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ORIGINAL PAPER

Economic impact assessment of alternative European Neighborhood Policy (ENP) options with the application of the GMR-Turkey model

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Abstract This paper applies the GMR-Turkey policy impact model to estimate the likely regional effects of a selected set of policies suggested in the European Neighborhood Policy literature. We grouped the policy suggestions into two alternative sets of measures, which became the bases of two alternative scenarios of regional economic development, the Conservative scenario and the Technology- and innovation-based development scenario. Our results suggest that a persistent and systematic long-term regional technology development-based economic policy which applies measures such as investment, education and R&D support, promotion of better connectedness to EU research networks and increased physical accessibility to developed markets could in the longer run result in higher levels of regional and national production together with decreasing interregional differences than a scenario supporting the expansion of traditional industries in the region.

JEL Classification O31 · H41 · O40

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1 Introduction

In 2004 the European Union (EU) established the European Neighborhood Policy (ENP) with the intention of creating stability and prosperity in its immediate European Neighborhood Countries (ENCs; European Commission 2003).[1] Numerous empirical studies have reported that ENCs experience significant difficulties in improving productivity and integration with EU countries. To overcome these difficulties, the literature suggests two markedly different policy approaches. One set of studies is in favor of measures that would further strengthen ENCs' current specialization in traditional industries and intensify trade relations with economically less developed EU countries. Another strand of literature suggests that ENCs possess yet unexploited economic potentials and thus encouraging the development of higher-technology and knowledge-intensive industries, on the one hand, and trade relations with core EU 15 members on the other is a reasonable option (Bergman and Sinozic 2014).

In this paper we provide a comparative analysis of the likely effects of these two divergent policy options. The particular country selected for the analysis is Turkey. Despite that Turkey is an accession country, its economic, social and cultural features make this country reasonably comparable to many of the ENP countries. The choice of Turkey is motivated also by practical reasons: availability and reliability of data for the analysis. Despite that data collection for Turkey is not a process without difficulties, the situation in this respect is relatively more advantageous there as compared to other ENP countries (with the exception of Israel which cannot be considered as a typical ENP country for other reasons).

The assessment of the viability of one policy approach over another is not straightforward and requires special methodologies. Economic impact modeling is one of such methodologies. With the application of an economic impact model ex-ante simulations of the likely impacts of different kinds of policies become possible. Thus model results provide a platform for the comparison of several policy options. The specific model construct chosen for policy analysis is the Geographic Macro and Regional (GMR) modeling approach. GMR models have been used earlier for EU Cohesion Policy and EU Framework Program impact analyses at the levels of European regions, the European Union and Hungary. In Varga et al. (2013) we provide a detailed description of the applied GMR-Turkey model.

Following the literature we formed two alternative scenarios of regional economic development, namely the Conservative scenario and the Technology development scenario. In the model simulations we run these two scenarios separately for a selected Turkish region to assess their likely impacts on regional GDP, national GDP and interregional inequalities in Turkey. These results then provide the basis of a comparison of the effectiveness of the two policy options suggested in the literature.

This paper has the following structure. In the second section we introduce and classify policy suggestions emerging from the ENP literature. In the third section

[1] The ENP framework is proposed to the 16 of EU's closest neighbors—Algeria, Armenia, Azerbaijan, Belarus, Egypt, Georgia, Israel, Jordan, Lebanon, Libya, Moldova, Morocco, Palestine, Syria, Tunisia and Ukraine.

we introduce our representative region where the policy simulations are carried out. The fourth section presents scenario set-ups, while the fifth one outlines the applied GMR policy modeling approach. Simulation results are detailed in the fifth section. A summary closes the paper.

