Empirica (2014) 41:445–465
DOI 10.1007/s10663-014-9267-x

ORIGINAL PAPER

A low growth path in Austria: potential causes, consequences and policy options

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Published online: 14 June 2014

Abstract This paper reports on an Austrian research project that deals with the question how the Austrian society could cope with long-lasting low economic growth. Various causes of low-growth that are relevant for Austria (a deteriorating balance of trade, increasing resource prices, consumer restraint of households and less immigration) have been identified, leading to an only moderate gross domestic product growth of 0.55 % per year. The resulting impact on the economy is substantial: the labour market suffers from a shortage of labour supply (due to reduced migration) and from a reduced demand for labour (due to reduced demand in consumption, investments and exports). Subsequently, less employment decreases the development of the disposable income of private households (tax rates and social security contributions held constant). Related to this, public debt is higher due to reduced tax incomes and slightly growing public expenditures. From an ecological perspective, resource consumption increases at a slower rate, however, no absolute reduction can be reached. CO_2 emissions also slightly increase. Therefore, it cannot be assumed that low growth necessarily leads to the achievement of energy and environmental policy goals. Based on these results, a policy scenario was used to analyze whether and how policy measures are able to cope with the negative consequences of persistent low growth. The results reveal that the selected measures are suitable to reduce negative economic effects: The implementation of reduced working time and an eco-social reform of levies might improve the labour market

Paper submitted to the Empirica Special Issues on the WWWforEurope Conference on "Modelling Growth and Socio-ecological Transition".

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situation. The negative effects on the national budget can be diminished by a reduction of environmentally harmful subsidies. Induced behaviour changes of private households can reduce energy and resource-intensive consumption.

Keywords Economic growth · Macroeconomics · Sustainability · Sustainable economy · Modelling

JEL Classification E27 · O44 · Q57

1 Introduction

Currently, economic and political assessments of the performance of an economy are mainly based on the development of the gross domestic product (GDP). Economic growth serves as an indicator for the measurement of political success. However, present ecological, economic and social trends imply that industrialized countries such as Austria must be prepared for permanently low levels of GDP growth (see e.g. Pirgmaier et al. 2010).

In the field of sustainable research, there is growing consensus that previous patterns of growth are not compatible with sustainable development (see e.g. Victor 2008; Jackson 2009). Neither have these patterns resulted into full employment, a more equitable distribution and increased well-being (Adger 2006), nor did they lead to reductions in resource consumption (Dittrich et al. 2012) and thus to a decreased environmental impact (Millenium Ecosystem Assessment 2005; Rockström et al. 2009).

The concept of limits to growth has generally been rejected on the part of neoclassical economics. Although environmental degradation such as declining fish stocks or biodiversity loss are considered as problematic, these issues are generally not viewed as being a profound threat to the continuation of global economic growth. Instead, an emphasis is placed on 'getting the prices right' in order to internalise external costs and to decouple economic growth from negative environmental impacts. Economic growth is regarded as a precondition for achieving rapid technological change enabling a development where economic performance is disconnected from environmental impact (Barker et al. 2010).

In sharp contrast to this position, ecological economists (among others Victor 2008; Jackson 2009) argue that for several reasons, it can be assumed that there are limits to growth, e.g. resource scarcities, commodity price shocks, instability of financial markets, government debts, or a decline in consumer confidence. These causes have a severe impact on our long-term ability to sustain prosperity—the capabilities that enable people to flourish. Based on these arguments, the paper is motivated by the assumption that low economic growth rates could be the norm and not the exception in developed economies in the near and also in the far future.

It is thus not the aim to demonstrate how low economic growth can be tackled by a growth-generating policy. Instead, it is regarded necessary to take into account the possibility that the success of such efforts might be limited. This implies that

consideration should be given to the question how a society is able to cope with lower growth rates. Without appropriate responses and concepts to deal with this situation, severe social consequences—first and foremost rapidly rising unemployment—could cause large welfare losses.

The Austrian research project "Implications of a persistent low growth path—A Scenario Analysis" responds to this challenge. The project deals with the question how the Austrian economy and society could cope with long-lasting low economic growth, measured in GDP. This paper reports on the results of this project.

Against the background of a comprehensive literature review concerning reasons, consequences and strategies for dealing with ongoing weak growth, domestic as well as foreign causes have been identified that could lead to a persistent low growth path in Austria.

In order to analyse the causes and consequences of a prolonged economic slowdown appropriately, scenario development and analysis and macro-econometric modelling (with the Austrian model e3.at) has been applied. In a *low-growth scenario*, domestic and foreign causes of weak economic development were combined and compared with a reference scenario without a decline in economic growth. Based on the results of the low-growth scenario, a *policy scenario* was used to analyze whether and how policy measures are able to cope with the negative consequences of persistent low growth.

The remainder of this paper is organized as follows: Sect. 2 presents the methodological approach; it explains the process of scenario development and introduces the integrated model "e3.at". Section 3 describes the reference scenario, while Sect. 4 carries out the assumptions and modelling results of the low-growth scenario. In Sect. 5, the policy scenario is introduced and analyzed. On the basis of the simulation results, reported in Sects. 4.3 and 5.2, we derive some conclusions in Sect. 6.

2 Methodology

In order to analyze the research questions posed, the project comprised two main blocks: (1) a participatory scenario modelling process and (2) the application of the simulation model "e3.at".

2.1 Scenario development

Scientifically, the causes and implications of a persistent low growth situation can be analyzed using "what if" positions, so-called scenarios. They can be regarded as illustrations of possible future developments—plausible and consistent, but not necessarily presenting a forward projection of historical and current trends. Therefore, they should not be seen as forecasts (Jäger et al. 2008). Scenarios allow for going beyond conventional thinking and thus for enlightening uncertain future developments from different perspectives. Moreover, they can be used as an orientation for decision making situations, as they are able to clarify problems with

which politics is confronted, thus creating an important basis for developing bundles of strategies and measures (Stocker and Bohunovsky 2009).

