our aggregate findings, the TFP growth rates for Germany, France and Italy (which comprise most of Euro-area GDP) are particularly poor over the most recent period, with TFP growth in Italy even declining since 2000.
- There are significant variations across countries in average TFP growth rates. It is tempting to link these cross-sectional variations with different approches to deregulation, and indeed research such as Nicoletti and Scarpetta (2003) has linked variations in productivity growth across countries with quantitative measures of policy regulation. That said, we think the evidence presented here that TFP growth has slowed across a range of countries despite intensified efforts at deregulation raises some interesting questions.

3.3 Measurement issues

As is the case with any growth accounting decomposition, these calculations must come with some important caveats. Both left- and right-hand sides of the growth accounting equation are subject to significant measurement error, and our measures of real GDP, labour input and capital input could potentially be considered imperfect. This is because our approach has been to compare US and Euro area economic performances over a long period using comparable statistical measures, and this necessitates using measures that may be slightly less sophisticated than those available for one of the regions or over shorter time periods. Overall, however, we do not think that measurement problems can "explain away" our finding of a steady deceleration in Euro area TFP growth and the emergence of a widening gap relative to US TFP growth since 2000.

Perhaps the most commonly raised measurement issue is that the output of high-tech sectors in the US are measured using quality-adjusted 'hedonic' indices, while there is limited application of such methods in Europe. This difference could potentially overstate US productivity growth relative to the Euro area. Studies based on re-calculating European GDP growth using US hedonic indices for high-tech sectors, however, have not confirmed this common conjecture. Because the relevant high-tech industries account for a relatively small fraction of European value added, the application of the hedonic index method makes very little difference to estimated European output growth.[8] Of course, the US hedonic index methodology also boosts estimates of the growth rate of real capital input, but Sakellaris and Vijselaar (2005) show that the relative patterns of TFP growth in the US and Euro areas are relatively unaffected by the application of such methods to both output and input growth.

A final measurement issue is changes in the composition of labour and capital. For instance, perhaps Europe's poor TFP growth performance could be due to the fact that it has been adding lower quality workers over time? A study by Schwerdt and Turunen (2006) suggests, however, that the pattern of labour quality growth in the Euro area over the period 1983–2004 was relatively steady, implying this explanation does not seem to work in practice. Similarly, our calculations do not adjust for capital quality, for instance in the sense that shorter lived capital should be more productive than longer lived capital. However, the calculations reported in Sakellaris and Vijselaar (2005) suggest that capital composition effect have contributed little to the decleration in European productivity relative to the US.

[8] See Lawless (2006) for a study of this issue.

3.4 Investment shares

One route through which the Euro area could, at least temporarily, offset the effects on productivity growth of weakening TFP growth is through raising the fraction of GDP devoted to capital investment. However, in this aspect also, the Euro area performance has been fairly weak. Figure 5, charts the ratio of real investment to real GDP for the US and Euro area, using 1995 as a base year. One needs to be extremely careful in interpreting ratios of real series of this type because they can be very sensitive to the base year chosen when the relative prices of the two series are shifting over time, as is the case here.[9] However, the nominal investment share does provide a useful comparison point free from base-year issues, and the Figure 5B confirms that the Euro area has tended to invest a higher fraction of GDP than the US. However, the European nominal investment share has fallen over time, and is now just a touch above the US level.

The difference between these real and nominal series is explained in Figure 6, which reports the price deflator for investment relative to the GDP deflator. This chart shows that real investment growth in both areas has been boosted by a steady decline since about 1980 in the relative price of investment. The data show that this factor has played a stronger role in boosting real investment in the US than it has in Europe. One may suspect that this difference is due to the application in the US of hedonic methods to estimate price indices for high-tech capital goods. However, investment in such equipment has been less prevalent in the Euro area, and it has been shown that the relative price of European investment would have not have fallen as much as in the US even if high-tech prices were measured using hedonic methods.[10]

Measurement issues aside, Figures 5 and 6 make it clear that a decline in the relative price of investment has been a significant factor boosting growth in real capital investment, and thus growth in capital input, for most of the period since 1980. Figure 6 provides a potentially negative warning for the future: for both areas, the pattern of falling relative prices for investment appears to have stalled for the moment, with the relative price being approximately flat since 2000. The Euro area data do not provide a disaggregation to allow us to examine the factors behind this flat relative price. However, an examination of the US data show that it is due to both an acceleration of prices for structures (perhaps relative to strong construction spending) and a slowing of the pace of price declines

[9] See Whelan (2002) for a more extensive discussion of this issue.

[10] We are referring here to series that can be found in Groningen Growth and Development Centre's(GGDc) Industry Labour Productivity Database. See O'Mahony and van Ark, 2003 for a detailed discussion of this database.

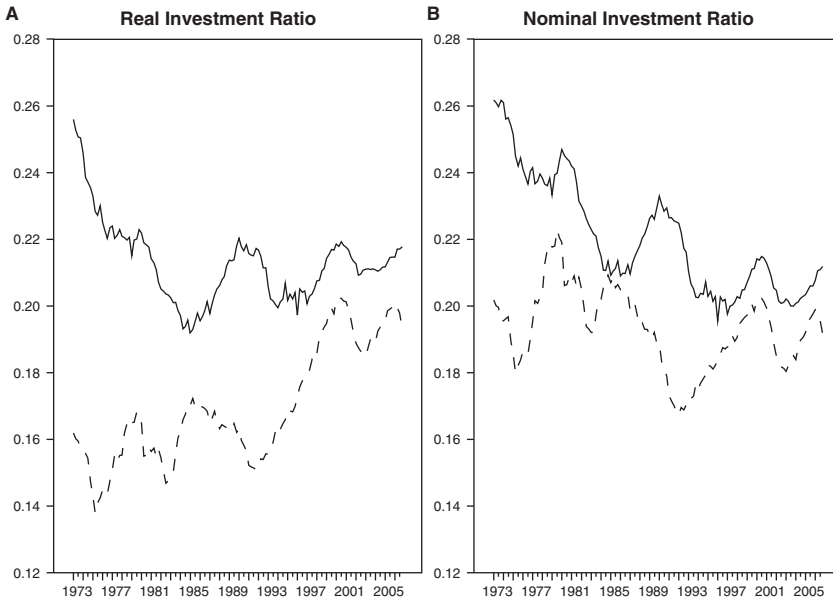

Figure 5 Comparing Euro and US investment shares (solid = Euro area).

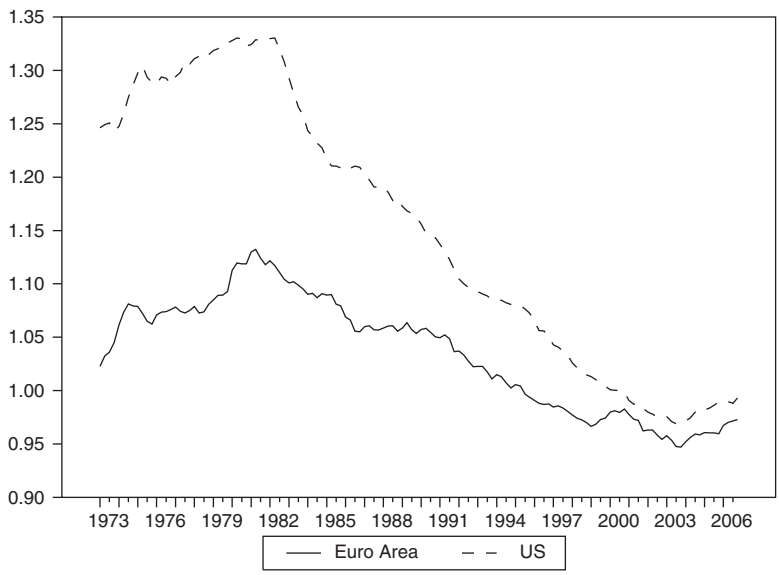

Figure 6 Price of investment relative to GDP deflator.

for high-tech goods. Assuming this latter pattern also accounts for the European pattern, it suggests that any further declines in the nominal investment share will result in real investment growing slower than in the past, and thus a further weakening of capital deepening.

4 Estimating potential output growth

Based on the analysis presented to date, what are the implications for future Euro area growth? In this section, we answer this question by focusing on two different horizons. The first provides an estimate of what we view as the current medium-run potential growth rate, which we view as the likely growth rate over the next couple of years if current trends in labour markets, capital investment and TFP continue. The second examines the implications over a longer run context using the Solow growth model as an analytical framework.

4.1 The medium-run outlook

In this section, we outline three different estimates of the potential growth rate of the Euro area economy (Cases 1, 2 and 3). These estimates are all based on the recent trends within the Euro area economy and can be regarded as relating to medium-term growth prospects. These results are summarized in Table 6.

In Cases 1 and 2, we extract trends from the basic data using the Hodrick–Prescott (HP) filter. The HP filter is commonly used to divide time series into its long-run components and those components linked to

Table 6 Alternative estimates of Euro area trend growth rates (%)

					Labour components			
Description	Δy	Δa	Δk	Δl	*Pop*	*P.Rate*	*Emp.Rate*	*Workweek*
Case 1								
HP-Filter	1.72	0.53	0.72	0.46	−0.42	0.09	0.10	−0.15
Case 2								
Filtered A								
Filtered K								
0 Δ% Hours P. C.	1.68	0.53	0.72	0.42	0.42	0.00	0.0	0.00
Case 3								
2000–2006 averages	1.79	0.57	0.76	0.46	0.37	0.26	0.09	−0.27

Note: *Pop*. refers to population, *P*. is participation, *Emp*. is employment and *Workweek* is average hours worked by employees. '0Δ% Hours P. C.' refers to the imposition of a 0 growth rate for the non-population components of the total labour figure.

the business cycle.[11] In Case 1, our estimate of the potential growth rate is based on filtering the log of real GDP y_t (we will use lower cases to denote logs). This reveals an average annual increase in output of just 1.72 percent. As a technical matter, we note that the HP filter is a linear operator, so the growth rate derived in this manner is identical to that obtained from separately filtering a, k and l. This allows us to decompose this 1.72 percent trend into separate components, with 0.53 percent due to increases in TFP, 0.72 percent due to capital growth and the remaining 0.46 percent due to the rate of increase in total labour hours. The actual and filtered series are plotted in Figure 7.

Similarly, we can decompose the 0.46 percent due to labour by filtering the individual components of l: population (*Pop*), labour force participation (*P.Rate*), the employment rate (*Emp.Rate*) and the average workweek (*Hours*). This decomposition shows that most of the increase is coming from the increase in population levels. This increase of about 0.6 percent per year contributes 0.4 percent per annum. However, the total labour contribution is reduced marginally by a decline trend in the average workweek (−0.15 percent), which is estimated to be a bit stronger than the contribution of positive trend increase in the participation rate (0.09 percent).

In Case 2, we switch-off the changes in participation and the workweek and assume that the only change emanating from the labour market is due to the growth in the population. Therefore, we are assuming that there is no net change in hours worked per capita (the sum of the non-population components of the total labour figure). This assumption is motivated by the patterns illustrated in Figure 8, which suggest that there is essentially no trend at present in participation, employment or the workweek. This produces an estimate of potential output growth of 1.68 percent.[12]

In Case 3, we present trend growth rates for each output component based on averages over the period 2000:Q1 to 2006:Q4. We choose this period because it represents something close to a full business cycle: qutput growth was strong during early 2000, the economy then went into recession, and has since subsequently recovered. For reference, the unemployment rate at the end of 2006 has been about 7.6 percent, which is close to the 8.3 percent value prevailing in mid-2000. As such, these results provide a type of common-sense alternative measure of the trend growth rate, providing a simple form of business-cycle adjustment. These results turn

[11] We use the standard value of $\lambda = 1600$ for the filtering parameter.

[12] Other changes that could be made, such as substituting actual recent population growth for its filtered growth rate, or substituting actual capital stock growth over the recent period for its filtered rate, do not make substantial differences and still produce a figure of about 1.7 percent.

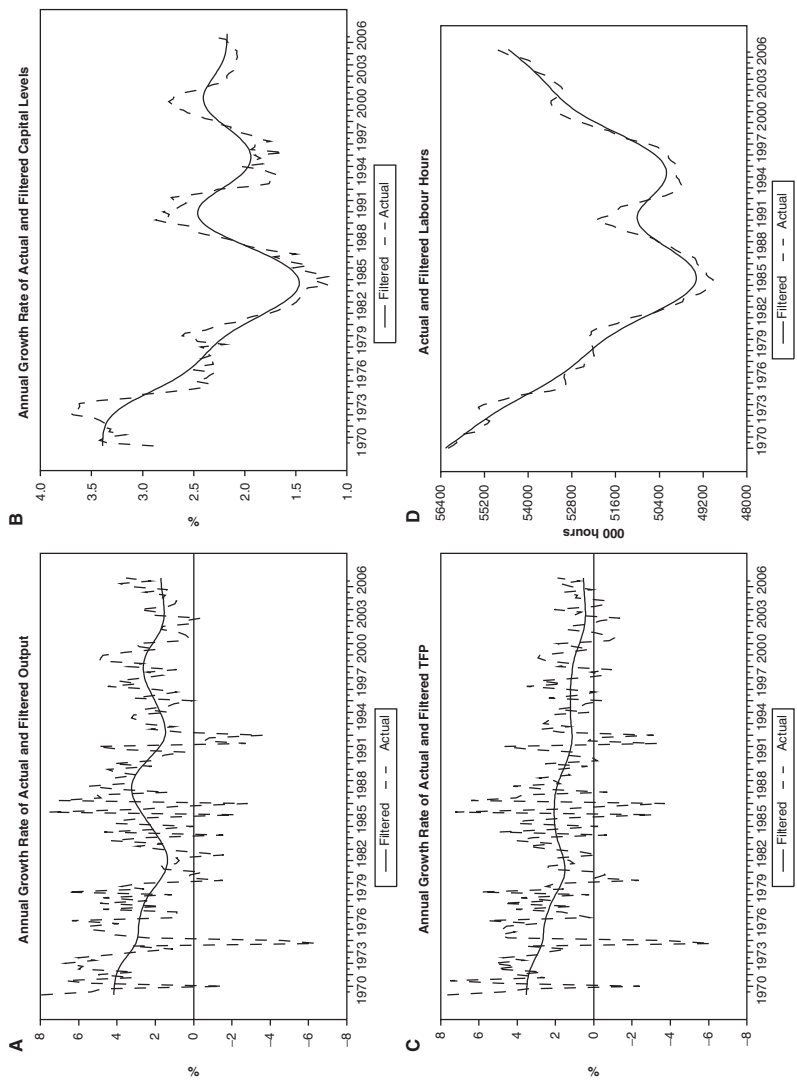

Figure 7 Euro area actual and filtered output components.