2 Policy options for regional economic development in EU neighborhood countries

A large number of policy interventions to foster economic development in ENCs have been suggested in the literature. These suggestions are related to numerous aspects of development like trade, labor markets, FDI, mobility, migration, remittances, innovation, diffusion of technology and institutions (Bergman and Sinozic 2014). Yet, in general these policy interventions converge in two diverse policy options rather than point to a single direction. First, a *conservative development policy option* may be identified, which is based on supporting traditional industrial sectors, the choice of trade partners with similar development levels and interventions related to labor market mismatches. Second, a *technology- and innovation-based development policy option* may also be recognized that suggests interventions targeting improving innovation inputs, the innovative environment and fostering diffusion of knowledge and technologies. Below we provide a review of the relevant empirical literature.

2.1 The conservative development policy option for ENCs and their regions

2.1.1 The focus of the literature: trade, local economic structure, human capital, and labor markets

In this strand of literature, the focus of studies is on trade patterns of ENCs, local economic structure, human capital endowments and labor market characteristics. Observed trade patterns imply that ENCs have an asymmetric trade relationship with core European regions (EU15), making it often their primary trade partner, while the opposite is not true. Anagnostou et al. (2013) find that when ENCs trade with newer EU members (accessed the EU after 2004), the impact of trade is positive on GDP growth, while trade relations with high-income EU countries have a negative impact. Kallioras and Petrakos (2013) find that ENCs trade more with their nearest EU neighbors than with the more distant core EU countries. Ongoing trade patterns and the lack of general purpose technological capabilities create a kind of path dependency that limits the regions of ENCs to diversify their industrial base and establish a more symmetric trade relationship with the more developed countries in the European Union (EU15). Low institutional development, lack of necessary resources such as human capital and supporting infrastructure, and associated uncertainties are other factors that discourage ENC regions.

A substantial and significant labor market mismatch is found in EU Neighborhood countries (Bartlett 2013), which likely further limits ENCs to expand their existing trade activities. Local culture also reduces options available to ENCs. Lebedeva and

Schmidt (2013) address that innovation adoption in ENCs is affected by gender differences and find that women are less supportive and more suspicious of innovations, especially as they get older. Evidence indicates that ENCs are best able to use their limited comparative advantages when trading with less advanced or less-sophisticated partners (Pinna 2013). These issues introduce an environment, which favors traditional industries rather than innovative sectors.

2.1.2 Policy options that favor the conservative development approach

On the grounds of circumstances analyzed in the empirical literature, several policy options emerge. ENP is in general supported, but it is also advised to take into account the specific assets of key regions, such as the quality of local infrastructures, capabilities, and the quality of regional institutions, as well as accessibility issues. A policy option under such circumstances is that the EU trade policies, incentives and supporting programs should focus ENCs trade access much more with recent EU Accession Countries than with core EU15 to maximize the potential of trade as a reform incentive. To do so, specific policies might be designed to promote trade flow parity as a whole in ENCs, by supporting sectors that are open to international imports and exports as well (Kallioras and Petrakos 2013).

Arguably, this could help in maximizing trade potentials and thus contribute to decreasing regional disparities, which, at present is a significant and increasing risk in the ENCs. It can be claimed that the EU and the ENP should assign an increased responsibility to implement and support actions that will reduce spatial disparities and asymmetries in the countries of the EU neighborhood. The EU should consider how best to calibrate its mix of conditionalities and trade concessions to address fairly the specific domestic and trade circumstances faced by its least able ENC trade partners (Bergman and Sinozic 2014).

Policy interventions targeting human capital and labor mismatches would improve conditions in the labor market, encourage expansion of trade activities and help in reducing spatial and social inequalities. Bergman and Sinozic (2014) recommend that; (a) older less skilled workers should be retrained, as well as workers of all skill levels, and (b) secondary and vocational education systems should be reformed and measures to improve the labor market matching for women workers need to be introduced such as provision of publicly provided nursery and similar services especially in the emerging market countries (such as Turkey).

A conservative development approach based on the policy options provided above could lead to expansion of labor and capital favoring existing patterns of trade and FDI structures while making better use of the current labor markets especially in the least developed ENC regions. On the other hand, the success of this approach also relies on improvements in transport connections to nearer EU countries as freight demand increases.