A participatory approach[1] has been used to utilize stakeholder[2] and expert knowledge for scenario development. An expert and stakeholder group of around 20 people—with participants from academia and the sustainability practice community, mainly consisting of representatives of the Austrian initiative "Growth in Transition"[3]- was formed, actively accompanying the project by means of expert interviews and participation in workshops. In total, three workshops were held, with the objective of presenting and discussing the functioning of the simulation model e3.at and to elaborate the scenarios. Thanks to these discussions, valuable inputs and helpful suggestions have been received and duly considered in the project work.

In case "normal", empirically observable paths are abandoned, evaluating interdependencies and trends is particularly difficult. This applies i.a. for productivity developments. Especially a scenario that is based on a persistent "abnormal" development constitutes a special challenge regarding econometric models. Thus, particular importance has been attached to the expert group during the project.

The participative character of the project fostered an intensive exchange of experiences between the developers of models and scenarios, and the users (or persons concerned) of the results from different political, economic and societal areas. Hence, on the one hand, the objective was to improve the modelling, and on the other hand, to increase the relevance of results.

With the involvement of experts and stakeholders, three scenarios have been developed: First, the *reference scenario* (see Sect. 3) is based on the assumption that the economic growth will not decline in the future. A *low-growth scenario* (see Sect. 4), supposing weak economic development due to domestic and foreign causes, has been compared to the reference scenario. Moreover, a *policy scenario* (see Sect. 5) has been developed based on the results of the low-growth scenario, analyzing whether and how policy measures are able to cope with the negative implications of persistent low growth.

2.2 Macro-econometric modelling of the scenarios

After the development of the scenarios, they have been implemented into the model e3.at. In this section, we briefly introduce the integrated environment–energy–economy model e3.at (for a detailed description see Stocker et al. 2011), which was

[1] A literature overview on participatory scenario development and its advantages and limitations is provided by Reed et al. (2013).

[2] Stakeholders are defined as all those actors who are affected by or can affect a decision or action (Freeman 1984).

[3] The initiative "Growth in Transition" constantly tries to involve as many institutions and persons as possible in a dialogue on how a process of transition towards sustainability can be framed. From the beginning, "Growth in Transition" in Austria was aiming at including all kinds of stakeholders, the whole range from innovative and critical toward business as usual to conservative and preserving business as usual. In the meantime, "Growth in Transition" has over 20 partners (ministries, companies, research institutes, interest groups, etc.) actively participating in the process (http://www.growthintransition.eu/partners/).

applied within the project to analyze the implications of a persistent low-growth path in Austria.

e3.at can be categorized as an E3 model that covers interactions between economy, environment and the energy system, therefore providing an integrated view on sustainability. e3.at does not only allow for the analysis of economic growth and employment effects, but also regarding impacts on resource use and CO_2 emissions.

The model is based on the assumption that agents in imperfect markets act under conditions of bounded rationality (see e.g. Rubinstein 1998). The application of econometric methods facilitates an empirically validated parameterization of the model. Such a model is able to produce reliable baseline projections, which, when confronted with environmental and economic targets, allow for the calculation of sustainability gaps.

In e3.at, the *economy* is shown at the macroeconomic and the industry level. It permits the illustration of structural change and, as such, is able to identify particular burdens on certain industries. This fact is important for the design of a social compatibility and of supporting measures to offset these burdens. The transition to a sustainable development can thereby be premised on social and economic compatibility aspects.

The model structure combines bottom-up with top-down approaches (Almon 1991). "Bottom–up" means that each of the 57 sectors of the Austrian economy is modeled in great detail. Macroeconomic variables such as GDP, disposable income or the consumer price index are calculated by explicit aggregation of the sectors. The implementation of different sectors or agents (private households, government, firms and abroad) at an aggregated level refers to the "top-down" approach and is modeled by using the system of national accounts and balancing items (SNAB). The SNAB depicts generation, distribution and use of income for every sector. Budget constraints for government or private households can be derived explicitly and used for deriving the demand side.

The economic module is completed with a labour market module. Wages, employees and labour productivity are modeled on the industry level and impacts of a low-growth path can be measured in additional or lost jobs by industries.

The *energy* module illustrates the relationship between economic development, energy prices and energy consumption. Furthermore, the energy model represents energy supply, transformation and consumption by energy carriers, different energy consumers and energy producers as stated in the energy balance. The *environmental* module comprises direct material inputs (DMI) and CO_2 emissions. DMI[4] differentiate between imported and domestically extracted materials. The latter are linked to the extracting sectors in the input-output-tables, the imported materials to the importing sectors, and fossil fuels are also connected to the energy module. CO_2 emissions are associated with the use and transformation of fossil fuels. This modelling approach reveals the impacts, for example, of a reduced consumer demand for durable goods and energy products on material and energy consumption.

[4] The DMI comprises "the flow of natural resource commodities that enter the industrial economy for further processing. Included in this category are grains used by a food processor, petroleum sent to a refinery, metals used by a manufacturer, and logs taken to a mill" (Adriaanse et al. 1997, p. 8).