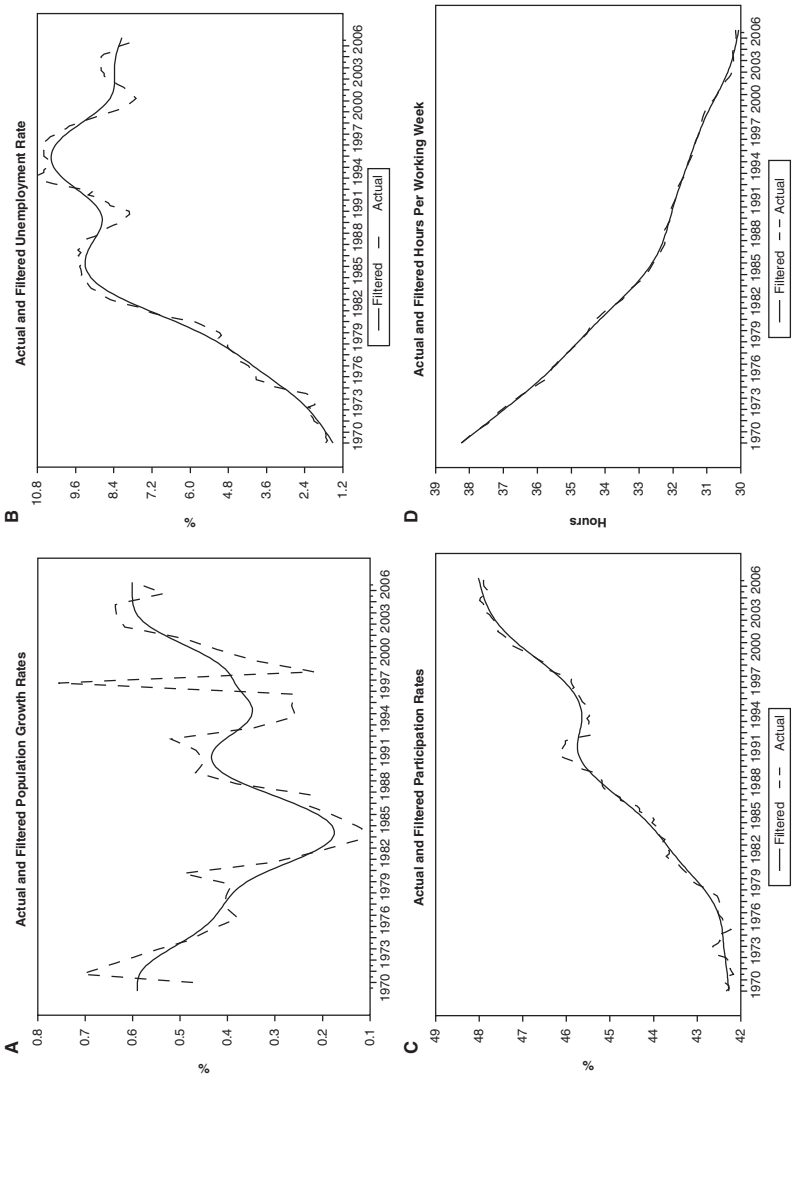

Figure 8 Euro area actual and filtered labour hours series.

out to be only slightly stronger than the other estimates, producing an average growth rate of 1.79 percent.

In general, all the results suggest that the medium-term outlook for potential Euro area GDP is a growth rate of ~1.7 percent. However, it should be noted that an important factor in this estimate is the relatively strong contribution from population growth. This pattern has been largely due to the inward migration from Eastern Europe associated with the enlargement process. As this process enters a more mature era, it seems likely that population growth and thus hours worked will slow down, implying a further decline in potential output growth.

Finally, it is worth noting that the application of similar methodologies to the US economy implies far higher estimates of potential output growth. Application of the HP-Filter, as in our Case 1, implies a figure of 3.03 percent. However, this incorporates an assumption of a declining trend in per capita hours worked, which Figure 3 suggests may not be warranted given that this series has been about flat on average over the past fifteen years. Assuming a flat trend for this series, one gets an estimate of potential output growth for the US of 3.04 percent. (See Table 7).

4.2 The longer-run outlook

In addition to assessing the medium-run outlook consistent with current trends, we are also interested in calculating the longer run implications of the continuation of these trends. One factor that needs to be taken into account is the fact that the growth rate of the capital stock depends on investment and thus on output. It is standard for estimates of potential output growth to follow the approach underlying Table 6 and use estimates based on actual or trend growth rates of capital input to assess the contribution of capital deepening to labour productivity. Indeed, such

Table 7 Alternative estimates of US trend growth rates (%)

					Labour components			
Description	Δy	Δa	Δk	Δl	*Pop*	*P.Rate*	*Emp.Rate*	*Workweek*
Case 1								
HP-Filter	3.03	1.44	0.76	0.83	−0.84	−0.08	0.15	−0.08
Case 2								
Filtered A								
Filtered K								
0 Δ% Hours P. C.	3.04	1.44	0.76	0.84	0.84	0.0	0.0	0.00
Case 3								
2000–06 averages	2.77	1.47	0.81	0.53	0.92	−0.15	−0.03	−0.21

procedures are used by the European Commission in its calculations of potential output used to cyclically adjust the budget deficits of EU member countries. However, in the longer run, capital growth cannot be considered a purely exogenous contributor to growth.

To address this issue, we have designed a simulation that describes how the Euro area economy would evolve over time if recent values for TFP growth and the investment share of GDP are maintained. Our simulation is based simulating the following model

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{4}$$

$$K_t = (1-\delta)K_{t-1} + It - 1 \tag{5}$$

$$I_t = s_t Y_t \tag{6}$$

$$\Delta \log A_t = g \tag{7}$$

$$\Delta \log L_t = n \tag{8}$$

using four baseline assumptions:

- TFP grows at our estimate of its current trend rate of 0.5 percent per year, so g=0.005/4.
- The ratio of real investment to real GDP is assumed to stay constant at its 2006:Q4 value of about s=0.217.
- Per capita hours are assumed to remain at their current levels, so n is determined by our assumption about population growth.
- Population growth is assumed to remain at its current high level of 0.6 percent per year for the duration of the forecast period.

Each of these assumptions could be questioned and in the next section we consider the effect of changing some of them. The assumption about TFP growth could be considered pessimistic given that it would likely entail the Euro area falling further behind the US level of TFP. However, one sense in which it is mildly optimistic is that it assumes an end to the long trend of declining TFP growth. Similarly, the assumed ratio of real investment to real GDP is relatively low by historical standards, and so could be considered pessimistic. On the other hand, given the patterns documented in Figure 5 and 6 (a declining nominal investment share and a flat current trend for the relative price of investment) this could also be an optimistic scenario.

The assumption concerning population growth may appear rather high, particularly when one considers the longer term demographic projections of Eurostat. These projections show population growth actually declining in the Euro area post 2020.[13] However, the primary consideration of the

[13] See Maddaloni et al. (2006) for an extensive discussion of Euro area demographic projections.

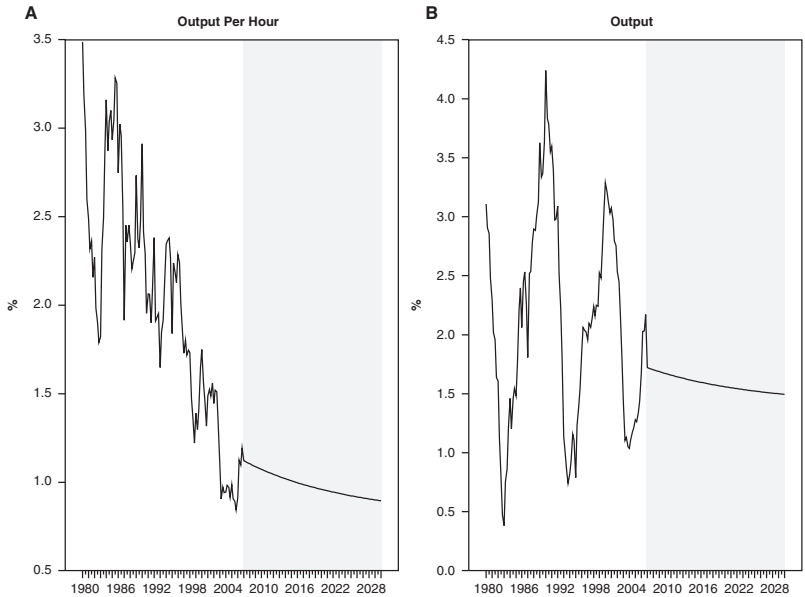

Figure 9 Output and output per worker growth rates: baseline forecasts.

present exercise is not to examine the implications of future demographic change on future Euro area growth, but to trace through the long-run implications of current trends in TFP and investment. Changing population projections at various stages in the forecast horizon would obscure these dynamics somewhat. For these reasons, we keep the assumed population growth constant at the present rate.

Figure 9 plots the values for the growth rate of output and output per hour generated by this simulation. (For comparison purposes, this and the following simulation charts will show historical values as 3-year moving averages.). Initially, in the medium term up to 2009, the growth rate of output per hour is equal to 1.1 percent as calculated in the previous section. Combined with our near-term assumption of 0.6 percent growth in hours, this produces the 1.7 percent growth in GDP calculated in the previous section.

An important aspect of the simulation is the decline in the growth of output throughout the forecast horizon. This moderation in output growth feeds through to a lower growth rate of investment and the rate of capital deepening is, accordingly, diminished. In the very long run (about 2050), the growth rate of output per hour falls to 0.8 per cent per annum. Thus, in the long run we have output growth of only 1.4 per cent per annum. To understand why this happens, it is useful to review the analytics of long-run growth as described by the famous model of Robert Solow (1956).

4.3 The solow model and long-run growth

Our simulation is essentially a practical application of the famous Solow model of economic growth, which is based on a standard production function, and a constant rate of TFP growth a constant share of real investment in GDP. This model provides a useful way of thinking about the linkages between medium- and long-run growth rates.

To describe this, we start by defining the capital–output ratio as

$$X_t = \frac{K_t}{Y_t} \tag{9}$$

Output per hour can now be expressed as

$$\frac{Y_t}{L_t} = A_t^{1/1-\alpha} X_t^{\alpha/1-\alpha} \tag{10}$$

This decomposition has been used in a number of previous studies, most notably by Hall and Jones (1997). Relative to the more familiar decomposition of output per hour into TFP and capital per-hour terms, this decomposition has an important advantage. The long-run capital output ratio can be shown to be independent of the level of A_t, something which is not true of capital-per-hour. Hence, this formulation completely captures the effects of A_t on long-run output, while the more traditional decomposition features a capital deepening term that depends indirectly on the level of technology.

DeLong (2003) shows that the capital-output ratio in this model follows a so-called ''error-correction'' equation of the form

$$\Delta X_t = \lambda(X^* - X_t) \tag{11}$$

such that it adjusts towards a long-run or ''steady-state'' level determined by

$$X^* = \frac{s}{\frac{g}{1-\alpha} + n + \delta}. \tag{12}$$

where the adjustment speed is

$$\lambda = (1-\alpha)\left(\frac{g}{1-\alpha} + n + \delta\right). \tag{13}$$

McQuinn and Whelan (2007) use data from the Penn World Tables on 96 countries to show that convergence speeds for the capital–output ratio tend to conform closely to the Solow model's predictions.

These calculations show that, over the long run with constant values for g and n, the capital–output ratio converges to its steady state. Thus, equation (10) tells us that all growth in output per hour ends up being due to the $A_t^{1/1-\alpha}$. This term grows at rate $g/1-\alpha$. Thus, in our example with TFP growth of $g = 0.005$ and a value of $\alpha = 1/3$, we end up with a long-run growth rate of $g/1-\alpha = 0.0052$ or 0.75 percent per year.

The analytics of our long-run scenario can thus be explained as follows. Our calculations show that the Euro area capital–output ratio is currently below the value consistent with the steady state implied by our parameters. For this reason, the economy undergoes a long period of transitional growth with labour productivity growth being slightly higher than its long run 0.75 percent value.[14] With a 0.6 percent trend for hours worked, this implies a steady-state growth rate of 1.35 percent per year. These calculations show that, over the long-run, the current trend growth rate of TFP would imply an even weaker growth rate of output than is implied by our medium-run estimate of 1.7 percent.

5 Scenarios for faster growth

In this section, we consider three experiments consistent with faster growth. The first experiment can be thought of as the outcome of programme of labour market deregulation, in that we consider increases in the labour force participation rate, reduction in the unemployment rate and an increase in the average workweek relative to their respective baseline levels. In the second experiment, we increase the rate of the Euro area investment again relative to its baseline level. Crucially, in both scenarios we maintain TFP growth at its present low rate. In a final scenario, we explicitly increase the rate of TFP growth.

For all experiments, the new growth rates of the variables of interest are evaluated with respect to their original baseline rate.

5.1 Labour market deregulation

Much of the discussion of Europe's relatively poor growth performance over the past few decades has focused on the fact that its labour market is more regulated than that of the US. Here, we consider the potential effects of a successful labour market reform program.

In Figure 10, we plot the assumptions underlying our scenario. We assume a set of gradual changes that occur over the period 2006–16. For example, in the case of the unemployment rate, we gradually lower the rate from 8 percent in 2006 to 6 percent in 2016. The average workweek is increased from 29 hours in 2006 to 32 hours in 2016. Participation rates gradually increase from 47 percent at present to 48.5 percent over the same period. After 2016, the levels no longer change.

[14] Note that the speed of adjustment is $(1-\alpha)((g/1-\alpha)+n+\delta)=2/3$ $(0.0075+0.003+0.06)=0.047$ so that the capital–output ratio closes about 4.7 percent of the gap to its steady-state value each period.

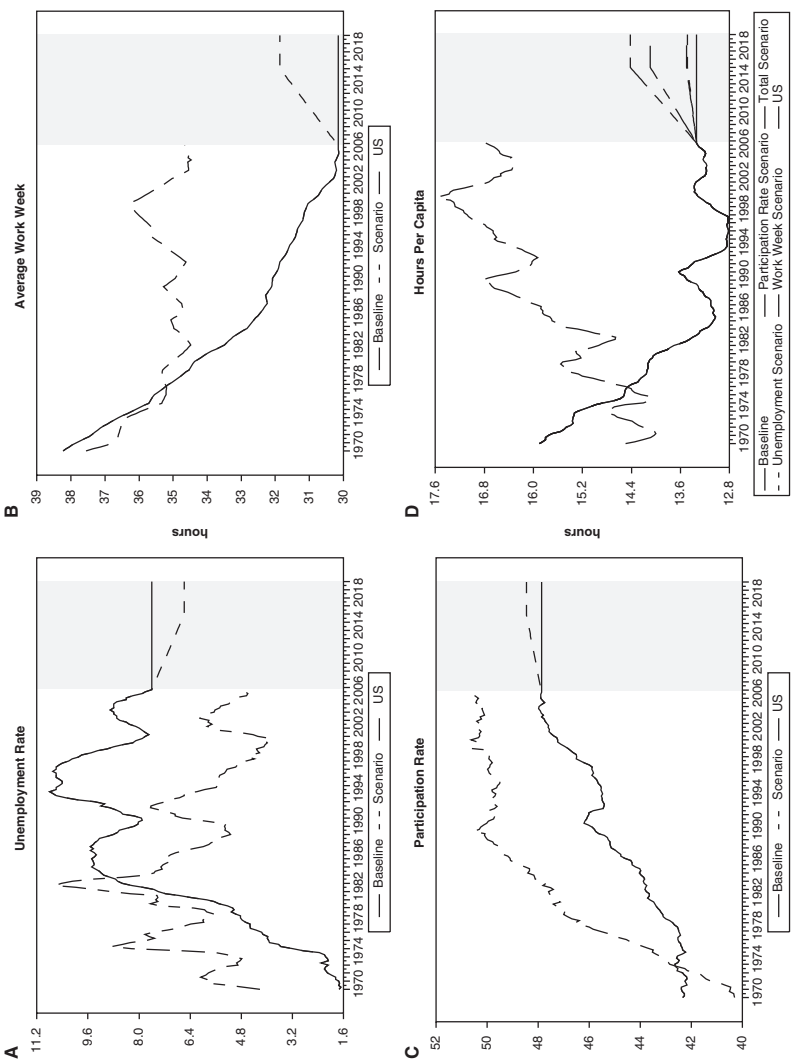

Figure 10 Labour scenario assumptions.