2.2 The technology- and innovation-based development policy option for ENCs and their regions

2.2.1 The focus of the literature: inputs to innovation, technology diffusion, and institutions

Skill endowments of well-educated labor force in the ENCs are found to have a stronger impact on innovation than formal R&D activities (Marrocu et al. 2013). Thus the role of human capital cannot be overlooked in the local generation of technology (Miguélez and Moreno 2013a). Pikalova and Mazurin (2013) suggest that there are potentials to improve innovativeness through training programs that address specific skills. In the case of Turkey, Erdil and Pamukcu (2013) have found that EU supports for innovation are effective in promoting firm-level innovation despite their small share in total R&D supports.

Available stocks of knowledge are also important innovation inputs. Most ENC regions lack accumulated stocks of knowledge. FDI in knowledge-intensive sectors in this stance could be important for stimulating patenting activities and increasing available knowledge assets for further innovations. In this respect EU-based FDI is found to be a facilitator of technology diffusion as it generates more knowledge spillovers in local economies of ENCs than FDI from other areas (Di Guardo and Paci 2013; Monastiriotis and Borrel 2013).

External technologies diffuse into regions through the mobility of researchers and their participation in research networks (Miguélez and Moreno 2013a). Mobility eliminates geographic barriers and enables access to distant sources of knowledge and technology. Inventors are central agents in ENC countries, but have a weak orientation to the EU (Autant-Bernard and Chalaye 2013). Thus inventor mobility policies can successfully intensify the transfer of knowledge (Miguélez and Moreno 2013a). Mobility of particularly young researchers and employees in industrial sectors between the EU and the ENCs are also seen as a key element in technology diffusion that quickly increases skill endowments in ENCs (Bergman and Sinozic 2014). In a similar vein, temporal migration of especially skilled workers is understood as yet another effective mechanism (Miguélez and Moreno 2013a). Mobility may also be important indirectly as remittances are found to influence education levels positively, particularly by increasing years of schooling in the receiving region Matano and Ramos (2013).

The success of programs supporting international research networks is found to be higher if regions posses embedded local networks that are globally connected (Miguélez and Moreno 2013c). Akçomak and Müller-Zick (2013) also found that fostering networks is beneficial. These findings are in line with other evidence that participation in research networks has a stronger effect in the diffusion of knowledge across regions, stronger than geographic proximity or the common language effects (Scherngell and Barber 2009). On the other hand, the likelihood of less developed regions to engage in inter-regional networks seems to be lower (Wanzenböck et al. 2014) and dynamic effects of networks to knowledge production depends on agglomeration (Varga et al. 2014).

Studies suggest that internationalization of productive systems is also an important factor in the diffusion of knowledge (Autant-Bernard et al. 2013; Autant-Bernard and

Chalaye 2013) along with cooperation in R&D (Sebestyén and Varga 2013; Miguélez and Moreno 2013a, b). Such activities ease adoption of technology (Autant-Bernard et al. 2013). On the other hand, expanded trade policies are expected to contribute also to patenting activity (Ondos and Bergman 2013a, b).

One primary issue is institutional capacity constraints (Bartlett et al. 2013; Parts 2013), while another is intellectual property rights (Favale and Borghi 2013; Yalciner et al. 2013) that hamper development of the technological base in ENCs. Boschma and Capone (2013) point out that creating a favorable innovative environment where firms can emerge and grow more easily might provide stronger incentives and opportunities for diversification. Technology parks and incubators are such institutions that foster the emergence and growth of innovative firms. Liargovas (2013) find that the EU and several neighborhood countries put different emphasis on technology parks and incubators depending on their endowments.

Cultural and institutional barriers and underdeveloped conditions limit mobility of actors and decrease knowledge diffusion, preventing innovations in ENC regions, (Autant-Bernard and Chalaye 2013), whereas weak ties with distant partners foster knowledge flows (Miguélez and Moreno 2013a). The introduction of ERASMUS MUNDUS program in this stance has been an important step for ENC countries (Wesselink and Boschma 2012).