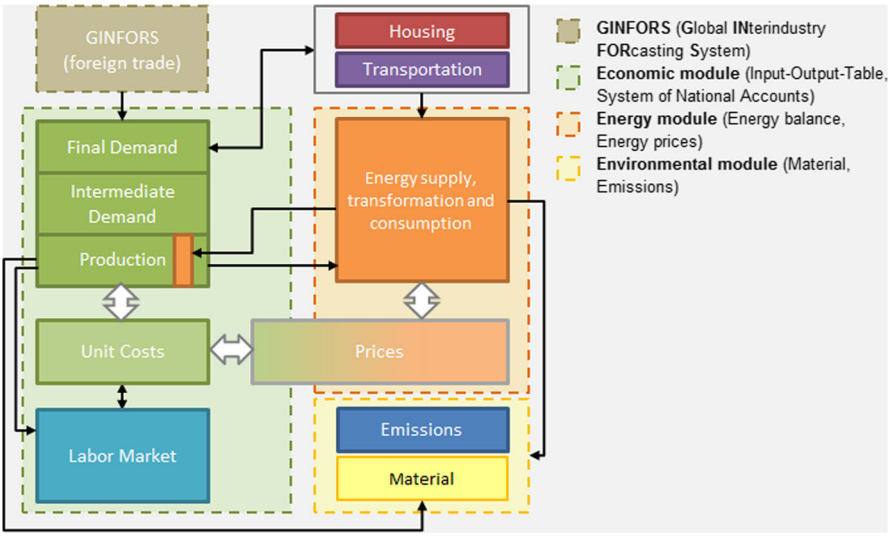

Fig. 1 Structure of the e3.at model. *Source* own illustration

Additionally, the core model was expanded by a *regional housing inventory model* and a *transportation model for private households* in order to show the manifold relationships between economy, energy system, and environment. Furthermore, e3.at disposes of a soft link to the world model GINFORS (Global INterindustry FORcasting System; see Meyer et al. 2007; and Lutz et al. 2010), in order to illustrate the effects of international trade on the Austrian economy.

Figure 1 provides a brief overview of the structure of the model.

This model serves as a basis for quantifying the effects of the reference scenario, the low-growth scenario and the policy scenario on economy, environment and energy system in Austria until 2025.

3 The reference scenario

First, a reference scenario was developed, showing the expected future development until 2025, under the assumption that no economic slow-down occurs. Comparing the reference scenario with the low-growth scenario allows us to recognize effects of changes induced by the scenario design.

It was agreed with the clients that the reference scenario is based on an *average growth rate of the Austrian* GDP by 2.0 % p.a. Because of the developments in 2010 (2 %), the growth rate applied in the model is a little bit lower compared with the past development (1980–2008: 2.3 % p.a., 2000–2008: 2.1 % p.a.).

For *work force development* and labour supply in 2025, an increase in labour force participation was assumed, due to net immigration of about 30,000 persons per year (Statistik 2010a, b, c, d, 2009; Kommission zur langfristigen Pensionssicherung 2010). Assuming that 70 % of immigrant people are aged between 15 and 65 years,

the number of working age people per year increased by at least 21,000. Over the period from 2010 to 2025, in total 315,000 people of working age migrate to Austria.

Regarding the *development of the state budget*, we assume that the Austrian government follows the Maastricht criteria. The development of the national budget in the model e3.at is based on the plans of the Federal Government of Austria until 2015. From 2016 to 2025, the development of the state budget is aligned in the reference scenario at balancing the budget balance, i.e. there is almost no new net borrowing.

Austrian exports increased from 1995 to 2008 with an average growth rate of 8 %. Due to the global economic situation, and under the assumption that the expansion of world trade does not grow at rates we have seen in the past (IEA 2009), we assume that until 2025, the Austrian exports will grow by nearly 6 % p.a. on average.

In its reference scenario, the IEA (2009) assumes that the oil price increases to 161.5 USD/barrel (nominal) and $ 107.5/barrel (in real terms) in 2025. This average import price of crude oil, which is used by the IEA as a proxy for the international crude oil prices, is applied in our reference scenario.

4 The low-growth scenario

In the low-growth scenario, it was the intention to identify possible reasons for a slow economic development in Austria and underpin these reasons with appropriate assumptions. The scenario is based on domestic and foreign low-growth causes. Foreign causes include a deteriorating balance of trade and increasing resource prices; domestic causes comprise consumer restraint of households and less immigration.

The reasons identified were adjusted in a way that an average GDP growth rate of 0.55 % p. a. was achieved until 2025. In consultation with the clients, this growth rate was agreed upon as a viable solution.

4.1 Domestic low-growth causes

For the domestic market, the main reasons of a potential economic weakness are a decreasing supply of labour and a change in consumption, especially household consumption and, related to this, a change in the government budget.

In general, immigration to Austria is seen as a positive influence to growth (Bock-Schappelwein et al. 2008). The low-growth scenario foresees a smaller increase of the labour force due to lower immigration. To generate economic weakness, we assume that the net immigration is lower by 20,000 people per year than in the reference scenario. The Austrian population is growing by 2.5 % during the period 2010–2025. The assumed annual increase of the population is thus consistent at the level of the years 1995–1998, the period with the lowest growth rates in terms of population since joining the European Union in 1995.

To what extent a decrease in the labour supply affects economic growth crucially depends on the level of *labour productivity*. Labour productivity is the average per capita production. It is measured in terms of the quantity of output produced by a worker per unit of labour-time (an hour, a shift, a month, or a year) or in terms of the time spent in producing a unit of output.[5]

The overall economic growth rates result from changes in the volume of work employed (full-time employees or hours worked) and changes with labour productivity growth (Hartwig 2005).

In other words, the number of people employed only increases if, during a given period of time, the economy grows faster than the average labour productivity.

Normally, labour productivity is endogenously calculated by e3.at. For this scenario analysis, however, the growth rate of GDP was assumed to be at a level of only 0.55 % p.a., a situation that did not exist in the past few years. Thus, it cannot be assumed that the model is able to calculate the size of labour productivity for a persistent low-growth situation on the basis of historical empirical findings.

Structural change also has an important impact on labour productivity. In developed economies such as Austria, a process called "tertiarisation" has been taking place over the last decades—an increase in the labour force share working in the tertiary sector (service sector). In principle, the service sector is more labour intensive than manufacturing and processing industries (Fretschner et al. 2002). Also due to demographic trends, i.e. an aging population, an increasing number of people will be employed in the service sector (especially the care sector).

Thus, we cannot assume that in the future labour productivity will grow at the same rate as in the past (e.g. due to an increase of labour-intensive service sectors such as care and education), especially in case economic growth rates are lower than in the past.

In principle, the increase in labour productivity is positively correlated with economic growth: it is high, if the economy is growing strongly; and it is low in times of a weakened economic development (see, e.g., Biffl 2001). However, the literature on this issue is rather scarce. According to Rohwer (1982), a slowdown in economic growth by one percentage point leads to a slowdown in productivity by 0.36 %.