The exact changes hypothesized in this scenario result in per capita hours worked in the Euro area closing about half of the current gap relative to the US level. Thus, from each graph in Figure 10, one can observe that, the hypothesized scenario levels lie approximately half way between the 2006 Euro area level for that variable and the current US level. The bottom right chart shows that among the different labour components, the largest effect on hours worked is that of the increase in the average workweek. This is not surprising, as the increase in the workweek affects the entire labour stock, whereas increases/decreases in participation rates/unemployment rates only operate at the margin. Worth noting is that, when combined with Eurostat projections for working age population, this scenario sees the Euro area meeting the Lisbon target of a 70 percent ratio of employment to working age population by the end our adjustment period in 2016.

It is well beyond the scope of our analysis to outline exactly what type of policies can achieve the outcomes envisioned in the scenario. It seems likely, however, that achieving this would require a wide range of policy initiatives. For example, boosting participation rates may require separate policies targeting the over-50s with measures to postpone early retirement as well as tax and social policy measures aimed to further increase participation among women. Reductions in unemployment may require more effective training policies for the low skilled as well as further steps in the direction of more efficient and integrated tax and social welfare systems, thus reducing "replacement rates" and providing stronger incentives for work.[15] Finally, increases in hours per capita may require the easing of restrictive legislation such as the French 35-hour workweek law or provisions related to overtime payments.

It is true, of course, that a certain amount of labour market deregulation has already taken place. However, Figure 3 evidence on hours per capita in suggests that actions to date have had little effect in improving labour market performance. Against this background, we consider the outcome described in Figure 10 as representing a likely "best-case" scenario.

Figure 11 plots the outcome of the labour market deregulation scenario for output and output per worker relative to the baseline forecast. Figure 11B shows that the simulation produces a stronger growth rate for GDP, with growth generally above two percent during the initial years when the deregulation programme is being implemented.

[15] We acknowledge, of course, that there is little agreement on the importance of the role played by tax rates in determining cross-country differences in per capita hours worked. Prescott (2003) ascribes almost all of the differences between European and US hours worked to differences in tax rates. Blanchard (2004) and Alesina, Glaeser and Sacerdote (2005) argue that tax rates are much less important.

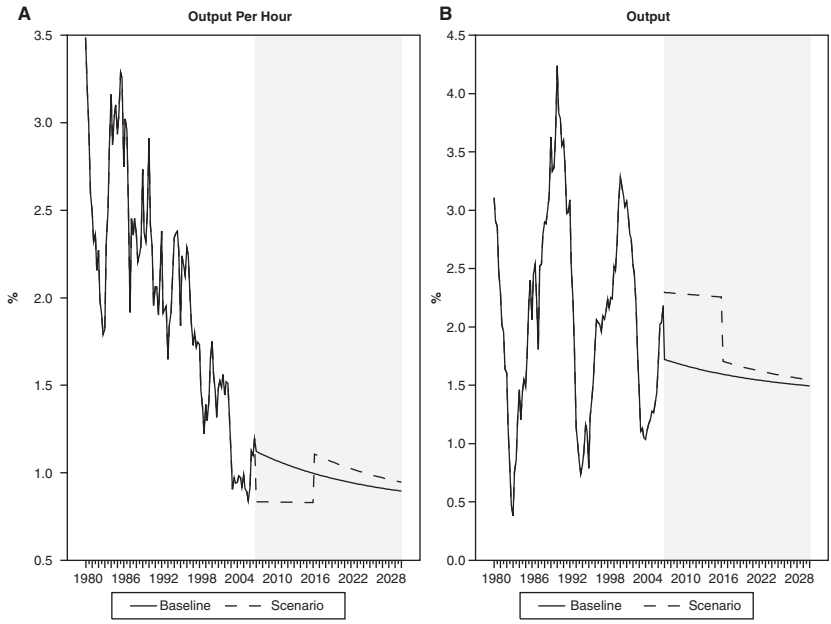

Figure 11 Simulating effects of improved labour market conditions.

However, for such major changes to the labour market, the outcome described here is fairly modest: over the 10-year period 2006–16, the growth rate in our deregulation scenario is only 0.6 percentage point per year higher than in the baseline case. And after 2016, when all of the changes have occurred, the growth rate in this scenario converges back to the original low baseline rate of growth.

Figure 11A shows the impact of the labour market deregulation on the growth rate of labour productivity. The scenario brings about a significant worsening of productivity growth relative to the baseline. One possible explanation for such an effect is that the deregulation brings lower productivity workers into employment: this mechanism has been stressed by Dew-Becker and Gordon (2006). However, this is not what is driving our results. Instead, our results are due to the underlying assumption of diminishing marginal returns to labour implicit in the Solow model. While each of the units of labour are assumed to be identical, as more and more labour is added, diminishing marginal productivity implies that the resulting impact on output growth becomes less effective.

Overall, we conclude from these results that the implication of a relatively comprehensive set of labour market reforms is more pronounced in the short term but, over the longer term horizon, the overall impact on growth is quite small.

5.2 Higher investment share

In the case of the investment ratio, we hypothesize a scenario in which the ratio of real investment to real GDP will increase from its present rate of almost 21.7 percent to 23 percent in 2016. This new rate along with the historical rates for both the Euro area and the US are plotted in Figure 12. After 2016, the rate is assumed to be constant at the new higher figure.

Again, we would note that it is beyond the scope of our analysis to outline exactly what type of policies can achieve this improved investment outcome. However, it seems likely that this would involve a package of ''business-friendly'' measures such as lower corporation tax rates, strengthened tax incentives such as depreciation allowances, as well as further moves towards product market deregulation such as the strengthening of the single market and the reduction of bureaucratic red tape.

The results of the scenario are presented in Figure 13. In this case, owing to the effect of the higher investment rate on the capital stock, we include baseline and scenario graphs for the growth rates of the capital–output and capital–labour ratios. As with the labour deregulation scenario, even though the investment rate has been increased quite significantly relative to its historical level, the implications for longer term output growth are rather limited. One can see that by the end of the forecast horizon, output

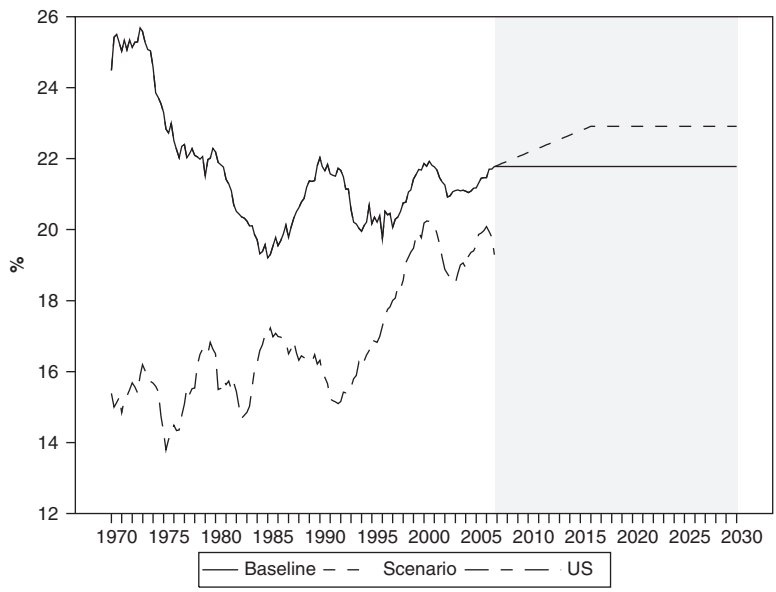

Figure 12 Investment rate scenario assumption.

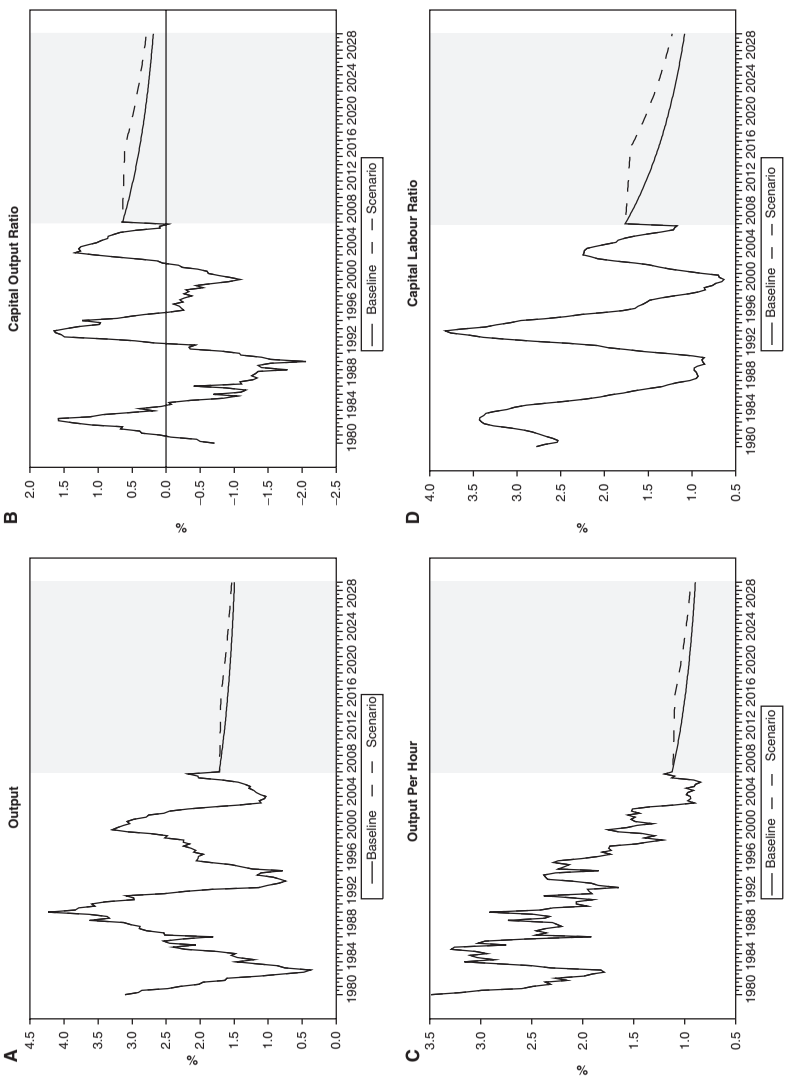

Figure 13 Simulating effects of an increased investment rate.

growth is still approaching 1.4 percent per year. Clearly, under this scenario labour productivity along with both the capital–output and capital–labour ratio are improved somewhat relative to their baseline level. However, again, this effect dissipates as one moves towards the long run horizon.

5.3 Faster TFP growth

In Section 4.3, we highlighted the crucial linkage between TFP improvements to long-run output growth. In this scenario, we highlight this by increasing quite substantially the level of TFP growth in the Euro area relative to its present, relatively, poor rate. We assume that by 2016, Euro area TFP growth is increasing at a rate of 1.5 percent per annum. Relative to the recent Euro area performance, this may appear quite high. However, as Figure 14 shows, such growth rates were achieved in the Euro area up to the late 1980s.

What do we have in mind for this scenario? Figure 4 has already shown that Euro area TFP growth consistently exceeded US rates from 1970 to 1990. As a relatively large gap has started to open again between US and Euro area levels of TFP, one might expect that the ''catch-up'' mechanism will play an important role in boosting European TFP. However, this mechanism appears to have done little to help Euro area productivity performance in recent years, and it may be that achieving this improvement could require various policy initiatives on the part of national governments. For instance, policy changes relating to promotion of R&D, completion of the single market and reductions in bureaucratic red tape may be required to properly faciliate the potential for efficiency gains posed by the gap relative to the US. Promotion of efficient usage of IT adoption may also play a role given the evidence that much of the gap in productivity growth between the US and Europe has been concentrated in sectors that are IT-intensive.[16]

Figure 15 illustrates the results from this scenario. Both output and output per worker enjoy sustained increases in their growth rates over both the medium and longer term, with output per worker growing at about 2.14 percent per annum. Capital deepening also improves significantly. The sustained dynamic response of output in this scenario contrasts with the relatively meagre response in the previous two scenarios. Evidently, as is consistent with the central message of Solow (1956), the most effective route to sustained increases in output is through

[16] See Daveri (2004) and Van Ark, Inklaar and McGuckin (2003).

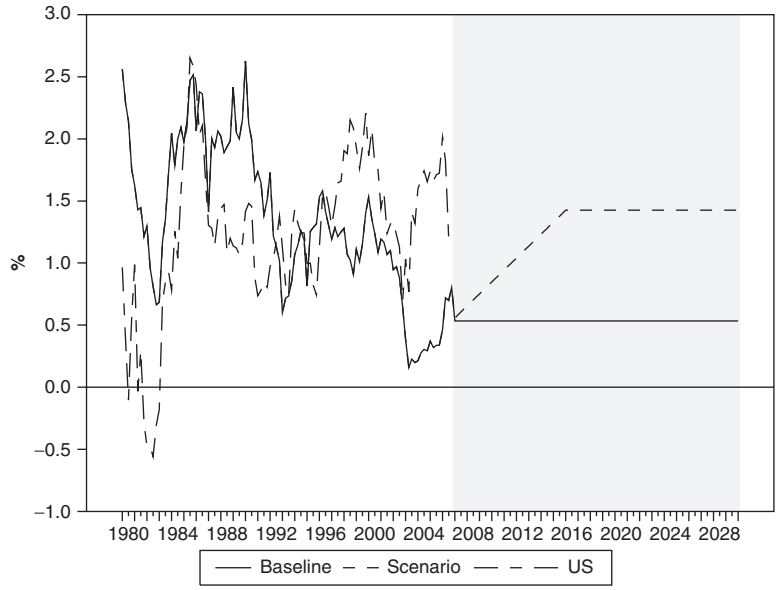

Figure 14 TFP growth rate scenario assumptions.

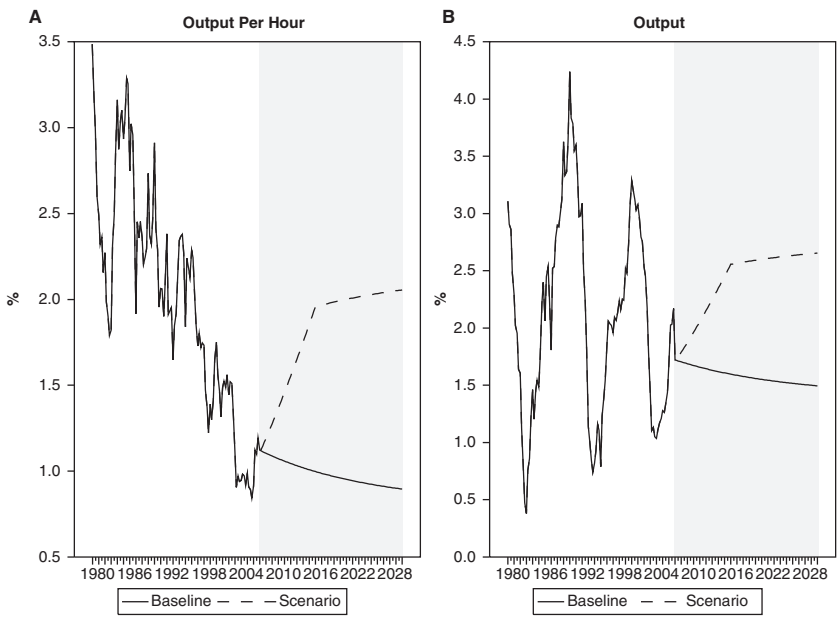

Figure 15 Simulating effects of an increasesd TFP rate.

improvements in the efficiency with which economies utilize their capital and labour inputs.