2.2.2 Policy options that favor the technology- and innovation-based development approach

A group of policy options are available for the ENCs and their regions targeting improvement of innovation inputs, institutional structure and diffusion of technology simultaneously. The first group of policy interventions focuses on increasing inputs to knowledge production fostering innovations in ENC regions. The need to increase R&D expenditures is straightforward, though Zvirgzde et al. (2013), suggests that supports should be promoted only according to specific assets of key regions. Training supports could target skill endowments of both genders rather than development of basic skills as advocated by conservative policy approaches (Bergman and Sinozic 2014). Another option is reducing the barriers to remittances as they could finance education (Matano and Ramos 2013). In order to boost skill endowments in a short time, mobility of skilled workers and temporary migration to more advanced EU members could also be promoted.

Mobility supports also enhance diffusion of technology and innovations into ENC regions as researchers and temporary immigrants bring back embedded knowledge and relationships. In addition to mobility, supports enhancing participation in research networks might ease flow of knowledge to an ENC region. Mobility supports may likely increase also cultural proximity and enable access to distant sources of knowledge in particular industries. Yet, mobility supports should be developed together with institutions to concentrate on these industries with strategic importance, and they should be balanced for students and workers from EU countries and ENCs. To be effective, mobility supports should also ensure reintegration of returned migrants.

Bergman and Sinozic (2014) suggest that EU–ENC policies should support both adoption of external technologies and R&D collaborations while also promote research excellence and international scientific networking in lagging regions. These supports should also focus on removing capacity constraints and improve intellectual property rights. Introduction of technoparks, incubators and similar institutions by ENP supports should be considered as potentially effective interventions under this framework.

On the other hand, integration to vertical networks may be required as well to facilitate knowledge and skilled labor flows and to achieve new capabilities. Incentives provided in ENC regions should address higher-technology investments and FDI to boost opportunities of vertical integration to advanced production systems. This is particularly important as these firms stimulate patenting and innovative practices in supporting industries while also offer significant future productivity benefits leading to potential economic growth. Bergman and Sinozic (2014) point that in order to augment innovation capacities of ENC regions, connectivity between EU and ENC actors should base on the European Commission's "smart specialization" strategy. This requires that the existing technology bases and potentials of regions should be taken into account.

3 The region for the policy simulations: the TR 72 Kayseri Sivas Yozgat region in Turkey

3.1 Turkey as a case country

A challenge for simulation studies is to choose a suitable case country and case region, which represent ENC conditions. Unfortunately most ENC countries do not collect adequate spatial and temporal data. We have chosen Turkey as our case country although officially Turkey is an Accession Country. However, Turkey has some structural and cultural similarities to ENC countries like high regional inequalities, gender issues, export–import structures, transport system constraints, and Turkey's geographic proximity to ENCs. Despite significant efforts, Turkey still struggles to shift to a higher-technology- and knowledge-based economic structure and overcome chronic trade deficits with more advanced EU member states.

Turkey provides some opportunities due to data availability and its efforts to harmonize with the Acquis.[2] Policies similar to cohesion, agriculture, transport and mobility policies of the EU are applied at national and regional levels. Since the 2007–2013 period Turkey also benefits the EU-financed Instrument for Pre-Accession Assistance (IPA). This provides policy tools for regional competitiveness, human development, rural development, territorial cooperation and institutional development.

3.2 The TR72 Kayseri, Sivas, Yozgat region

The (NUTS 2 level) TR72 Kayseri, Sivas and Yozgat region (the Kayseri region; Fig. 1) is selected as the case region. It has similar features to other less developed ENC regions. The region accommodates 2.3 million people (2012), 3 % of the Turkish pop-

[2] The *Acquis* is the body of common rights and obligations that is binding on all the EU member states.