Based on this connection, we assume a productivity growth of 1 % p.a. for the low-growth scenario, while in the reference scenario the model calculates an average growth rate of productivity of 1.4 %.

Regarding the future *consumption of private households*, it is expected that the level of equipment of households with durable goods (such as household, communications and consumer electronics and cars) will not yet increase massively in all areas. It primarily involves the replacement of existing assets of equal or higher quality consumer goods. In addition to this partial satiation, increased spending on the individual retirement security can be assumed. Moreover, rising prices and slower growth rates of disposable income, compared to previous years

[5] Labour productivity is the product of working hour productivity and average working hours per capita. It rises with increasing labour productivity per hour and decreases with reduced working hours. Employment can only increase if the increase in labour productivity per hour is smaller than economic growth - otherwise the working time must decrease to offset increases in the labour productivity per hour.

(following from the assumptions of the low-growth scenario), restrict the consumption possibilities.

Regarding the *development of the state budget* in the low-growth scenario, we make the assumption that the deficit path is approximately 0.7 percentage points higher than in the reference scenario. While government spending will grow more slowly, mainly due to lower population growth, state revenues are affected by several factors. The subdued increase in production compared to the reference scenario leads to less value added. Together with a lower consumption level, this results into a reduction of tax revenues.

In order to reduce the public deficit, following BMF (2010), we assume that 60 % of the consolidation will be carried out by expenditure measures (savings) and 40 % by revenue measures. This ratio will also be maintained after 2015.

4.2 Foreign low-growth causes

Since Austria does not dispose of large amounts of resources deposits and therefore depends on the import of raw materials, also foreign reasons may affect economic growth. For example, as a result of raw material shortages, commodity prices are rising and spending on imports increases. Simultaneously, due to international competition, the prices for domestically produced goods cannot be set at any height, leading to a deterioration of the sales prospects.

Specifically, we assume a growth rate of exports of about 4.3 % p.a. between 2010 and 2025. Compared to previous years (2000–2008: 6.5 %, without consideration of 2009), this represents a significant lower growth rate.

The low-growth scenario also assumes substantial price increases for fossil fuels and foodstuffs. The price of imported food will almost double until 2025, compared to 2009. The fossil fuel prices in 2025 are 2.5 higher than in 2009. This situation is similar to the historical increase that could be observed since 2000.

The assumptions for the parameters of the reference scenario and the low-growth scenario are summarized in the following table.

4.3 Modelling results of the low-growth scenario

The results of the low-growth scenario are presented in two ways: compared to the reference scenario and regarding the development over time. The low-growth scenario is abbreviated in the tables and figures with “LG”, the reference scenario with “REF”; “MS” stands for the policy scenario.

Figure 2 shows the development of GDP in the reference and the low-growth scenario. In the reference scenario (REF), an average GDP growth of 2 % p.a. is achieved. According to the assumptions outlined above, the average growth rate in the low-growth scenario is approximately 0.55 % p.a. It has to be noted again, that the measure of GDP is a result of modelling. Thus, in the low-growth scenario the input parameters of the model were chosen in a way to fit this growth rate. Nevertheless, per capita GDP increases during the whole simulation period because of the population changes assumed (Table 1).

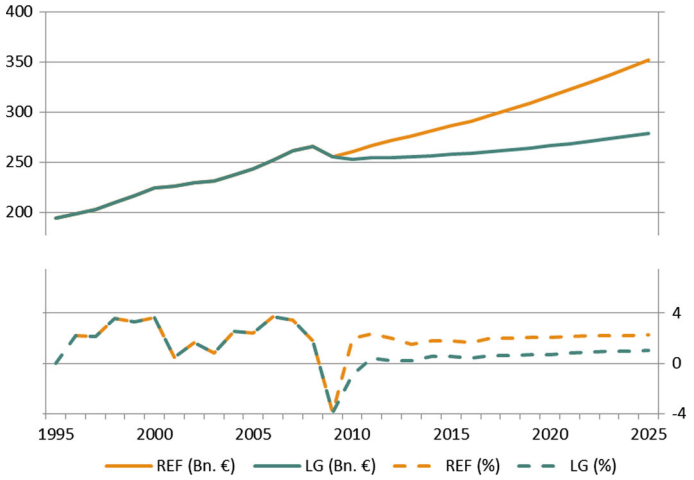

Fig. 2 Development of GDP (price adjusted) in the reference and the low-growth scenario (absolute development and growth rates). *Source* Own calculations with e3.at

Table 1 Overview of scenario assumptions

	Reference scenario	Low-growth scenario
Development of work force	315,000 people of work force age immigrate to Austria from 2010–2025 (21,000 per year)	109,000 people of work force age migrate to Austria from 2010–2025 (7,300 per year)
Consumption behaviour	Consumption and savings rate are calculated by the model e3.at (endogenously determined)	Exogenously determined: savings rate −5 % points until 2025 compared to reference scenario
Exports	Around 6 % growth p.a.	Around 4.3 % growth p.a.
Oil price (world trade price)	107.5 USD/Barrel (real) in 2025	182,75 USD/Barrel (real) in 2025
Government's deficit rate	0 until 2025	0.7 % points higher than reference scenario
Growth of labour productivity	ca. 1.4 % p.a. (endogenously determined)	ca. 1 % p.a.

Table 2 (see end of this Section) summarizes the findings related to the weak economic growth scenario discussed, in numbers.

Given the assumption of slower population growth, the development of consumption and investment is adversely affected. Consumption is further reduced by the reticence of households. The balance of trade weakens because of the assumed development of exports in comparison to the reference scenario.