6 Conclusions

We take a number of messages from our results. The first is that the recent productivity performance of the Euro area has been very poor. The gap between US and European productivity performances in the 1990s was a key inspiration for the Lisbon Agenda policy process that began in 2000. However, despite this official diagnosis of a productivity problem, the period since 2000 has seen a further worsening of the productivity growth rate of the Euro area.

The second message is that the composition of recent growth suggests the potential for a further worsening of the Euro area's productivity performance. Recent growth has relied heavily on increases in capital and labour inputs, with very little improvement in TFP, which measures the efficiency with which inputs are used. We have used the Solow growth model to illustrate how the continuation of recent rates of TFP growth will lead to a further decline in productivity growth. Specifically, we calculate that a continuation of the recent trend of 0.5 percent per year growth in TFP will eventually lead to a fall in the growth rate of output per worker to only 0.8 percent per year.

The third message is that policies aimed at labour market deregulation or increased rates of capital investment, while beneficial, will only have a limited impact on the medium- or long-run growth rates of the Euro area economy. For instance, our simulation of a highly successful set of labour market policies shows a temporary increase of 0.6 percent in output growth, fading away to zero after the deregulation program is finished.

Together, these results suggest that Euro area policy-makers need to focus their energies on policies likely to improve overall economic efficiency and so boost TFP growth. The Lisbon agenda process has suggested many such policies but there has been limited progress as of yet. It may be that significant progress has to be made on the implementation of this agenda before a positive outcome, such as described in our final scenario, can come to pass.

An important caveat to our analysis, and indeed to any forward-looking analysis, is that the future for the Euro area economy may look more positive than its recent past even in the absence of new policy initiatives. Indeed, the latter half of 2006 has produced the strongest productivity performance seen over the past few years, and it is possible that we are on the cusp of a new era of faster productivity growth driven by a catch-up process relative to the US. However, the catch-up process has not helped

the Euro area to grow faster during the period since 2000, and recent performance provides little room for complacency. The implementation of a policy agenda aimed at facilitating greater economic efficiency seems likely to be an important element in any European productivity recovery.

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A Data Appendix

A.1 Euro area data

The data for the Euro Area come from a number of sources. All series used in our analysis are quarterly and cover the period 1970:Q1–2006:Q4. The recent values for GDP, real and nominal investment, the unemployment rate, employment and population are mainly taken from NewCronos, which is the principal database of EuroStat, the Statistical Office of the European Communities. However, the availability of these series varies somewhat. For instance, GDP and investment are only available from 1995:Q1, while employment is available from 1991:Q1. Unemployment rates are available from NewCronos from 1993:Q1. To ''backcast'' these series to 1970:Q1, growth rates for the corresponding variables from the AWM database of the European Central Bank was used. This dataset

covers the period 1970:Q1–2003:Q4. Details of this model and the data set are available in Fagan, Henry and Mestre (2001).

Three points to note about both the AWM and the NewCronos data are:

- The data set includes Greece, hence, it can be considered an Euro 12 data set.
- For nearly all countries ESA95 data is used (where available).
- The data are seasonally adjusted and also adjusted by working days.

Population data for the 12 countries were also taken from the NewCronos database. In particular, the annual series from the Population and Social Module was used. This annual series gives the Euro area population at the first of January each year. We set this value as the fourth quarter observation from the previous year and then linearly interpolated the series for the quarterly observations. For 2006, we assumed that population has continued to grow at the same rate as in 2005, which is 0.6 percent for the year as a whole. Labour force participation rates were calculated such that they equal (Employment)/(Population $\times$ (1 – Unemployment Rate)).

There are no official capital stock data for the Euro area. Following most other studies, we adopt the perpetual inventory method to "roll out" the capital stock as per Equation (5) in the text. We do this using a depreciation rate of six percent per year. However, the issue of a starting value for the stock still arises. We assume that the capital stock level in 1970:Q1 was such that the corresponding capital–output ratio [Equation (9) in the text] was equal to its steady-state level in that quarter. Consequently, the capital stock in 1970:Q1 was determined as

$$K_{1970:1} = X^{*}_{1970:1} \times Y_{1970:1}$$

or

$$K_{1970:1} = \frac{s^F}{\frac{g^F}{(1-\alpha)} + n^F + \delta} \times Y_{1970:1}$$

where s^F, g^F and n^F are the HP-filtered levels of s, g and n, respectively. To capture the idea that the steady-state capital-output ratios correspond to the very long run, we used a filter parameter of $\lambda = 16000$ rather than the usual value of $\lambda = 1600$, which corresponds to a business cycle frequency. However, our growth accounting calculations were not much affected by the choice of starting value for the capital stock series or the choice of depreciation rates.

The data on the average Euro area workweek were constructed from figures taken from the GGDC, available online at www.ggdc.net. is that

the series would most equate to the preferred concept of ''actual hours worked per person employed''. In some cases (e.g. the Netherlands, US and Taiwan), national sources were used. For the United States a combination of unpublished total working hours from the BLS Productivity Database divided by smoothed employment series from the Current Population Survey were used. In other cases, estimates from the OECD Growth Project were used, which are updated in Table A.13 of Scarpetta et al. (2000). For the European countries the latter data set makes use of the number from the Eurostat Labour Force Survey, but with downward adjustment to account for overstating of hours actually worked. For later years, the trend of the OECD Employment Outlook has been used. For the pre-1980 period, the trend in working hours per person employed was derived from the OECD Employment Outlook and subsequent studies by Angus Maddison (1995). Our series for the Euro Area workweek was calculated by adding the total hours worked for the 12 Euro area countries and then dividing this figure by the summation of the total civilian employment series. This annual series was then interpolated and scaled by 1/52 to arrive at the average weekly amount of hours worked in the Euro area.

Finally, while all calculations of productivity growth rates in this article use our series for real GDP divided by our series for total hours worked, the relative *levels* comparison charted in Figure 1 comes from using GGDC Purchasing Power Parity adjusted figures for 2000 as a reference point, and the growing these series forwards and backwards using our estimates of productivity growth.

A.2 US data

All US data come from either the Department of Commerce's Bureau of Economic Analysis website (www.bea.gov) or from the Department of Labor's Bureau of Labor Statistics website (www.bls.gov).

Data on GDP and investment come from the detailed National Income and Product Accounts (NIPA) tables on the BEA website. The figures for GDP come from Tables 1.1.3 and 1.1.5. The series on real investment was obtained by applying Fisher chain aggregation to the series on real private investment and real government investment. To do this calculation, we used data on nominal private investment from Table 5.1 and nominal government investment from Table 3.9.5. Data on price deflators for these series were obtained from Tables 5.3.4 and 3.9.4.

Our series on the US capital stock is based on the official series published by BEA. Specifically, we used the annual series for fixed assets, constructed from the quantity index and nominal values on Fixed Asset Tables 1.1 and 1.2. The quarterly series were than equated with the annual series for the fourth quarter of each year, and the data for the rest of the

year were linearly interpolated. These data go through 2005, so the 2006:Q1 through 2006:Q4 values were obtained by assuming that the aggregate depreciation rate (obtained by inverting a perpetual inventory formula) has remained at its 2005 value.

Data on population come from the BLS. Data on employment, unemployment, and labour force participation came from the BLS website based on the monthly household survey (Current Population Survey). For the workweek, our growth accounting calculations are based on an index for weekly hours worked per employee in the business sector, taken from the part of the BLS website relating to the Productivity and Costs release. This index is based largely on the monthly establishment survey. The levels shown in Figures 2 and 3 were obtained by using data from the GGDC to provide a level for this index comparable to the levels used to construct workweek series for the Euro area.

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What Explains Germany's Rebounding Export Market Share?

Stephan Danninger* and Fred Joutz†

Abstract

Germany's export market share increased since 2000, while most industrial countries experienced declines. This study explores four explanations and evaluates their empirical contributions: (i) improved cost competitiveness, (ii) ties to fast growing trading partners, (iii) increased demand for capital goods and (iv) regionalized production of goods (e.g. offshoring). An export model is estimated covering the period 1993–2005. The dominant factors explaining the increase in market share are trade relationships with fast growing countries and regionalized production in the export sector. Improved cost competitiveness had a comparatively smaller impact. There is no conclusive evidence supporting the increased demand for capital goods hypothesis. (JEL codes: C22, F41).

Keywords: International trade, export, cointegration, bazaar economy.

1 Introduction

Germany's export sector has become its main source of economic growth. Since 1999 about 80 percent of real GDP growth was generated from net exports. Real exports have grown by more than 7 percent per annum since 2000 on the back of growing trade volumes with both traditional European partners and emerging economies (Table 1).[1] Since 2000 Germany also began to regain export market share, especially among industrial countries and the euro area (Figure 1).[2]

Empirical studies of German export behavior have detected changes in the determinants of German exports. Since unification the impact of relative prices on exports has become smaller, possibly related to a shift in pricing behavior or product mix (Stahn 2006). There is also evidence that structural factors related to European integration boosted export growth (Stephan 2002).

The duration of Germany's high export growth rates has generated much speculation about its sources (German Economic Council 2004). This article discusses four hypotheses and attempts to quantify their relative importance. The four hypotheses are: (i) improved cost competitiveness through

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1 Import growth has been strong despite weak domestic demand.

2 By 2005, Germany became the official world goods export champion if measured in nominal $US values (German Statistical Office 2006).

Table 1 Germany: selected export growth rates and shares

	Annual growth rate			Share of exports 2005 (in percent)
	1995–2000	2000–2005	1995–2005	
Total exports of which[a]	9.3	5.6	7.4	100
EU	–	–	7.4	63.3
Euro area	–	–	6.9	43.3
EU (new)	–	–	12.5	8.6
Asia	6.2	5.9	6.3	11.0
China	11.4	17.6	14.5	2.7
India	−2.3	15.1	6.0	0.5
Oil exporters				
Saudi Arabia	7.8	8.9	8.3	0.5
Arab Emirates	12.8	14.9	13.8	0.5
Iran	5.4	23.1	13.9	0.5

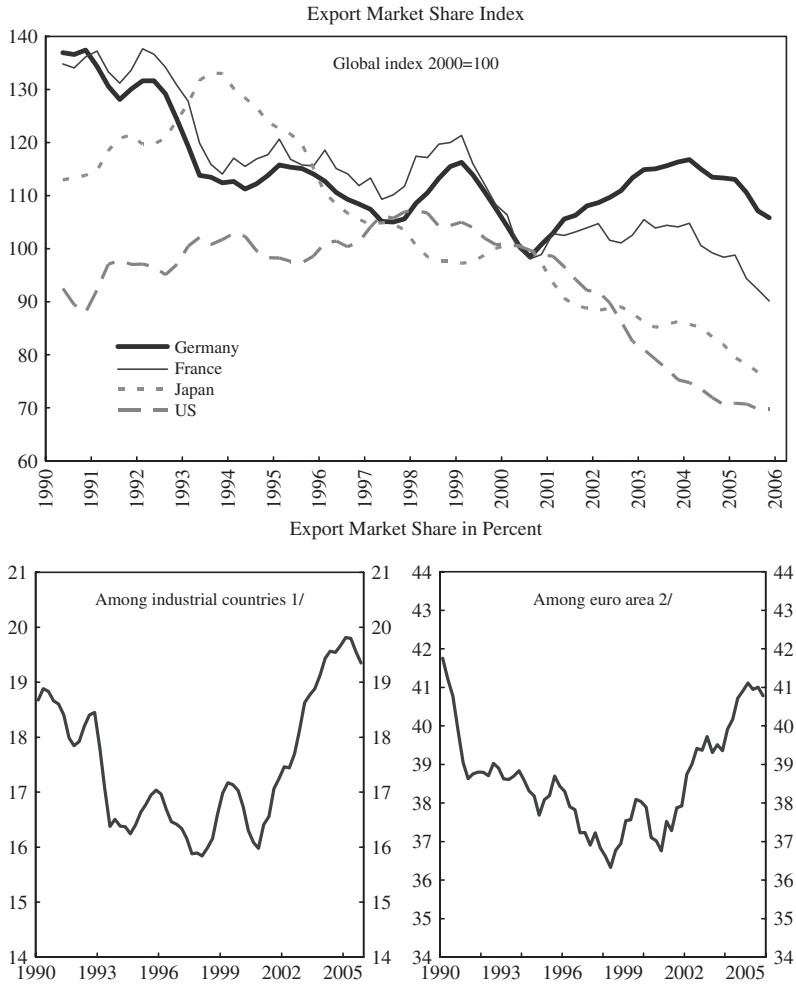
Source: German Statistical Office.

[a]Of which does not add up to total.

moderate collective wage agreements since the mid-1990s; (ii) ties to fast growing trading partners as a result of a desirable product mix or long-standing trade-relationships; (iii) increased export demand for capital goods as a response to a global rise in investment activity; and (iv) regionalized production patterns through off-shoring of production to lower cost countries, partly a result of European economic integration (Sinn 2006).

The proposed explanations encompass traditional determinants of German exports, namely relative prices and export demand of trading partners. The analysis goes beyond this standard approach and also tests the relevance of other explanatory variables, in particular whether exports were affected by the global investment cycle or by off-shoring of production processes to other countries. The article also quantifies the relative contribution of the relevant empirical determinants since 2000.

The empirical literature on German export growth has mainly been focused on assessing the relative roles of price competitiveness and economic activity in partner countries. Stahn (2006) offers a detailed summary of past empirical studies on this subject. Some of these studies also explore structural changes in export performance, but they do so indirectly by comparing the export performance across different time periods, regions, or industries (e.g. Kappler and Radowski 2003; Milton 1999). The contribution of the current study—and along the lines suggested by Strauß (2004)—is to directly test for additional factors that can explain the improvement in Germany's export performance (e.g. globalization



Source: ITS.
1/ Share of German imports in total imports of industrial countries from other industrial countries.
2/ Share of German imports in total imports of euro area from other euro area countries.

Figure 1 Germany: export market shares in the world and among industrial countries and the Euro area 1990–2005

of production), while at the same time exploring the possibility of structural breaks in the standard determinants.

By directly assessing the relative importance of the four approaches, prospects for continued export growth and economic activity can be gauged. A large impact of regained cost competitiveness would signal a structural improvement and a continuation of export growth. In contrast, if the

recent export surge is driven primarily by cyclical factors, such as a global investment boom, the benefits may prove temporary.

The analysis is based on the estimation of a multivariate system, which reduces to a stable, conditional single equation error-correction model for export demand. The study uses quarterly data for Germany's post-unification period. Although this restriction limits the sample size and the ability to draw statistical inferences, key data items were either missing (e.g. value added in industry at a quarterly frequency, trade partner country weights) or not comparable due to unification related fluctuations and measurement issues. Estimates of the long-term export elasticities for relative prices and activity in partner countries are consistent with other studies (e.g. Stahn 2006).