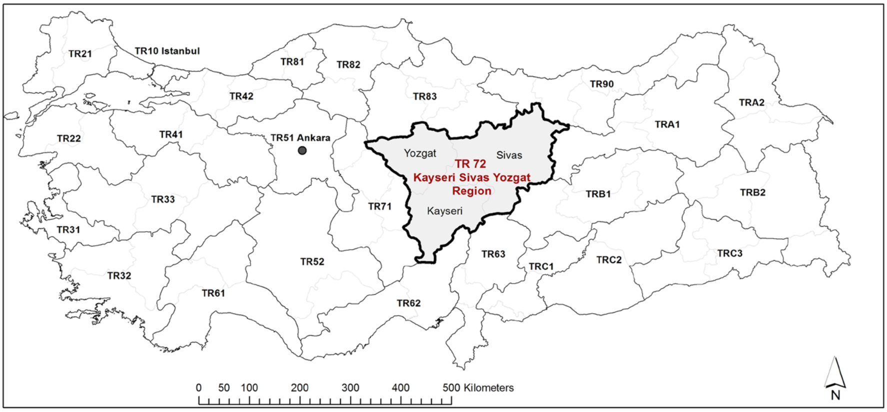

Fig. 1 The TR72 region on the map of Turkey

ulation, while covers 8 % of the land of Turkey. The region's GDP is below 75 % of the average in Turkey and thus has been designated as a priority region in the IPA program. The region has exercised an annual growth rate of 3 % in GDP during 2004–2012. It has 8 organized districts and significant amount of land suitable for industrial development.

3.2.1 Potentials in the Kayseri region for a conservative development path

Its current level of development and other features make the Kayseri region a good case to evaluate potential impacts of interventions that are based on the conservative development policy option. The region has trade relations with both higher income EU members, as well as new member states. Similar to other ENC regions trade relations with countries in the EU 15 group is asymmetric. The region's industrial structure is dominated by low- to medium-technology industries such as food and beverages, textiles and clothing, construction materials and furniture clustered around the city of Kayseri. During the 2005–2012 period, the TR72 region was designated as one of the priority regions in Turkey's economic support (incentives) program. In line with country averages, 12600 low-technology jobs (furniture, textiles, plastics) were created through the incentives. The region in general exercises trade deficit due to trade with advanced EU countries, while in rural parts trade balance is better (ORAN 2013; Yeldan et al. 2013).

Unemployment is extremely high among higher educated men (59 %). Women have on average a lower education level, but higher educated women also have high unemployment rates (39 %) for semiskilled workers. Illiteracy rates (6.4 %) are higher than the national average (4.8 %). Similar to transition countries like Ukraine or Moldova, labor market is characterized by a mismatch of skills and jobs. Turkish labor market is characterized by a high degree of gender discrimination (Bartlett 2013), which is also the case for the Kayseri region. The region also received policy supports through IPA programs that targeted re-education of women to work in traditional jobs like day-care, nursery, etc. during 2007–2013.

The constraints on the transport system limit growth prospects of industries that produce lower technology bulk products in the region. New transport projects are expected to improve the region’s access to major ports. The capacity of the freight rail connection to Samsun and Mersin ports are to be improved until the year 2023, while road connections are also being upgraded to better integrate the region to the Trans-European and Trans-Asian systems.

3.2.2 Potentials in the Kayseri region for a technology- and innovation-based development path

Interestingly, the region also accommodates a number of higher-technology industries with potentials to compete and integrate with the Western EU markets. Though an airplane factory was closed 65 years ago in the region, defense, machinery, plastics and optics industries continue their operations (ORAN 2013; Yeldan et al. 2013). The region’s registered patent stocks are very low, similar to other regions in ENP countries. Our assessment shows that despite increasing tertiary education, R&D expenditures, and patent applications, successful patent registrations are extremely low (0.38 per 100.000 people). As the TR72 region mainly imports lower technology products (Yeldan et al. 2013) learning potentials are low. On the other hand, the region has well-established universities with increasing R&D activities. TR72 has also benefited the Regional Competitiveness Operational Program under IPA as it received support for technology parks, incubators, networks and upgrading of plants during the 2007–2013 period. A technology transfer office is receiving supports in 2014–2020 period by TUBITAK.