Consumption and exports in the low-growth scenario are similarly affected. Compared to the reference scenario, the relative deviation of private consumption and exports in 2025 is −20 and −21 %, respectively. While the price-adjusted GDP per capita in the low-growth scenario also increases in absolute terms, this is not true for per capita consumption. Only in the last 5 years of the period considered,

Table 2 Results of the low-growth scenario—development for selected years in absolute figures, as well as absolute and relative deviations from reference scenario (components of GDP price adjusted)

	LG		Deviation of LG to REF	
	Absolute		Absolute	Relative
	2010	2025	2025	2025
Population in 1,000 persons	8,377	8,584	−320	−3.6
GDP				
Total in Bn. EUR	253	279	−73	−20.7
Per capita in EUR	30,258	32,527	−6,995	−17.7
Private consumption				
Total in Bn. EUR	142	140	−35	−19.9
Per capita in EUR	16,998	16,358	−3,336	−16.9
Public consumption in Bn. EUR				
Total in Bn. EUR	49	50	−5	−9.3
Per capita in EUR	5,906	5,842	−367	−5.9
Investments in Bn. EUR	48	51	−9	−14.4
Exports in Bn. EUR	125	236	−63	−21.1
Imports in Bn. EUR	113	202	−39	−16.3
Disposable income of private households in Bn. EUR	171	220	−37	−14.4
Employees in 1,000 fulltime equivalents	3,140	2,990	−470	−13.6
Employment rate[a]	70.9	67.8	−7.5	
Deficit rate	−4.2	−0.6	−0.1	
Final energy demand in PJ	1,086	1,167	−108	−8.5
CO_2 emissions in Mio. tons	71	72	−9	−11.6
DMI in Mio. tons	218	240	−53	−18.2

[a] Self-employed and paid workers in relation to the population between 15 and 64 years

Source Own calculations with e3.at

positive growth rates can be achieved (see Table 2 below). In 2025, per capita consumption is still lower than in 2010. Between 2010 and 2025, per capita consumption declines by 3.7 %.

Not only the loss of momentum of population growth, but also the lower income of private households applies pressure on housing investments. While the population dynamics influence the number of households in Austria and thus residential construction, at the same time investing activities in the housing stock (building-up and renovation) are reduced.

Compared with the reference scenario, *public debt* is also higher. While government spending grows more slowly due to lower population growth, tax revenues decrease strongly. The smaller increase in production compared to the reference scenario leads to less value-added.

The *labour market development* is characterized by the following effect: Generally, the level of labour force demanded is determined by production, productivity and the total of effective annual working hours. Thus, the more real

goods and services are produced, the higher the labour force demand. On the other hand, labour force demand decreases with increasing labour productivity and rising number of hours worked per year.

Additionally, labour demand is decisively determined by the economic structure. Along with the structural transformation to a service economy, labour demand has increased. This is because services (especially in knowledge-based sectors, F&E) are generally said to be more labour intensive (e.g. Fretschner et al. 2002).

The level of *labour supply* is primarily determined by demographic developments (transformations in age-structure, migration), but also by the choice of participating in the labour market and the average annual working hours.

In a scenario of weak economic growth, the low population growth rate, consumer reluctance and a weak export demand affect the labour market differently, compared to the reference scenario: while reduced migration results in labour supply scarcities, labour demand is lower due to decreasing demand in consumption, investment and exports. This would explain why production is growing less rapidly than in the reference scenario.

The number of employed labour, measured in full-time equivalences, decreases by about 13.5 % until 2025, as well as in absolute terms, in comparison to the reference scenario (see Fig. 3).

The number of unemployed persons decreases in both scenarios. However, unemployment as well as unemployment rates are higher in the scenario of low economic growth than in the reference development path (see Fig. 4).

Because employment is affected negatively in the scenario of low economic growth, also income increases are weakened in contrast to the reference development path. If tax rates and social security contributions stay constant, also

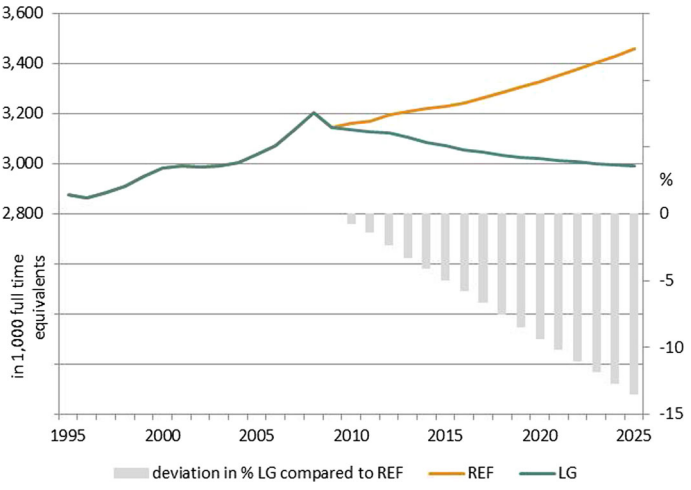

Fig. 3 Development of employees (full time equivalents) in the reference and the low-growth scenario. *Source* own calculations with e3.at

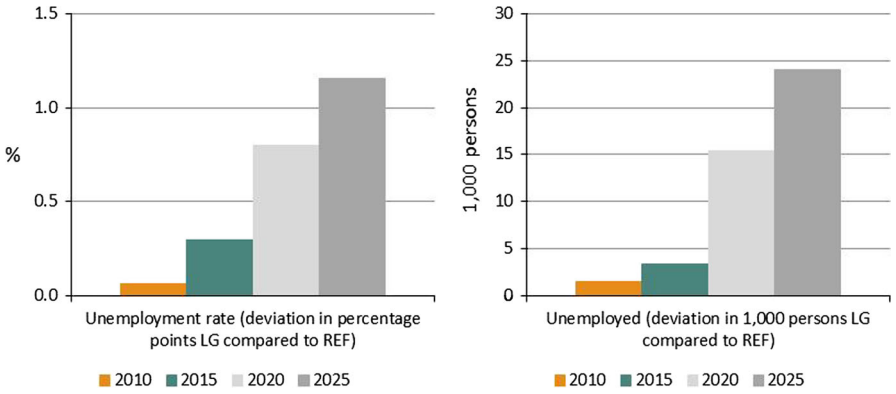

Fig. 4 Development of unemployment rate and unemployment in the low-growth scenario compared to the reference scenario. *Source* Own calculations with e3.at

the growth of available income for private households is lower than in the reference scenario.