The findings show that recent export growth can be traced back to the ability of German exporters to meet global demand and to exploit new production and cost cutting opportunities from offshoring activities. The estimated baseline export model shows a unitary export elasticity with respect to overall import demand of trading partners. In other words, Germany has been able to take advantage of the rapid growth of global markets (Everaert et al. 2005).

The analysis presents also a final and preferred model, which provides empirical support for the claim that German exports increased as a result of a regional division of labor in the production of goods (Sinn 2006; Hummels et al. 2001). Global demand and the re-organization of industrial production explain about 60 percent of the relative increase of German exports since 2000 *vis-a-vis* other advanced countries. Changes in relative prices, measured by the real effective exchange rate, on the other hand contributed comparatively little despite prolonged wage moderation. This is not surprising given the strong nominal effective appreciation of the euro since 2000. These two effects would have offset each other to some degree. There is no conclusive evidence of faster export growth due to higher investment expenditures of trading partners and the demand for capital goods.

The article comprises three sections. Section 2 discusses the empirical literature and presents the four hypotheses for export growth together with some stylized facts. In Section 3, a time-series model of German goods exports is developed using quarterly data since 1993. Long-term determinants of export growth are identified and their relative contribution to the growth in export market share is computed. The final section concludes.

2 Empirical literature and potential explanations

Since the early 1990s the German economy has been exposed to several domestic, regional and international economic shocks, which all have

likely affected its export performance. These shocks were: *German unification* and an associated increase of labor costs and economic restructuring; *a global labor supply shock* through the market entry of emerging countries with low labor costs (e.g. India, China), *EMU creation*, and *European economic integration*, which opened new export markets and allowed new production processes to emerge (e.g. through offshoring; Marin 2006).

2.1 Empirical literature

There is ample empirical literature on Germany's export performance. Although the focus of the studies differs (aggregate exports, sectoral exports, regional or bilateral trade), the vast majority relies on two main explanatory variables: economic activity in partner countries and a measure of relative price competitiveness. All studies use standard time-series analysis and rely mainly on error correction models to assess the relative effects of price competition and market growth. Stahn (2006) provides a comprehensive overview of the main findings.

A common feature of earlier studies is that they explore a longer time span—covering data back to the 1970s—to identify lasting determinants of export growth. For instance, Hooper et al. (1999) covers the years 1970–96/97, Meurers (2004) the period 1975–99 and Deutsche Bundesbank (1998) the period 1975–98. Estimates of the export elasticity for export market growth and price competitiveness are derived from simple export demand models and are in the range of 0.8–1.[3] Most models implicitly assume parameter constancy over time, which led to some criticism of ignoring important structural breaks. Stahn (2006) shows that while indeed the elasticity of price competitiveness has been large in the past (close to 1), it was substantially smaller after unification (0–0.4). This finding is also confirmed in this article. The export elasticity with respect to partner country activity has, on the other hand, remained stable over time at close to 1.0.

In an effort to go beyond standard single-equation export demand models, Strauß (2004) estimates a vector error correction model, which includes additional demand and supply factors. He covers the period 1975–2000 and finds a similarly small price elasticity of exports 0.3 (real effective exchange rate). An important innovation of this study is

[3] Most authors use single-equation models, which capture both long and short-run influences. Definitions of export market growth usually involve some trade-weighted measure of economic activity in partner countries. Indicators used to capture price competitiveness rely on a variety of different variables: terms of trade changes, real effective exchange rate based on consumer prices or unit labor costs or measures linked to producer prices and or differences between export prices and domestic prices (see Stahn 2006).

the inclusion of a globalization variable, which measures the ratio of real global exports to real global output. This variable is added to disentangle the effects of cyclical demand changes and world trade volume growth due to globalization. He finds that in Germany, globalization enhanced export growth through the entry of new supply chains and additional demand. The current article takes this latter finding as a point of departure and explores other factors that may have given rise to the improved export performance. A particular effort is made to distinguish between different possible explanations, which are presented in more detail subsequently.

2.2 Alternative hypotheses

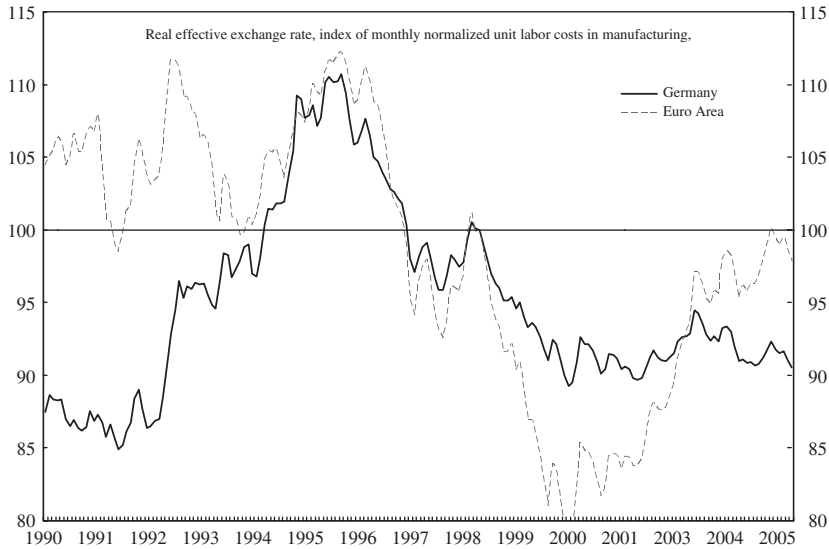
Most explanations for Germany's rapidly rising exports are in one way or another representing adjustment processes triggered by changes in the external environment. The two most commonly referred to examples are 'wage moderation' and the 'Bazaar' effect (Sinn 2005). Wage moderation refers to efforts to regain cost competitiveness by reducing comparative labor costs through low wage growth. The 'Bazaar' effect describes the response of enterprises to new international production opportunities and the relocation of production processes, which may have turned Germany into a trading hub, hence the reference to a Bazaar. Other explanations are linked to the entrance of new players in global trade and their high demand for capital goods, or a more pronounced cyclical upswing in Germany's trading partners.

This article focuses on four hypotheses, which are discussed below together with stylized facts heuristically underpinning the arguments.[4] Empirical support for the proposed explanations are explored in section 3.

2.2.1 Cost competitiveness through wage moderation

German unification resulted in a steep increase in wage costs mainly from pressures to close the wage gap between new and old Länder and from tax increases to cover the cost of extending the welfare state. The resulting loss of cost competitiveness and economic restructuring led to high unemployment. By the mid-1990s, a period of restrained wage setting followed, referred to as wage moderation, to reverse these developments (Blanchard and Phillipon 2004). During this period, wages and salary growth lagged behind productivity—the cost-neutral margin—in almost every year (Ulman, Gerlach and Giuliano 2005).

[4] Although the offered explanations appear quite plausible, alternative explanations for the rapid export growth are conceivable, but were not pursued (e.g. trade activities within the euro area could have also been spurred by tax evasion strategies).



Source: IMF.

Figure 2 Real effective exchange rate at unit labor costs Germany and Euro area

From an international perspective, the relevant measure capturing cost competitiveness is the real effective exchange rate at unit labor costs (*REER_u*) in industry.[5,6] Wage costs per unit of output began to decrease sharply in 1995 and remained at a low level since 2000 despite a significant nominal effective appreciation of the euro (Figure 2). The main factor responsible for this adjustment was muted wage growth in industry (Carlin, Glyn and Van Reenan 2001; ECB 2005). Average hourly nominal wage growth declined continuously and hovers since 2003 around 1–2 percent. Labor productivity growth in manufacturing was positive but lagged behind the OECD average. Hence many observers concluded that cost competitiveness has been a main source for export growth and even argued that a return to more normal wage growth was possible and would help strengthen domestic demand.

[5] Improved price competitiveness could have also been helped by cuts in profit margins. However, this is unlikely given the large increase in profit shares in the corporate sector since the early 2000s.

[6] Other non-wage cost measures (energy, material, services inputs and capital costs) also influence cost competitiveness. Schnatz (2007) shows however that the explanatory performance of different measures of competitiveness does not differ much. For a related discussion see also: http://www.bundesbank.de/statistik/statistik_zeitreihen.php?lang=de&open=&func=row&tr=JAA019

2.2.2 Ties to booming trading partner(s)

A second hypothesis relies on Germany's ability to penetrate growing export markets. German exporters have well established trade links to emerging market countries. Prior to 2000 Germany's share of exports to Asian countries was larger than that of France and Italy.

Table 1 shows that in 2005 exports to Asia reached 11 percent of total exports on the back of a strong acceleration of exports to China and India. Similarly, traditional ties to oil exporting countries may have allowed Germany to benefit more than its competitors from a recycling of Petro dollars. As Table 1 shows, exports to oil exporters have grown rapidly, although their share in total exports is still small.

A more comprehensive view of export demand by German partner countries can be obtained from an index of trade share weighted import volumes of German partner countries (*Gdem*).[7] Figure 3 compares *Gdem* with global trade growth (i.e. growth of global real imports) and the trade-share weighted import growth of all industrial countries. This comparison suggests that after 2000 Germany experienced relatively higher export demand than industrial countries in aggregate. Global export demand expanded even faster, reflecting the rapid increase of trade with emerging market countries, especially China. It is therefore plausible that part of the increase of Germany's export market share among industrial countries could have been due to its ties to fast growing economies.

2.2.3 Meeting global investment demand

Another potential explanation for Germany's rapid export growth is a structural shift in goods demanded. The global upturn since 2000 was characterized by increasing investment activity. Germany traditionally exports capital goods and could therefore have benefited more than other countries from an increase in the demand for these export goods.[8]

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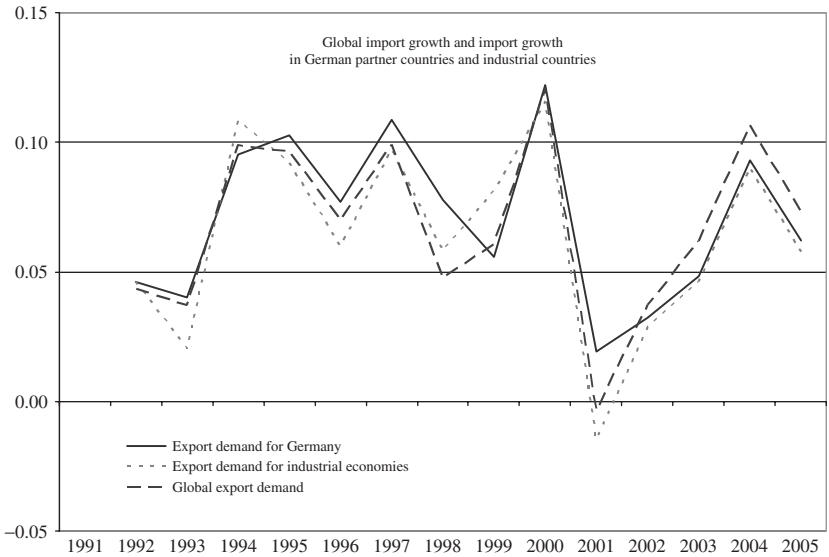
[7] This variable was computed using data of the IMF's World Economic Outlook database.

[8] Another reason why exports of investment goods may have accelerated are incentives to further specialize in capital intensive activities. This argument has been put forward by Sinn (2006) and is based on a standard trade model with labor market rigidities (Davies 1998). In this model, the existence of a binding wage floor (e.g. through high welfare benefits) can drive a wedge between domestic and international relative factor prices. As a result, the economy adjusts through further specialization in the capital intensive sector which creates unemployment in equilibrium. This process leads to more international trade, but also an inefficient allocation of factors. Sinn argues that this development could have taken place in Germany. European economic integration and a global labor supply shock have both decreased the price for unskilled labor and driven a wedge between German relative factor prices and international prices. Germany's increased exports of capital intensive goods could therefore be interpreted as a response to a global labor supply shock. Thus, a slowdown in global trade could have a relatively strong negative growth impact on the German economy.



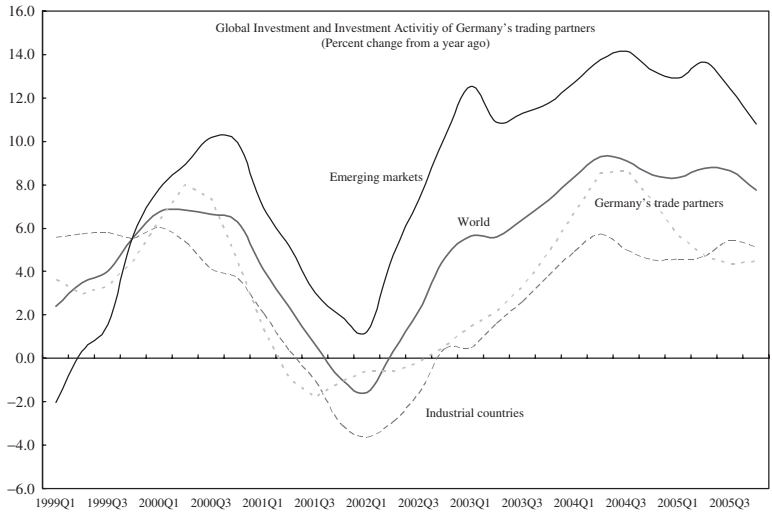
Source: IMF World Economic Outlook database.

Figure 3 World volume growth and Germany's demand growth

A cursory look at the data suggests that exports in particular of capital goods may have increased. Global growth in traded goods since 2000 was associated by a strong rebound in investment activity especially in emerging markets (Figure 4). This global trend can be compared to investment growth in Germany's trading partners, assuming that growth of investment activity is linked to a rise of capital goods imports. Investment growth of Germany's trading partners weighted by export trade shares (*Ginv*) has been slightly higher than in industrial countries as a whole. A more disaggregated view of German exports by types of export goods offers however no clear evidence: the share of capital goods among overall exports in Germany appears to have been stagnant thus suggesting that there was no faster acceleration in the exports of capital goods compared to other goods (Figure 5).

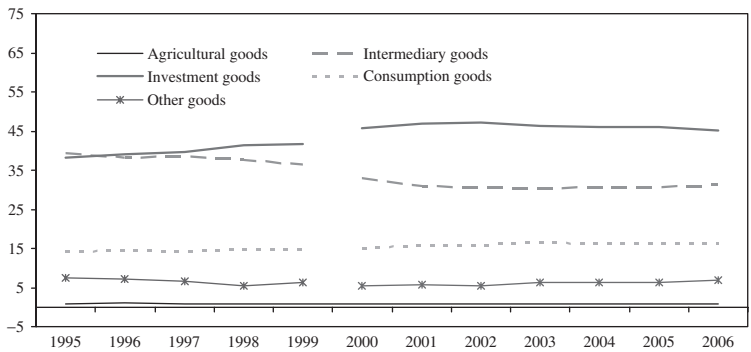
2.2.4 Regionalization of production processes

A final explanation is based on increasing the cross-border division of labor to take advantage of lower production costs of labor intensive processes outside Germany. For Germany, this process has been documented by Sinn (2005) and the German Economic Council (2004). Since the mid 1990s, the share of imported inputs in the export sector increased from 28 percent to over 42 percent in 2005 while at the same time domestic value added



Source: IMF World Economic Outlook database.