The most advanced urban center in the region is the city of Kayseri and is designated by the Ministry of Development as one of the 15 growth centers in Turkey. The Regional Development Strategy Plan of the ORAN Regional Development Agency for 2014–2020 aims at increasing innovativeness and supporting higher-technology sectors such as optics and machinery in the region. New transport connections will make the city better connected to Western ports and provide better access to more advanced EU markets.

Increased FDI from advanced EU members, growing local investments in higher-technology sectors, higher R&D spending and better institutions could improve knowledge production. This would also increase skill endowments of labor, the likelihood of research networking due to agglomeration (Varga et al. 2014) and proximity (Wanzenböck et al. 2014) effects, and contribute to the diffusion of technology. Our own assessment shows that participation in ERASMUS MUNDUS programs or EU financed research collaborations (EU Framework programs) were much lower than in the more developed western regions of Turkey. Institutional advancement, removal of visas and increased supports could increase mobility and temporary migration of skilled workers and thus contribute to skill endowments in the region. It may well increase scientific network connections leading to higher knowledge diffusion. A high-speed rail system under construction will significantly decrease passenger trip durations and enable daily round trips between important technology centers such as Istanbul and Ankara. This may increase knowledge spillovers through increased mobility of skilled labor.

The Kayseri region could therefore choose a technology- and innovation-based development path, but it could also reinforce its current comparative advantages in traditional sectors. That is why the region is an interesting case for our policy simulations.

4 Traditional or technology-based development? Scenario set-ups

We developed two policy scenarios that reflect the messages of the ENP literature: the conservative and the technology development scenarios. These scenarios are extreme realizations of the policy suggestions. Their role is to indicate the directions where the two sets of policy suggestions would move the sample region. Surely, path dependency in policy formulation usually does not allow introducing such extreme changes in the arena of real-world policy making. However, our designs well indicate the directions where steps toward either of the policies would change the economic performance of the sample region.

The main financial instrument of the simulations is the planned EU-supported IPA budget for the period of 2014–2020. We assume that the TR72 region follows the same success rate in earning IPA financed projects as was experienced in the previous planning period (about 15 %). Thus we designed two policy scenarios where different distributions of the same total IPA financial support are assumed. In order to contrast the two scenarios that reflect policy prescriptions suggested by the literature with the actual policies followed in TR72, we designed a third scenario where we assume that the distribution of the IPA budget across policy measures follows the same pattern in the coming period as was experienced between 2007 and 2013. We call this scenario the Default IPA scenario.

IPA projects are categorized into three classes: support of private investments, R&D funding and the promotion of human resources development (education). Table 1 presents the different allocations of support for the whole period in the Kayseri TR72 NUTS2 region. In all the three scenarios, we assume an even distribution of financial supports across years during the 2014–2020 planning period.

Table 1 Scenarios with different distributions of the planned total IPA support in the Kayseri Turkish NUTS2 region (2014–2020), million EUR (2012)

	Investment support	R & D support	Human resources development	Total support
The Default IPA scenario	28.80	24.71	4.13	57.63
The Conservative scenario	57.63	0.00	0.00	57.63
The Technology development scenario	19.21	19.21	19.21	57.63

Source: Information retrieved from Ministry of Labor and Social Security, Ministry of Industry, Science and Technology, and Ministry of Food, Agriculture and Husbandry of Turkey. Data derived from announced IPA projects that are funded