In comparison to the reference scenario, a lower level of domestic production reduces the country's CO_2 emissions and the use of materials (measured in DMI—DMI). At the same time, because of Austria's weakened demand for imported goods, the imported material decreases in comparison to the reference development path. Nevertheless, in the course of time—compared to the 2010 situation—CO_2 emissions and material use keep on rising slightly. Therefore, a sustained weakness in economic growth cannot be expected to automatically reach energy and environmental policy targets.

5 Policy scenario

5.1 Selection of policy measures

After having discussed the results of a continuous low economic growth scenario, it is time to come up with concrete measures that are able to deal with a prolonged weakness in economic performance.

The choice of a measure should be guided by the ambition to minimize possible negative consequences entailed in the low economic growth scenario, without the need to revert to interventions that are primarily focused on pushing economic growth. Such consequences are, amongst others, decreasing employment rates, decreasing incomes, rising domestic prices, increasing expenses for resources, resulting in lower resource consumption and CO_2 emissions than in the reference scenario. However, resource use and CO_2 emissions are increasing in absolute terms over time.

Four measures that affect employment, consumption and government budget were selected as these three areas can be influenced by domestic measures (e.g. this

is not the case for energy price on the world market). The measures were designed to not create any additional costs for national finances.

Together with the clients and experts, the following measures have been selected:

- Reduction of working time by 10 %; this measure was designed in a cost-neutral way, i.e. wages increase by the degree of induced productivity effects.[6]
- Introduction of a cost-neutral eco-social reform of levies; the petroleum tax rate is increased and social security contributions are reduced; the reduction is equally shared between employees and employers.
- Reduction of environmentally harmful subsidies; about 1 billion annually until 2025.
- Promotion of the private demand for services; the demand for labour-intensive services of private consumption was assumed to increase at a standard rate of about 3 % until 2025, while at the same time private households reduce their consumption expenditures for resource-intensive goods.

Shorter working hours and an eco-social tax reform brings about changes on the labour market, the revenues from the elimination of environmentally counterproductive subsidies are used for fiscal consolidation, and the stronger focus on services intends to achieve a reduction in energy and resource-intensive mass consumption. With all the measures also other positive effects are associated: The eco-social tax reform and the elimination of environmentally harmful subsidies serves environmental goals. Shorter working hours will help to reduce health risks (e.g. burn-out) or fears of job loss. The promotion of labour-intensive services has a direct impact on the labour market, as the demand for labour-intensive products and services will increase.

Since the selected measures also influence each other, an integrative analysis is particularly important. Therefore, the four measures are combined and analyzed based on one policy scenario, before being compared to the low-growth scenario to show their effects.

When interpreting the results, it should be noted that the complexity of the scenario is considerable: In the scenario design, the interdependencies between the economic core of the model e3.at and its modules (energy balance, material module, flat module of the federal states and transport module) are considered. However, the policy scenario remains still rudimentary in some areas. Each part of the scenario,

[6] Discussions about a reduction in working hours are associated with the question whether and how wages should be adjusted. The decrease of working hours *without wage compensation* (in other words, wages remain stable) have the highest effect on employment rates. In this case, the costs per hour of work would stay the same as long as there is no increase in labour productivity or decrease, respectively, if labour productivity rises. This method of reducing working hours represents a suitable alternative, especially for those who are highly qualified and belong to the upper salary range. However, those who belong to the lower-income groups are also in need of reduced working hours, in order to be able to better balance their job and family life. To reach this target, the reduction of working hours would have to be coupled with a corresponding minimum wage. *Complete or partial wage compensations* would also represent a possibility. If they are granted, the costs per hour of work would rise; but only if (at a constant level of employment) increases in productivity do not cover the rising costs. However, if the *wage compensation is implemented proportional to the increases in productivity*, additional work force can be employed. Since the unit labour costs stay the same when implementing this measure, it is referred to as a cost-neutral reduction of working hours.

owing to its complexity, may be the subject of a separate study. In this context, the result can be seen as a first approach to the problem.

5.2 Modelling results of the policy scenario

The results of the low-growth scenario show that a persistent weakness in consumer spending negatively affects services and thus primarily employment-intensive sectors. With the measures "reduction of working time" and "promote higher private demand of services", the negative effects on the labour market can be counteracted. Similarly, a reduction in labour costs by shifting the tax burden from labour to environmental taxes (eco-social tax reform) can have a positive impact on labour demand. The elimination of environmentally counterproductive subsidies contributes to the improvement of public finances, thereby relieving public expenditures. Regarding public revenues, there may be positive effects due to the broadened tax base through a higher employment rate.

Overall, the policy measures proposed include either a redistribution or reduction of payments. No measures have been introduced which explicitly stimulate economic growth. Effects on GDP are triggered by income and price effects: e.g. subsidy reductions decrease disposable income and fuel taxes increases the price level.

Table 3 (see end of this Section) summarizes all findings in numbers.

The policy scenario (MS) results in *positive employment effects*. Through the reduction of working time, ceteris paribus, more employees are requested when demand remains constant. The number of employed persons increases, but not to the same extent, since wages are rising through induced effects on productivity. Labour costs are reduced, as the eco-social tax reform is based on a reduction of social security contributions. Also, due to the higher demand for services, positive employment effects are induced. The number of employed workers is about 4.5 % higher (approximately 152,000 people), compared with the low-growth scenario. From 2009 to 2025, the number of employed workers slightly increases. The unemployment rate lies one percentage point below the low-growth scenario (see Fig. 5).

The *public budget* is positively influenced by the developments on the labour market. The higher value-added broadens the tax base, e.g. of income tax. Although there are more people involved in the labour market, the income tax revenue increases only slightly. This is due to lower per capita wages resulting from the reduction in working hours. At the same time, government revenues, which includes both the authorities and the social security funds, diminishes due to lower social security contributions, which reduces the positive effect.