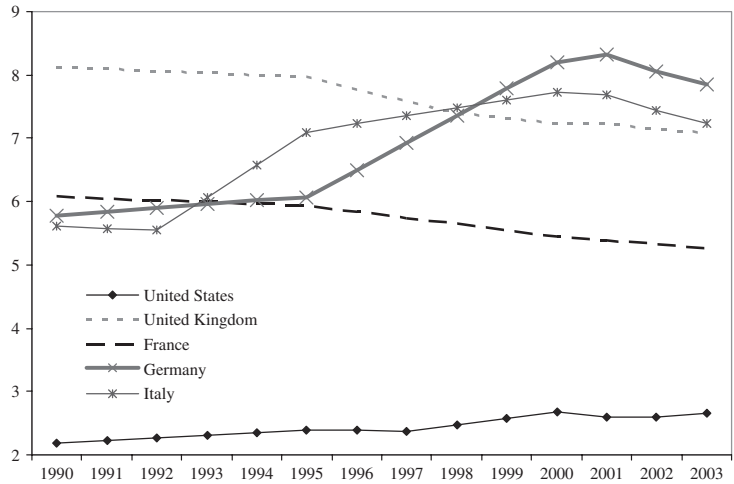
Figure 4 Global investment demand



Source: Bundesbank. [1] Break in series in 1999/2000 due to change of goods classification to EU harmonized standard.

Figure 5 German exports by types of export goods: 1995–2006[1]

in the export sector (*Ind_VA*) decreased from 65 percent to 56 percent. As an increasing share of industrial production began to be placed abroad, trade volumes increased between German exporters and its subsidiaries or suppliers abroad. To the extent that Germany has taken advantage of this opportunity at a faster pace than other industrial countries, it could have improved productivity and increased its export market share.



Source: IMF World Economic Outlook, April 2007, Chapter 5.
[1] Offshoring measured as share of imported manufacturing inputs in gross manufacturing output.

Figure 6 Trends in offshoring in G7 countries (in percent)[1]

Several studies have documented the incentives for outsourcing and offshoring and their effect on trade (Figure 6) Estimates by Marin (2006) on relative unit labor costs in countries outside of Germany indicate large cost savings from relocating production steps. An empirical link between the geographic relocation of production and the trade of goods was also established by a recent Deutsche Bundesbank (2006) study. The empirical evidence supports that increased outbound FDI to new EU member countries from Germany appears complementary to increases in both imports from and exports to these countries.

To conclude, the four presented hypotheses are not necessarily competing explanations. Most likely, all of them have contributed to some degree to Germany's surge in exports. It is therefore an empirical question to identify their relative contributions. It is also important to note that they have different implications for a continuation of export growth and longer-term economic outlook. Greater cost competitiveness, either through wage moderation or through regionalization of production processes, should have a longer lasting positive effect on export prospects. Also, increasing preferences for German products (*Gdem*) could signal strength in penetrating growth markets for instance through a desirable product mix. In contrast, if exports were growing primarily because of a first mover advantage or global investment activity, then these developments may come sooner or later to an end, as either the global cycle matures or competitors enter growth markets.

3 Disentangling export demand

We develop a time series econometric model of German goods exports utilizing information on relative cost competitiveness, export demand and the structure of production in the export sector. The analysis makes use of integration, cointegration and error correction in their reduction to the local data generating process and its interpretation.

Using quarterly national accounts data beginning in 1993, a baseline and a preferred econometric model are identified using standard inference and estimation methods. We then interpret the parameter estimates and assess whether they are consistent with theory. Robustness tests are carried out to determine the stability of the empirical models. In a final step, we compute the economic impact of the various variables in explaining growth of Germany's export market share compared to industrial countries from 2000 to 2005.

The next part contains a discussion of the data followed by an outline of the empirical modeling strategy. Subsequently we discuss the main findings.[9] While all hypotheses were explored, the discussion focuses on the results from analyzing the regionalization hypothesis, which fit the data the best. The results from the preferred model are used in the final subsection to quantify the contribution of the determinants of export demand.

3.1 Data

The empirical analysis explores the possible cointegrating relationships between five of the variables discussed earlier: volume of goods export (*xgr*), the real effective exchange rate based on unit labor costs (*REER_u*), and global import demand (*Gdem*), and the share of domestic value added in industry (*Ind_VA*). The sample period for the analysis is 1993Q1 through 2005Q4. Details on the variables used in the study are presented in Appendix A.

The bulk of Germany's exports are from the manufacturing sector. The relevant measure for cost competitiveness is hence the real effective exchange rate based on unit labor costs in industry rather than unit labor costs economy wide. The comparison of unit labor costs is quite common and has been applied in a number of recent studies (Deutsche Bundesbank 1998; Hooper et al. 1999).

An increase in *REER_u* denotes a real appreciation and means a loss of competitiveness. Between 1993 and 1996 cost competitiveness decreased by roughly 30 percent followed by a 25 percent real depreciation thereafter.

[9] Readers interested in a more technical discussion of the model results can examine Appendix B in the IMF Working Paper version available online at http://www.imf.org/external/pubind.htm.

The real effective exchange rate stabilized in 2001 despite a significant appreciation of the Euro *vis-à-vis* the US dollar indicating further decreases in relative unit labor costs.

To measure global demand, we use a trade weighted index of import volumes by Germany's trading partners (*Gdem*) as opposed to sales or manufacturing output. The advantage of this variable is that the estimated elasticity allows inferences about developments of Germany's market share. A value of 1 indicates a constant market share or that German exports to its trading partners increase proportionately with world trade volume. If the value is less than unity, this indicates a loss in global export market share. Also the results can be more readily compared with other studies.

The global investment activity variable *Ginv* proxies for the demand for capital goods. The index measures the trade-share weighted investment activity of trading partners and hence, indirectly measures import demand for investment goods. A possible drawback is that this measure overlaps with the import demand measure *Gdem*.

The share of domestic value added in industry, *Ind_VA*, attempts to capture the globalization process, in particular the off shoring of production processes. The observed decline in value added in the export sector has been interpreted as a reflection of an increase in the share of imported intermediate goods (Sinn 2006). In the empirical analysis we use value added in industry as a proxy for increased regionalization of production processes.

Data for unified Germany prior to 1993 were either missing or have been dropped due to unification related fluctuations and measurement issue concerns. Table 2 provides summary statistics. Figure 7 shows plots of all variables used in the analysis. Time-series plots of the series and their autocorrelation function (ACFs) suggested that the series were integrated of order one, which was confirmed through augmented Dickey Fuller (ADF) tests (Table 3).

Table 2 Summary statistics 1993Q1–2005Q4[a]

	n	Means	Standard deviation
Lxgr	52	4.8770	0.27603
LREER_u	52	4.6711	0.07372
LGdem	52	4.4651	0.25959
LGinv	52	4.5145	0.14991
Ind_VA	52	0.3603	0.02057

Source: German Statistical Office and IMF World Economic Outlook.

[a]Variables in log levels except for Ind_VA.

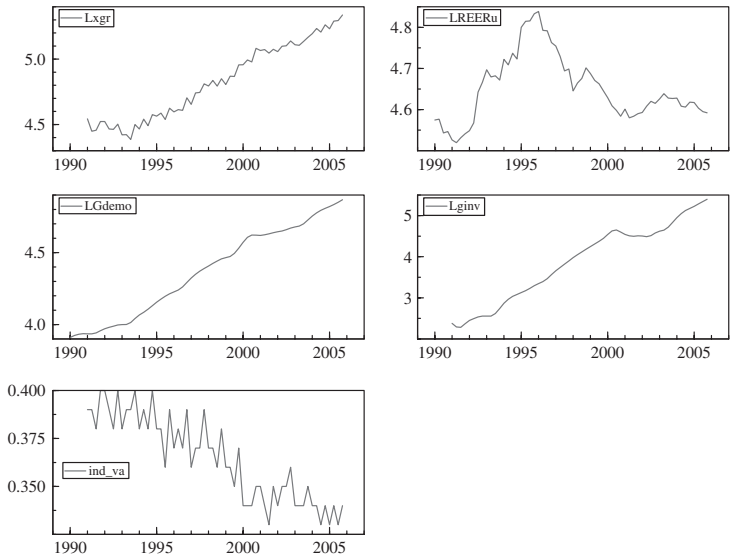


Figure 7 Time series plot of main variable (log levels except for Ind_VA) 1990–2005

Table 3 Augmented Dickey–Fuller tests for unit roots

Variable	t-adf	beta Y_lag	t-DY_lag	Maximum lags	AIC
Levels—sample 1993q1–2005q4[a]					
Lxgr	0.025	0.996	n.a.	0	−7.101
LREER_u	−2.164	0.878	2.603	2	−7.712
LGdem	−1.991	0.966	2.931	5	−11.230
LGinv	−2.507	0.944	3.118	3	−10.840
Ind_VA	−0.541	0.974	−1.994	3	−9.915
First differences—sample 1993q1–2005q4[b]					
DLxgr	−7.768**	−0.122	n.a.	0	−7.116
LREER_u	−4.029*	0.267	−2.595	1	−7.655
LGdem	−2.801	0.773	−3.669	2	−10.940
LGinv	−2.879	0.737	−2.514	2	−10.750
Ind_VA	−5.207**	−1.686	1.417	4	−9.962

[a]Constant, trend and seasonals included—critical values; 5% = −3.43, 1% = −4.01; constant and trend included—critical values; 5% = −3.50, 1% = −4.14.

[b]Constant and seasonals included—critical values; 5% = –2.88, 1% = –3.46; constant; critical values; 5% = −2.92% = −3.56; seasonal factors included for Lxgr and Ind_VA.

3.2 Empirical modeling strategy

3.2.1 Specification of the vector autoregression (VAR) model

A general to specific approach is employed in estimating the model. First, a simple unrestricted VAR is estimated and evaluated for statistical fit and stability. Second, the lag structure of the VAR is determined while the evaluation for statistical fit and stability is repeated. Next, we test for equilibrium or cointegrating relation(s) among the variables. Finally, based on the existence of cointegration, we test hypotheses on the relation(s) and interpret the models.

The test for a long run or equilibrium relationship for German exports demand starts with the estimation of the VAR, which was specified as:

$$\begin{bmatrix} xgr_t \\ REER\_u_t \\ Gdem_t \\ Z_t \end{bmatrix} = \Pi(L) \begin{bmatrix} xgr_{t-1} \\ REER\_u_{t-1} \\ Gdem_{t-1} \\ Z_{t-1} \end{bmatrix} + B \begin{bmatrix} \text{Constant} \\ C\text{seasonals}_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \end{bmatrix}$$

$$\text{where } \Pi(L) = \Pi_1 L + \Pi_2 L^2 + \Pi_3 L^3 + \cdots + \Pi_p L^p$$

$$\varepsilon_t \sim MWN(0, \Omega)$$

with L denoting the lag polynomial operator and the individual Π_i terms representing a 5×5 matrix of coefficients at the ith lag. The variable Z_t refers to alternative time-varying measures related to the four presented hypotheses.

Below we present the results for two models: a baseline model which includes only three variables xgr_t, $REER\_u_t$ and $Gdem_t$ and a final specification related to the fourth hypotheses, which uses Ind_VA as the variable Z_t. Alternative models using the variable $Ginv_t$ for Z_t were explored, but were not supported by the data and are discussed at the end of the results section.

3.2.2 Model selection and cointegration analysis

All variables were transformed into natural logarithms. Constant and centered seasonal terms are included in each equation, because we use seasonally unadjusted data for German exports. The error terms are assumed to be white noise and can be contemporaneously correlated.

Tables and 5 report measures of statistical fit for different lag lengths and Tables 6 and 7 contains the finite sample results for lag reduction tests. The test statistic is calculated for maintained models starting with the maximum number of lags, which is equal to five, and then for one fewer number of lags for each time. There are four columns in Table 6 and 7 with a heading for the maximum number of lags. Below each is the *F*-test with the *P*-value reported in brackets for reducing the number of lags to the number in the row. We find that the maximum number of lags is five

Table 4 Baseline export demand model: lag structure and reduction tests, sample 1993Q1–2005Q4

Model	*T*	*P*	Log-likelihood	SC	HQ	AIC
1	52	48	499.6372	−15.57	−16.68	−17.371
2	52	39	486.0981	−15.733	−16.635	−17.196
3	52	30	474.9738	−15.989	−16.683	−17.114
4	52	21	446.3374	−15.571	−16.057	−16.359
5	52	12	413.0468	−14.975	−15.252	−15.425

Comparisons of information criteria at different lag lengths: SC, Schwarz criterion; HQ, Hannan-Quinn; AIC, Akaike information criterion.

Table 5 Final export demand model driven by regionalization of production processes, model for lag structure and reduction

1	52	96	742.8686	−21.277	−23.499	−24.88
2	52	80	716.8998	−21.494	−23.345	−24.496
3	52	64	710.147	−22.45	−23.931	−24.852
4	52	48	670.0764	−22.125	−23.235	−23.926
5	52	32	642.1267	−22.266	−23.006	−23.466

Comparisons of information criteria at different lag lengths: SC, Schwarz criterion; HQ, Hannan-Quinn; AIC, Akaike information criterion.

Table 6 Baseline export demand model lag structure and reduction tests, sample 1993Q1–2005Q4

	Unrestricted models			
Restricted lags	5	4	3	2
4	2.1975 [0.0303]*			
3	2.1396 [0.0096]**	1.9263 [0.0580]		
2	3.7668 [0.0000]**	4.1889 [0.0000]**	6.2002 [0.0000]**	
1	5.8658 [0.0000]**	6.5102 [0.0000]**	8.3400 [0.0000]**	8.0619 [0.0000]**

for the baseline model (Table 6) and three lags is appropriate for the alternative model (Table 7). Further lags lead to a loss of explanatory power in the respective system.

Tables 8 and 9 report the results from residual diagnostic tests for the VAR by equation and the vector or system tests. The Portmanteau test and vector tests aimed at detecting autocorrelation, deviation from normality, and heteroskedasticity did not identify significant departures from white noise residuals.

Table 7 Final export demand model driven by regionalization of production processes, model reduction tests: lag length and specification of the VAR

	Unrestricted models			
Restricted lags	5	4	3	2
4	1.8614 [0.0376]*			
3	1.1921 [0.2549]	0.49487 [0.9437]		
2	2.1890 [0.0005]**	2.1356 [0.0020]**	4.1603 [0.0000]**	
1	2.6454 [0.0000]**	2.6299 [0.0000]**	3.9792 [0.0000]**	2.9962 [0.0004]**

Note: *F*-test of a lag exclusion test with *P*-values in parentheses.