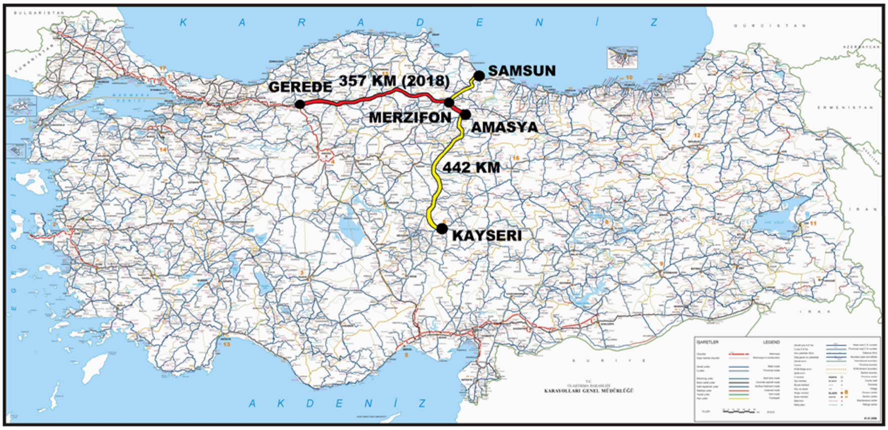

Fig. 2 Highway extensions in the Conservative scenario. *Notes* New highways of the scenario are highlighted with *yellow lines*, while motorway fragments already under construction are indicated by *red color* (color figure online)

In the Conservative scenario following policy suggestions from the literature, we assumed that the IPA budget is mainly used for supporting investment in traditional industries, which are considered competitive in those member states of the EU that accessed in the last waves after 2004. Thus we allocated the total budget to investment support. Following suggestions from the other stream of research, we designed the Technology development scenario where we assumed that the total IPA budget is allocated equally to the three categories considered: investment support, R&D funding and human resources development.

Additional to the above pecuniary regional policy instruments, we included some further policy tools in our scenarios. In the Conservative scenario, we supposed the introduction of two measures by the Turkish central government. On the one hand, we assumed that the central government of Turkey makes important steps to intensify trade with Central and Eastern European (CEE) EU countries by easing export regulations. On the other hand, the construction of new highways is assumed in order to improve the connection of the Kayseri region to an important Black Sea port, Samsun. In Fig. 2 the planned new highways are highlighted with yellow lines, while motorway fragments that are already under construction are indicated by red color. It is supposed in the scenario that transportation costs of Kayseri region products decline as a result of the new highways, which increase competitiveness in CEE markets. We assumed in the simulations that the new highways will be in operation from the beginning of 2018.

In the Technology development scenario, the set of financial instruments indicated in Table 1 is extended by some specific, innovation-related measures. The first of such instruments reflects policies targeting more successful participations in EU-funded research projects. We measure the quality of EU research networks by the Ego Network Quality (ENQ) index introduced by Sebestyén and Varga (2013). Higher values of this index reflect participation in higher-quality networks measured by the number and initial knowledge of immediate research partners, their willingness to interact with each other and the extent to which the immediate partners can help access novel

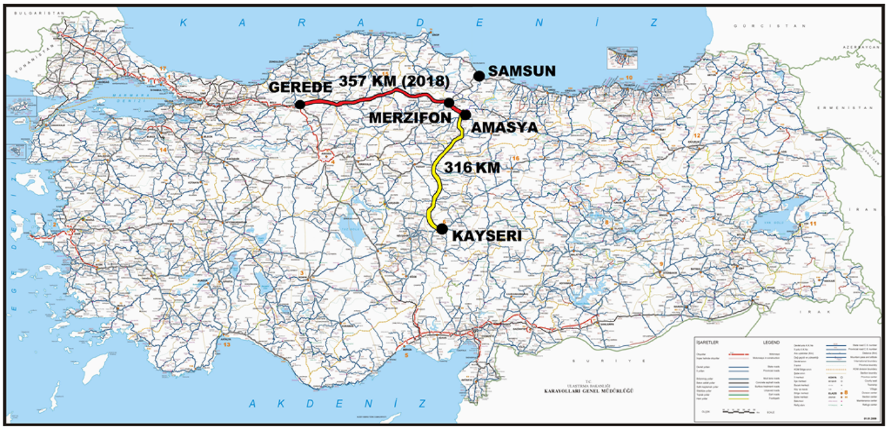

Fig. 3 Highway extensions in the Technology development scenario. *Notes* New highway of the scenario is highlighted with a *yellow line* while motorway fragments already under construction are indicated by *red color* (color figure online)

knowledge by being connected to more distant partners in the whole EU research collaboration network. We assumed that Turkish Science and Technology Policy and the partnership in the EU Horizon 2020 Program[3] successfully increases the ENQ index of the TR72 region by 10 % over the 7-year time period.