The higher demand for services (and the lower demand for goods) by households will also affect the structure of the tax revenue of the state, since services are (at least partly) taxed at lower rates.

Reducing environmentally counterproductive subsidies has positive effects on the state budget. By removing subsidies in the amount of approximately EUR 1 billion p.a., governmental expenditures can be reduced. However, this discharge is reduced by indirect effects. Both households and businesses are assumed to bear the

Table 3 Results of the policy scenario - absolute development in absolute figures as well as absolute and relative deviations of the policy scenario from the low-growth scenario

	Policy scenario (MS)		Deviation of MS to LG	
	Absolute 2010	Relative 2025	Absolute 2025	Relative 2025
Population in 1,000 persons	8,377	8,584	0	0.0
GDP				
Total in Bn. EUR	253	277	−1.8	−0.7
Per capita in EUR	30,216	32,316	−212	−0.7
Private consumption				
Total in Bn. EUR	142	137	−3.3	−2.3
Per capita in EUR	16,912	15,974	−384	−2.3
Public consumption in Bn. EUR				
Total in Bn. EUR	50	50	0.1	0.2
Per capita in EUR	5,917	5,854	12	0.2
Investments in Bn. EUR	48	51	0.2	0.5
Exports in Bn. EUR	125	236	0.1	0.0
Imports in Bn. EUR	113	201	−1.0	−0.5
Disposable income of private households in Bn. EUR	170	223	3	1.5
Employees in 1,000 fulltime equivalents	3,130	2,810	−180	−6.0
Employment rate[a]	71.1	70.9	3.1	
Deficit rate	−4.0	−0.4	0.2	
Final energy demand in PJ	1,081	1,077	−90	−7.7
CO_2 emissions in Mio. tons	71	66	−7	−9.2
DMI in Mio. tons	218	239	−1	−0.5

[a] Self-employed and paid workers in relation to the population between 15 and 64 years

Source Own calculations with e3.at

loss of subsidies by 50 % each. Thus, disposable income of the economic participants is reduced, which in turn lowers consumption and production. The tax base of state revenue decreases and partly offsets the positive effects on the state budget.

The increase in mineral oil for gasoline and diesel by 0.23 EUR/litre and 0.32 EUR/litre causes, ceteris paribus, an increase in the fuel tax revenue. In 2009, the oil tax revenue accounted for EUR 3.8 billion with a consumption of about 8 billion gallons of gasoline and diesel (Statistik 2010b, c). Based on this amount of fuel consumption, this results in additional fuel tax revenues of about EUR 2.3 billion. However, this calculation does not take into account the adaptation of economic participants. On the one hand, "fuel tourism" will declines (−18 % according to Steininger et al. 2007), on the other hand, the domestic road users will change their driving behaviour due to higher fuel prices. This can be realized by altering the distances (less driving) or by modal shift (shift from private car to public transport).

Higher fuel prices not only cause changes in the oil tax revenue, but induce volume and price changes, which reduce revenue of value added tax (Kummer and

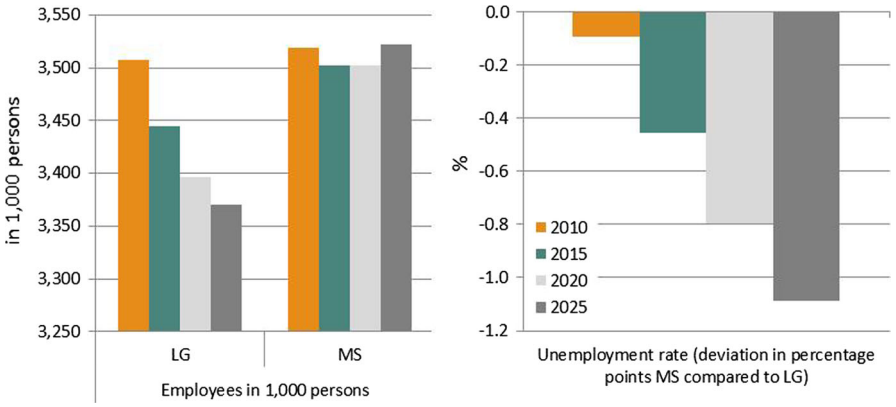

Fig. 5 Development on labour market in the low-growth (LG) and policy scenario (MS). *Source* Own calculations with e3.at

Schramm 2010). Nevertheless, the overall financial balance and the deficit ratio improve compared with the low-growth scenario (see Fig. 6).

The effects on CO_2 emissions and resource use (measured in DMI) are illustrated in Fig. 7. Although CO_2 emissions significantly decrease in comparison to the low-growth scenario, the Austrian Kyoto target is clearly missed.[7]

However, it must also be taken into account that the policy measures are not primarily aimed to achieve energy and climate policy objectives. They mainly serve to alleviate the negative consequences of continued weak growth in employment, consumption and state budget.

According to the results, the effects on resource use are low, as the measures are mainly aimed at reducing CO_2 emissions (such as the abolition of the commuting allowance or the increase of fuel tax).

Nevertheless, resource use grows less in the policy scenario compared to the low-growth scenario. While weakened by the increased demand for services by households, the resource use increases due to income and consumption effects. Especially the development of exports and imports hardly change through the selected policy measures. In addition, the measures require higher use of renewable energy, especially biomass, resulting in an increased use of materials over time.

With 0.51 % p.a., the growth of the price-adjusted GDP is lower than in the low growth scenario (0.55 % p.a.), which shows that the selected measures have positive effects on labour market, consumption and government deficit, although they do not favour GDP growth. GDP per capita also increases more slowly than in the low-growth scenario, because population remains stable.

[7] The Kyoto target stipulates that the total greenhouse gas emissions have to be reduced by 13 % between 2008–2012, relative to the base year 1990, when they amounted to 68.8 million tons of CO_2 equivalents. Since the e3.at model only accounts for CO_2, and not all greenhouse gases included in the Kyoto Protocol, the relevant CO_2 stabilization target of 1990 would be at 62.08 million tons of CO_2 (assuming that the share of CO_2 emissions in total greenhouse gas emissions is about 80 %; see e.g. Umweltbundesamt 2009). If the Austrian Kyoto target of −13 % is referred to this amount only, the CO_2 reference value would be at about 54 million tons.