Table 8 Baseline model: individual equation and vector misspecification tests for the standard export demand model

Lxgr	Portmanteau(6):		3.65372
LREER_u	Portmanteau(6):		1.20985
LGdem	Portmanteau(6):		8.20337
Lxgr	AR 1-4 test:	$F(4,32)$	1.7037 [0.1735]
LREER_u	AR 1-4 test:	$F(4,32)$	0.34946 [0.8424]
LGdem	AR 1-4 test:	$F(4,32)$	1.3315 [0.2796]
Lxgr	Normality test:	$\chi^2(2)$	0.83290 [0.6594]
LREER_u	Normality test:	$\chi^2(2)$	0.75053 [0.6871]
LGdem	Normality test:	$\chi^2(2)$	2.5739 [0.2761]
Lxgr	ARCH 1-4 test:	$F(4,28)$	0.41948 [0.7932]
LREER_u	ARCH 1-4 test:	$F(4,28)$	0.07348 [0.9896]
LGdem	ARCH 1-4 test:	$F(4,28)$	1.5709 [0.2095]
Lxgr	hetero test:	$F(30,5)$	0.23698 [0.9949]
LREER_u	hetero test:	$F(30,5)$	0.27972 [0.9882]
LGdem	hetero test:	$F(30,5)$	0.16732 [0.9994]
Vector Portmanteau(6):			33.4183
Vector AR 1-4 test:		$F(36,65)$	0.9493 [0.5586]
Vector Normality test:		$\chi^2(6)$	3.3193 [0.7678]
Vector hetero test:		$F(180,8)$	0.0618 [1.0000]

To assess robustness, tests for model constancy and structural breaks were conducted using recursive estimation techniques. Changes to the German domestic economy, labor and product market reforms and the effects of globalization and European integration could all have impacted the dynamic relationships among the variables and structure. We hence computed two types of recursive Chow tests while taking an agnostic view on the possibility and timing of structural breaks over the period 1993–2005. Results from one-step Chow and Break Point Chow tests did not reveal any systematic or significant breaks in the estimated VAR model. The test results are graphically presented in Figure 8A and B.

In a final step, the Johansen procedure is applied to test for the presence of cointegration. The VAR model in levels can be linearly transformed into one in first differences.

$$\begin{bmatrix} \Delta xgr_t \\ \Delta REER\_u_t \\ \Delta Gdem_t \\ \Delta Ind\_VA_t \end{bmatrix} = \Pi \begin{bmatrix} xgr_{t-1} \\ REER\_u_{t-1} \\ Gdem_{t-1} \\ Ind\_VA_{t-1} \end{bmatrix} + \Gamma(L) \begin{bmatrix} \Delta xgr_{t-1} \\ \Delta REER\_u_{t-1} \\ \Delta Gdem_{t-1} \\ \Delta Ind\_VA_{t-1} \end{bmatrix} + B \begin{bmatrix} \text{Constant} \\ C\text{seasonals}_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \end{bmatrix}$$

$$\text{where } \Gamma_i = -\left(\Pi_{i+1} + \Pi_{i+2} + \cdots + \Pi_{p-1} L^{p-1}\right),$$

$$\Pi = \Pi_1 + \Pi_2 + \Pi_3 + \cdots + \Pi_p - I.$$

Results from Johansen cointegration tests are presented in Tables 10 and 11; the tables are partitioned into five parts. The first provides the tests for cointegration. The reduced rank standardized coefficients are shown in the second panel. The next two parts show individual hypotheses tests on the β and α vectors, respectively, and the last line reports the joint hypotheses test for the two vectors. Fifth, the final reduced form rank relations are presented.

3.3 Results

There is evidence of a single cointegrating relation in the two models. Further testing of the β and α vectors in Π suggested that the identified relationship can be interpreted as one for export demand.

3.3.1 Baseline export demand

Results for our baseline model can be found in Table 10. The second panel shows parameter estimates for two vectors under the assumption of a single cointegrating relation. The first standardized eigenvector or β

Table 9 Final model: individual equation and vector misspecification tests for the export demand model driven by regionalization of production

Lxgr	Portmanteau(6):		2.82619
LREER_u	Portmanteau(6):		1.00148
LGdem	Portmanteau(6):		7.62194
Ind_VA	Portmanteau(6):		1.37764
Lxgr	AR 1-4 test:	$F(2,34)$	0.10128 [0.9812]
LREER_u	AR 1-4 test:	$F(2,34)$	0.25279 [0.9058]
LGdem	AR 1-4 test:	$F(2,34)$	4.5998 [0.0048]*
Ind_VA	AR 1-4 test:	$F(2,34)$	0.15007 [0.9616]
Lxgr	Normality test:	$\chi^2(2)$	0.49661 [0.7801]
LREER_u	Normality test:	$\chi^2(2)$	5.3022 [0.0706]
LGdem	Normality test:	$\chi^2(2)$	0.12052 [0.9415]
Ind_VA	Normality test:	$\chi^2(2)$	2.3650 [0.3065]
Lxgr	ARCH 1-4 test:	F(24,11)	0.9640 [0.4426]
LREER_u	ARCH 1-4 test:	F(24,11)	0.2631 [0.8991]
LGdem	ARCH 1-4 test:	F(24,11)	2.035 [0.1166]
Ind_VA	ARCH 1-4 test:	F(24,11)	0.3338 [0.8528]
Lxgr	Hetero test:	F(18,17)	0.26675 [0.9967]
LREER_u	Hetero test:	F(18,17)	0.64676 [0.8206]
LGdem	Hetero test:	F(18,17)	0.62324 [0.8393]
Ind_VA	Hetero test:	F(18,17)	0.50927 [0.9191]
Vector Portmanteau(6):			67.044
Vector AR 1-4 test:		$F(64,68)$	1.2482 [0.1842]
Vector Normality test:		$\chi^2(8)$	10.620 [0.2242]
Vector hetero test:		F(240,43)	0.24518 [1.0000]

vector is normalized on German exports implying that the 'long-run' or equilibrium relation explains export demand. We find:

$$\text{Exports}_t = \underset{(0.11)}{-0.17}\ \text{Real effective exchange rate}_t + \underset{(0.03)}{1.06}\ \text{Global export demand}_t$$

$$\text{Speed of adjustment} = \alpha = -0.52\ \ (0.18).$$

The β coefficients for the real effective exchange rate, *LREER_u*, foreign demand and *LGdem*, are 0.17 and −1.06, respectively.[10] The *P*-value for testing the real exchange rate elasticity is zero is marginal, and cannot be rejected individually.

[10] The signs are reported as if the sum of the entire vector equals zero, thus opposite to the presentation in a standard export model equation. Standard errors are reported in parentheses.

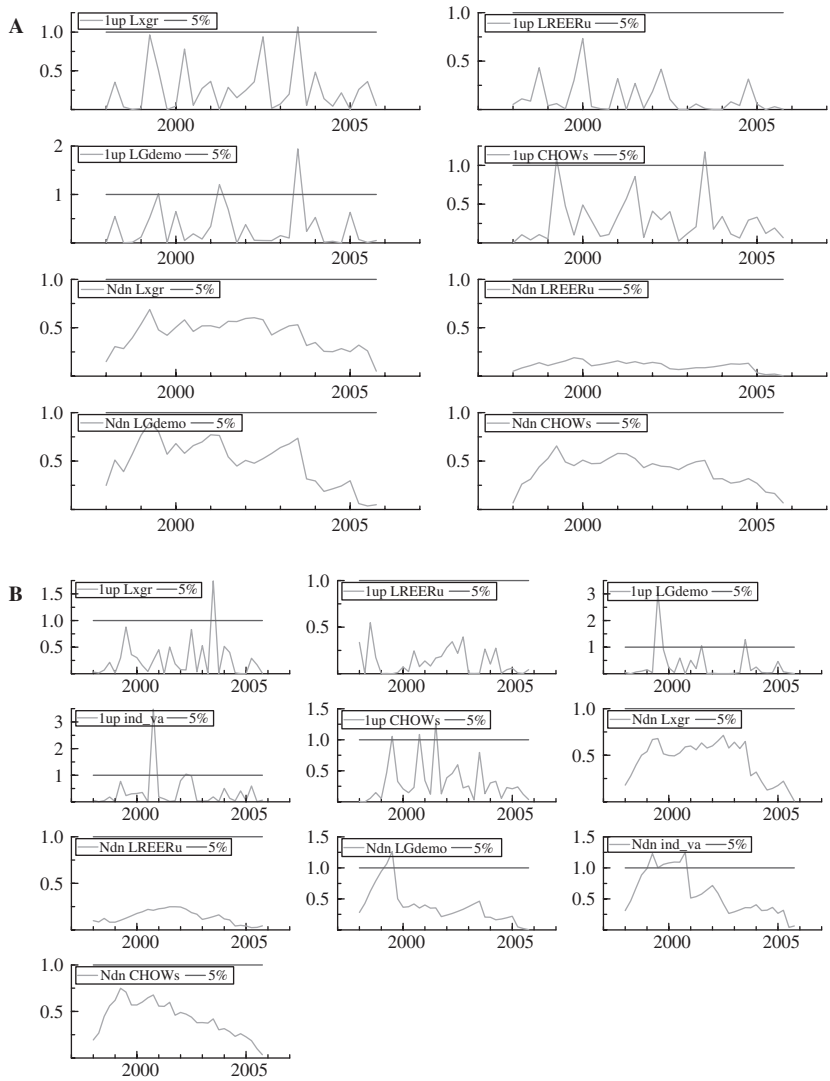


Figure 8 (**A**) Recursive stability analysis: standard export demand model. (**B**) Recursive stability analysis export demand model driven by regionalization of production processes

Next, we conduct hypothesis tests on the second α vector, which is reported in the third column and shows the speed of adjustment coefficients. If the cointegrating relation, we have specified is appropriate, then α must be negative for the relation to be consistent with a

Table 10 Baseline export demand model: cointegration analysis with Johansen test: sample 1993Q1–2005Q4

H0:rank	Eigen value	Log likelihood for	Trace test [Prob]	Max test [Prob]	Trace test (T-nm)	Max test (T-nm)
		484.3679				
0	0.26591	492.4053	30.54	16.07	21.73	11.44
			[0.041]*	[0.229]	[0.324]	[0.614]
1	0.21409	498.6689	14.46	12.53	10.29	8.91
			[0.070]	[0.092]	[0.264]	[0.300]
2	0.036556	499.6372	1.94	1.94	1.38	1.38
			[0.164]	[0.164]	[0.240]	[0.240]
Reduced rank standardized coefficients						
	Beta vector	SE	Alpha vector	SE		
Lxgr	1	0	−0.51799	0.18397		
LREER_u	0.16791	0.11838	0.28222	0.15061		
LGdem	−1.0584	0.030943	−0.01167	0.02797		
Hypotheses tests for the beta vector						
LREER_u		Zero	χ^2 (1)	0.4505		
				[0.5021]		
LGdem		Zero	χ^2 (1)	3.5376		
				[0.0600]		
LREER_u and LGdem		Zero	χ^2(2)	9.0188		
				[0.0110]*		
LGdem		Unit Elastic	χ^2(1)	2.7530		
				[0.0971]		
Hypotheses tests for the alpha vector: weak exogeneity						
Lxgr		Zero	χ^2(1)	3.2877		
				[0.0698]		
LREER_u		Zero	χ^2(1)	1.7550		
				[0.1852]		
LGdem		Zero	χ^2(1)	0.0757		
				[0.7832]		
LREER_u and LGdem		Zero	χ^2(1)	2.6166		
				[0.2703]		
Joint hypothesis test: weak exogeneity and unit elasticity						
			χ^2(3)	3.8190		
				[0.2817]		
Reduced rank cointegrating relation testing for a unit demand elasticity						
	Beta vector	SE	Alpha vector	SE		
Lxgr	1		−0.62753	0.19348		
LREER_u	0.41898	0.096262				
LGdem	−1					

P-values are given in brackets.

Table 11 Preferred export demand model driven by regionalization of production: cointegration analysis with Johansen test: sample 1993Q1–2005Q4

H0:rank	Eigen value	Log likelihood for	Trace test [Prob]	Max test [Prob]	Trace test (T-nm)	Max test (T-nm)
		681.061				
0	0.4398	696.125	58.17 [0.003]**	30.13 [0.020]*	44.75 [0.094]	23.18 [0.170]
1	0.2426	703.348	28.05 [0.080]	14.45 [0.343]	21.57 [0.333]	11.11 [0.645]
2	0.1950	708.988	13.60 [0.094]	11.28 [0.142]	10.46 [0.251]	8.68 [0.321]
3	0.0436	710.147	2.320 [0.128]	2.320 [0.128]	1.780 [0.182]	1.78 [0.182]
Reduced rank standardized coefficients						
	Beta vector	SE		Alpha vector	SE	
Lxgr	1	0		−0.3671	0.1199	
LREER_u	0.1926	0.1033		0.2050	0.1099	
LGdem	–0.7707	0.0785		0.0239	0.0239	
Ind_VA	4.0097	1.0937		−0.0686	0.0335	
Hypotheses tests for the beta vector						
LREER_u		Zero	χ^2 (1)	1.8956 [0.1686]		
LGdem		Zero	χ^2 (1)	6.0381 [0.0140]*		
Ind_VA		Zero	χ^2 (1)	9.0793 [0.0026]**		
All Three		Zero	χ^2 (3)	20.553 [0.0001]**		
LGdem		Unit elastic	χ^2 (1)	6.0593 [0.0138]*		
Ind_VA		Unit elastic	χ^2 (1)	5.2927 [0.0214]*		
LGdem and Ind_VA		Unit elastic	χ^2 (2)	6.0684 [0.0481]*		

Hypotheses tests for the alpha vector: weak exogeneity			
Lxgr	Zero	χ^2 (1)	8.8437 [0.0029]**
LREER_u	Zero	χ^2 (1)	3.2272 [0.0724]
LGdem	Zero	χ^2 (1)	0.8122 [0.3675]
Ind_VA	Zero	χ^2 (1)	3.7070 [0.0542]
All three	Zero	χ^2 (3)	11.999 [0.0074]**
Joint hypothesis test: weak exogeneity and unit elasticity for export demand and value added			
All three		χ^2 (5)	13.755 [0.0172]*
Lxgr		χ^2 (3)	12.854 [0.0050]**
LREER_u		χ^2 (3)	9.0895 [0.0281]*
LGdem		χ^2 (3)	6.4688 [0.0909]

Reduced rank cointegrating relation testing for a unit demand elasticity weak exogeneity of Gdem only

	Beta vector	SE	Alpha vector	SE
Lxgr	1		−0.4312	0.1119
LREER_u	0.1377	0.1001	0.2585	0.1095
LGdem	−0.7836	0.0761		
Ind_VA	3.8428	1.0604	−0.0777	0.0343

stationary process. The estimate is −0.52 and significant. We also confirm that the remaining α or speeds of adjustment coefficients are sensible.

A natural hypothesis at this point is to test whether Germany's global export market share is stable despite the entry of fast growing emerging markets (e.g. China and India). This hypothesis implies a unit demand elasticity. Imposing this restriction cannot be rejected together with imposing weak exogeneity for the exchange rate and foreign demand (*P*-value of 0.28). The results for the restricted baseline model are summarized at the bottom of the table where we also report the joint tests for the β and α coefficients:

$$\begin{aligned}\text{Exports}_t &= \underset{(0.10)}{-0.42}\ \text{Real effective exchange rate}_t \\ &+ 1\ \text{Global export demand}_t \\ \text{Speed of adjustment} &= \quad \alpha \quad = -0.63 \ \ (0.19).\end{aligned}$$

The empirical results confirm the basic expectations. Improved cost competitiveness and global growth have the correct signs and the model adjusts fairly rapidly to deviations from the 'export fundamentals'. The exchange rate elasticity is about 0.4 percent. Thus a 2.5 percent real appreciation in the Euro will reduce Germany's goods exports by 1 percent.

These results compare well to estimates by Stahn (2006), which cover a similar time period. However, the price and income measures may be masking the effect of additional information. In particular, there were structural changes in the German economy and export sector. Based on these concerns about omitted variables, we explored alternative models guided by the earlier discussed hypotheses to see whether they offer an improved fit to the data.