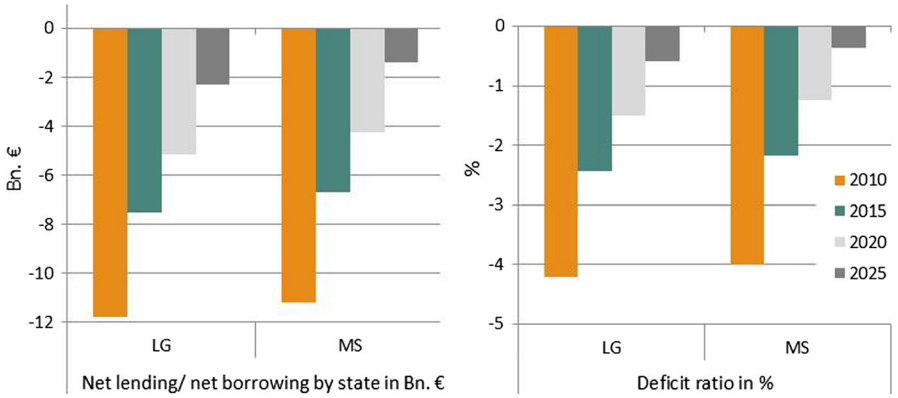

Fig. 6 Net lending/net borrowing and deficit ratio in the low-growth (LG) and policy scenario (MS). *Source* Own calculations with e3.at

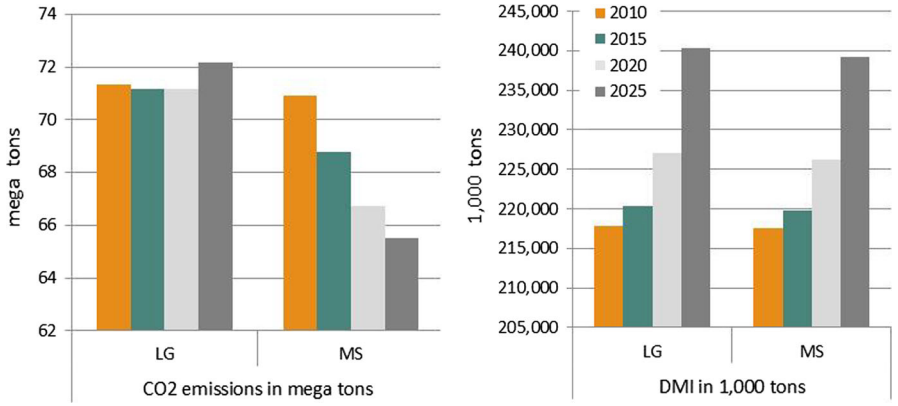

Fig. 7 Development of CO_2 emissions and DMI in the low-growth (LG) and policy scenario (MS). *Source* Own calculations with e3.at

6 Summary and conclusions

In order to comprehensively investigate the causes, consequences and strategies in coping with a persistent low growth situation, in the course of the project presented in this paper, a low-growth as well as a policy scenario have been developed and extensively analyzed with the integrated environment–energy–economy model e3.at. This integrated approach allowed to make both mutually reinforcing effects and compensating effects visible.

The results show that the macroeconomic consequences of low economic growth in Austria are substantial: the labour market suffers from a shortage of labor supply (due to reduced migration) and from a reduced demand for labor (due to reduced demand in consumption, investments and exports). The decrease in employment in

the integration scenario leads to a negative development of the disposable income of private households (tax rates and social security contributions held constant). Compared to the reference scenario, public debt is higher. Due to the assumption of slight population growth, public expenditures grow slower, however, tax incomes decrease at a higher rate.

From an ecological perspective, a persistently low growth rate in Austria leads to a slower increase of resource consumption, but not to an absolute reduction. CO_2 emissions also slightly increase in the scenarios. It can therefore not be assumed that low growth necessarily leads to the achievement of energy and environmental policy goals.

Based on the results of the low-growth scenario, a policy scenario was used for analyzing whether and how policy measures are able to cope with the negative consequences of persistent low growth. The aim was to introduce policy measures that do not generate GDP growth. Together with the clients and experts, the following four measures were chosen: a cost-neutral reduction of working time by 10 %, the introduction of a cost-neutral eco-social reform of levies, a reduction of environmentally harmful subsidies, and the promotion of the private demand for services. These measures were designed not to create additional costs for national finances.

The selected policy measures are suitable to reduce the negative economic effects of low growth. Implementing a reduction of working time as well as the eco-social reform of levies can improve the labour market situation. The negative effects on the national budget can be diminished by a reduction of environmentally harmful subsidies. Induced behaviour changes of private households are able to reduce energy and resource-intensive consumption.

What is needed is an effective implementation of wide-ranging policy measures, supported by a shift in underlying motivations and value patterns. A sustainable future calls for a gradual, but steadily strengthening transition process.

In the process of scenario modelling, participative elements have been integrated. The involvement of experts enabled to appropriately consider statistical as well as economic particularities of the Austrian economy, which improved the relevance, consistency and hence usefulness of the scenarios.

So far, the effects of persistent low-growth paths are not studied in detail. Thus, this study represents an important first step to discuss appropriate solutions for an economic slow-down. However, it should only be the starting point for further efforts to deal with this important issue. Whether or not low growth rates are considered probable, economic policy makers in Austria would be well advised to also consider this as an option for the future development and to think about appropriate measures in this context.

Acknowledgments We want to thank the clients of this project, the Federal Ministry of Labour, Social Affairs and Consumer Protection, the Ministry of Science and Research and the Federal Ministry of Agriculture, Forestry, Environment and Water Management for financing the project. In addition, we thank the expert advisory board, who enriched the project work with many valuable suggestions and inputs. Finally, we are grateful to Stefanie Gerold for proof-reading.

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