3.3.2 The preferred export model

The share of value added in industry (*Ind_VA*) improved the model's explanatory power and addresses these concerns. The preferred specification for the model is reported at the bottom of the Table 11, where we also report the joint tests for the β and α coefficients. The final cointegrating relationship with weak exogeneity for demand imposed is therefore:

$$\begin{aligned}\text{Exports}_t &= \underset{(0.10)}{-0.14}\ \text{Real effective exchange rate}_t \\ &+ \underset{(0.08)}{0.78}\ \text{Global export demand}_t - \underset{(1.06)}{3.84}\ \text{Value added}_t \\ \text{Speed of Adjustment}: &\ \alpha_{xgr} = \underset{(0.11)}{-0.43}\,,\ \alpha_{reer\_t} = \underset{(0.11)}{0.26} \\ &\text{and}\ \ \alpha_{ind\_va} = \underset{(0.03)}{-0.08}\,.\end{aligned}$$

where the standard errors are reported below the coefficients. The empirical results confirm the basic expectations. Improved cost competitiveness, global growth and value added have the correct signs and the model adjusts fairly rapidly to deviations from the 'export fundamentals'.

To arrive at this model, several diagnostic tests were applied and restrictions tested, the results of which are presented in the upper partitions of Table 11. The top panel reports the eigenvalues of the Π matrix sorted from largest to smallest. The test for no cointegration ($r = 0$) is rejected at 0.01 with the Trace test (58.17) and at 0.02 with the Max(eigenvalue) test (30.13). There was no evidence suggesting a second cointegrating relation among the variables.

The second panel of Table 11 reports the initial, unrestricted estimates for two vectors and their associated standard errors assuming a single cointegrating relation. The β-coefficients for the real effective exchange rate, *LREER_u*, global demand (*LGdem)* and the share of domestic value added in industry (*Ind_VA*) are 0.14, −0.78 and 3.8, respectively.

In the third panel we test for the significance of the β coefficients individually, jointly and for unit elasticities. All variables have the correct sign and are statistically significant except for *LREER_u*. A joint test that all three coefficients are zero is rejected with a chi-squared statistic of 20.55 and *P*-value less than 1 percent. The null hypotheses of unit eleasticities for *LGdem* and *Ind_VA* are rejected.

The fourth panel of Table 11 presents results for tests of the α, feedback, coefficients or weak exogeneity tests. The zero restriction for exports, *Lxgr*, is rejected at 1 percent consistent with the cointegration and error correction specification. The remaining tests for the individual coefficients are not rejected at five percent. But, the *LREER_u* and *Ind_VA* coefficients are rejected at 10 percent. However, the joint restriction that they are both zero is rejected at the 5 percent level (the chi-squared statistic is 6.44 and has a *P*-value of 0.04). The weak exogeneity tests suggested that there might be a richer and more complex relationship between the variables explaining export demand. In particular, rather than reducing to a conditional single vector error correction equation, there is evidence that two other variables are influenced by the cointegrating relation.

Thus, we reduced the system to a conditional three equation model. We proceeded with joint tests for the β and α coefficients. The final reduced rank cointegrating relation with weak exogeneity for only *LGdem* had a chi-square statistic with one degree of freedom as 0.81 and a *P*-value of 0.37. Our discussion focuses on the export equation. Further discussion of the other two equations is beyond the scope of this article.

The obtained parameters offered a meaningful economic interpretation. The exchange rate elasticity is 0.14 and indistinguishable from unrestricted baseline export demand model. Thus, a 7 percent real appreciation in the

Euro will decrease Germany's goods exports by 1 percent. The global demand elasticity is less than unity about 0.8. Domestic value added has a negative sign meaning that the decline in domestic value added increases export growth. The intuition being that declining value added in industry reflects increased use of imported intermediate inputs and hence improves output and productivity. A decline of domestic value added in industry by one quarter of a percent increases exports by nearly 1 percent.[11]

The results above imply that the baseline model suffers from omitted variable bias. We tested whether the information provided by German exporters changing their supply chain process or value added shares improves the statistical fit. When the value added shares are not included, the price elasticity and income elasticity are biased upwards, and overstate their respective impacts on exports, because they ignore the structural changes.

Furthermore, our result is consistent with and tends to support Sinn's efficiency or Bazaar economy argument. However, we cannot determine the degree of the misallocation of inputs, especially capital, and its potential impacts on the economy. In a global marketplace competitive pressures will distribute the content of production to the most cost-efficient producers. The decline of value added is probably driven by larger imported inputs which through volume effects have a positive effect on German net exports.

The speed of adjustment coefficient for exports is negative and significant; it has a value of -0.43 implying a fairly rapid correction of a disequilibrium (89 percent after four quarters). If export demand were above the 'equilibrium' level last period, this leads to a temporary increase and/or appreciation in *LREER_u*, the labor cost adjusted effective exchange rate, which is in line with theoretical expectations. In addition it implies there would be a temporary decline in *Ind_VA*, share of domestic value added in industry.

3.3.3 Alternative specifications

We explored other modifications to the baseline export demand model by including an indicator of investment demand by Germany's export partners (*LGinv*) motivated by the above discussed hypotheses. The Johansen tests for cointegration suggested the possibility of more than one cointegrating relation with the addition of the new variable. We failed to find a second cointegrating relation which was stable or meaningful. Thus, we

[11] The estimated range at the 95% confidence interval is one half to one and half percent.

restricted the vector error correction model to a single relation, which however does not deliver economically meaningful results.[12]

A puzzling aspect of the obtained model was that the coefficients for *LGdem* and *LGinv* had opposite signs, while our hypothesis was that both would have the same sign. There are two reasons generating this puzzle, which may also explain why the countervailing influences of the two variables cannot be easily assessed with the current data. First, the result becomes clearer when we compare *LGdem* and *LGinv* across different regions. Increases in demand for German goods by other European countries and the United States are negatively correlated with investment activity. Since these two regions have large weights in the aggregate investment index for Germany, they may account for the opposite signs. In other words, investment activity and import demand in key partner countries have moved in opposite directions and hence tend to reject the hypothesis that export growth was driven by increased investment activity in partner countries. Second, the investment index may be too crude to pick-up demand for capital goods. The index is based on the assumption that the share of capital goods imports per investment unit is identical across countries. This assumption may be too restrictive. In particular, the import demand for capital goods from fast growing emerging markets may have been underestimated. In light of these considerations, we subsequently abandoned this modeling approach.

3.4 Quantifying the contributions to gains in export market share

The long-term relationship unearthed in the final model are in a next step used to back out the relative contributions of the different variables to the increase of Germany's export market share relative to industrial countries. Industrial countries are the natural comparator for Germany and have therefore been chosen as a benchmark. As a starting year we chose the year 2000 when Germany began to increase its export market share.

To assess which factors are responsible for the increase in export market share, we first decompose predicted export growth into two components: one is the level of export growth that is necessary to keep the export market share constant *vis-à-vis* industrial countries; and the remainder that is responsible for changes in the export market share.

Before we carry out this decomposition, we must first assess the model fit. If the estimated export models explain only a small fraction of overall export growth between 2000 and 2005, then the decomposition is of limited value. The first line in Table 12 summarizes the model fit and the

[12] Results for the alternative specifications are reported in the working paper version: Danninger and Joutz (2007).

Table 12 Comparing actual export growth with preferred model's explanatory value of variables: annualized export growth 2000–2005 and model contribution[a]

	Export growth			Global demand			Reer_ule	Ind_VA
	Actual	Model	Residual	Total	Adv. country common	German specific		
				(Average annual growth rate)				
Model Table 11	6.01	4.99	1.01	3.99	3.27	0.72	0.08	0.93
				Percent of export growth by				
Model Table 11		83.1	16.9	66.4	54.4	12.0	1.3	15.4
		–		Percent of market share increase explained by				
Model Table 11			37.1	–	–	26.2	2.8	33.9
Memorandum item								
Long run parameters								
Model Table 11		–		0.78	0.78	0.78	−0.14	−3.84

[a]The model export growth is defined as the predicted annual growth rate of real exports between 2000 and 2005 from the cointegrating relationship presented in Table 11 (bottom panel). The decomposition of the export growth forecast for the global demand variable deducts from overall export demand for Germany in 2000–05 the growth rate common to all advanced economies based on estimates from the IMF WEO. database.

respective contributions of the individual variables. For the period 2000–05 final model predicts an average annual export growth rate of 5.0 percent. The actual growth rate was slightly higher (6.0 percent) indicating that about 80 percent of actual export growth can be explained by the fundamental variables.

The respective model contributions of the variables *Gdem, REER_u* and *Ind_VA* are reported in the columns to the right of the model results. The bulk of export growth, 4.0 percent, is explained by growth in global export demand. An additional 1.0 percent of export growth is explained by the other two variables *REER_u (0.08)* and *Ind_VA (0.93)*.The bazaar effect appears to explain about 15% of total export growth.

We now make a crucial assumption that allows us to assess the relative contribution of the various variables in explaining the increase in export market share compared to industrial countries. We assume that for any industrial country global export demand can be broken into a component common to all industrial countries and a country-specific component. The common component captures the demand for exports which keeps market shares unchanged. The country-specific part explains changes in market share: a negative-specific component would indicate a loss in market share relative to this group, a positive component gains in market share. By implication, the export growth explained by the other two variables (*REER_u, Gdem*), and the residual (unexplained growth) would also contribute to changes in the export market share.

The middle two columns in Table 12 show the decomposition of Germany's export demand growth into the common and the country-specific demand component.[13] In both models the bulk of export growth is explained by the common components. From a total of 6.0 percent export growth roughly 3.3 percent (54 percent of model fit) would have been necessary to maintain a constant export market share. The remainder can be attributed to the other variables (0.7 percent from *country-specific demand, REER_u, Gdem and Ind_VA*), and the rest comes from the residual (1.0 percent).

The relative contribution from the four components responsible for the change in export market share is reported in the third panel of Table 12. The German-specific component of global demand and the decline in

[13] Data for export demand for industrial countries comes from the IMF WEO database and reflect trade-weighted import demand for these countries. Since Germany is part of this group and its export demand could not be removed from the group average, the estimated of the common component is biased upwards. As a result, the country-specific export demand component is biased downwards, which underplays its role in explaining the increase in export market share.

domestic value added account for the bulk of the increase with 26 and 34 percent, respectively. Relative cost improvements only account for around 3 percent of the increase in export market share. The unexplained residual component accounts for another 37 percent.

The large contribution of the country-specific demand is consistent with findings by Everaert (2005) and confirms that German exporters are benefiting from growth in trading partners. The sizeable contribution of a declining share of *Ind_VA* lends some empirical support for the Bazaar hypotheses proposed by Sinn (2006). It is also consistent with estimated trade effects of German outward FDI to the new EU member countries (Deutsche Bundesbank 2006) and explains the limited spillovers of export to domestic employment and demand (German Economic Council 2004).

The small role of *REER_u* is surprising at a first glance given prolonged wage moderation. However, the influence of wage moderation on international cost competitiveness appears to be muted by the large effective nominal appreciation of the euro between 2000 and 2005. If this offsetting exchange rate adjustment is taken into account, the small positive contribution of *REER_u* to gains in export market share is actually quite remarkable.

Conclusion

Since 2000 Germany's export market share has gradually recovered. The article reviews four different hypotheses explaining export growth and evaluates their relative contribution to the gain in export market share. They are: (i) regained cost competitiveness through wage moderation since the mid-1990s; (ii) ties to fast growing trading partners; (iii) increased export demand for capital goods in response to a global increase in investment activity; and (iv) new regionalized production chains in the export sector, for instance, through off-shoring of labor intensive steps.

The long-term parameters estimated by the models are consistent with previous empirical findings in the literature. The econometric analysis identifies stable long-run relationships between export growth and variables which measure the proposed hypotheses. The estimates are then used to quantify the relative contribution of these factors to the observed market share increase. The dominant factors explaining the increase in export market share *vis-à-vis* industrial countries since 2000 are trade relationships with fast growing countries and a suggested trend to regionalized production in the export sector. Together they account for 60 percent of the faster export growth compared to other industrial countries.

Improved cost competitiveness played a comparatively smaller role in explaining the brisk export growth. Although the euro experienced a

substantial nominal effective appreciation, prolonged efforts in containing costs through wage moderation lowered unit labor costs and neutralized this negative effect. Cost competitiveness improved hence primarily *vis-à-vis* euro area countries and explains also the significant rise of Germany's export market share within the eurozone. There was no conclusive evidence of faster export growth due to higher investment expenditures of trading partners and the demand for capital goods. The delayed response of investment activity during the most recent upswing may have not allowed to capture this effect with current data.

An important contribution of the article is its attempt to test whether Germany's export growth was linked to the emergence of new production chains (Marin 2006). Following a well known literature (e.g. Sinn 2005, 2006), the article argued that the fall of value added in Germany's export sector reflects a growing share of traded intermediate inputs in the production process. From this perspective, the empirical link between value added and export growth can be viewed as evidence for a more decentralized production process. This interpretation also helps explain why the recent surge in exports did not translate into a significant employment growth in German industry (Becker et al. 2005). While this finding is intuitively appealing, the empirical evidence is only indirect and further research is needed to confirm this result.

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Appendix: Variable descriptions

Sample 1993Q1–2005Q4

xgr

Total goods export volume.
Base year 2000, quarterly 1993Q1–2005Q4, billions of Euros.
Source: German Federal Statistical Office.

REER_u

Real effective exchange rate based on relative unit labor costs in industry (ULC),

Index 2000 = 100.

Source: International Financial Statistics (IFS).

Gdem (Germany's global export demand)

Export share weighted volumes of real aggregate import volumes (ex/including oil) in Germany's trading partner countries transformed into an index normalized to 100 = 2000.

$\mathrm{Gdem_t} = \bar{\chi}\ \Sigma_i\, \Delta \mathrm{m_{it}}$

$\bar{\chi}$ = average 2000–03 share of German goods export to country *i*. More precisely: $\bar{\chi} = \frac{\bar{\chi}_i}{\bar{\chi}_G}$ where x_i are Germany's exports to country. *i* and x_G are Germany's total exports. The ratio is averaged over 2000–03.

Δm_{it} = annual growth rate of real goods imports in country *i*.

Source: IMF World Economic Outlook database.

Ginv (investment activity of German trading partners)

Export share weighted growth volume of real investment activity in Germany's trading partner countries.

$\mathrm{Ginv_t} = \bar{\chi} \Sigma_i\ \varepsilon_{it}\ inv_{it}$

ε_{it} = national currency/$US exchange rate.

inv_{it} = real volume of investment activity.

Source: IMF World Economic Outlook database.

Ind_VA (domestic value added in industry)

Domestic value added as percent of total output of industrial sector.

Source: German Statistical Office GENESIS database and own calculations.

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Erratum

Marriage: Past, Present, Future?

Lena Edlund

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The first paragraph of Section 3.2, p. 630, on Children as public goods – free-riding, should read:

Children are sometimes modeled as public goods to their parents, e.g. Weiss and Willis (1985). And from a genetic point of view, they are. Each parent shares 50 percent of the genes of the child, and the success of the father's genes is intrinsically linked to those of the mother's, since they are embodied in the same organism.[16] The public good nature of children to their parents may allow one parent to free-ride on the other parent's parental investment. The free-rider gains at the expense of the other parent and possibly the offspring.