The likely positive effects of remittances on human capital are also emphasized in some of the studies in the literature. Following Kifle (2007) we assumed that a 1 % increase in remittances income increases the share of remittances spent on children's education by 6.4 %. In our scenario national policy successfully increases remittances incomes in the TR72 region by 10 % over the 7-year time period.

We also assume that the Central government of Turkey finances a highway construction project to better connect the Kayseri region to core EU markets where more technology-based products of the region are supposed to be sold. Figure 3 depicts the new highway fraction. It is supposed in the scenario that as a result of the new highway transportation costs of Kayseri region products decline which increase their competitiveness in Western markets. We assumed in the simulations that the new highways will be in operation from the beginning of 2018.

5 GMR-Turkey: a general overview

5.1 Policy instruments related to the three scenarios in GMR-Turkey

To compare the likely influences of the policies detailed in the preceding section, we apply an economic policy impact model. Policy impact models calculate the differences between the state of no intervention (i.e., the baseline scenario) and any of the simulated policy scenarios. Many of the policy simulations targeted in this paper

3 Horizon 2020 is the EU's collaborative research support program that follows the Framework Programs (FPs) from 2014.

requires specific impact modeling capabilities. The particular model we apply for the simulations is the GMR-Turkey model (Varga et al. 2013). Those instruments in the GMR-Turkey model that are relevant for policy analyses of this paper are the followings:

1. National *macroeconomic* (space-neutral) policy instruments (such as policies promoting increasing trade with EU countries, policies supporting temporary migration, specific government tax and expenditure regulations to foster research activities and innovation collaborations).
2. *Regional/local* (place-based) interventions (such as private investment support, research subsidies, promotion of more intense local knowledge flows and international scientific networking, physical infrastructure construction, promotion of human capital development by supporting education).

5.2 General features of GMR models

The GMR framework has been established and continuously improved to better support development policy decisions by ex-ante and ex-post scenario analyses. Policy instruments including R&D subsidies, human capital development, entrepreneurship policies or instruments promoting more intensive public–private collaborations in innovation are in the focus of the GMR approach.

Most models frequently applied in development policy analysis are macromodels (i.e., they focus is the national level). These models follow either the tradition of macroeconometric modeling (like the HERMIN model—ESRI 2002), the tradition of macro-CGE modeling (like the ECOMOD model—Bayar 2007) or the most recently developed DSGE approach (QUEST III—Ratto et al. 2009). However, most recently a stream of 'new generation policy impact models' (Varga 2015) emerged. These models aim to extend the traditional macroeconomic orientation of impact models toward the regional and interregional directions. GMR models belong to this stream of models.[4]

The novel feature of the GMR approach is that it incorporates geographic effects (e.g., agglomeration, interregional trade, migration), while both macro and regional impacts of policies are simulated. Why does geography get such an important focus in the system? Why is the system called "regional" and "macro" at the same time?

Geography plays a critical role in development policy effectiveness for at least four major reasons. First, interventions happen at a certain point in space and the impacts might spill over to proximate locations to a considerable extent. Second, the initial impacts could significantly be amplified or reduced by short-run (static) agglomeration effects. Third, cumulative long run processes resulting from labor and capital migration may further amplify or reduce the initial impacts in the region resulting in a change of the spatial structure of the economy (dynamic agglomeration effects). Forth, as

[4] The MASST (Capello 2007) and the RHOMOLO (Brandsma et al. 2015) models should also be referred here. Though GMR, MASST and RHOMOLO are different in many respect in their internal structures (e.g., MASST is a partial equilibrium econometric model, RHOMOLO is a general equilibrium, SCGE model on six industries, the GMR model is an integrated econometric-SCGE–DSGE model) they share the common interest of incorporating geographic effects into their model structures.

a consequence of the above effects, different spatial patterns of interventions might result in significantly different growth and convergence/divergence patterns.

‘Regions’ are spatial reference points in the GMR approach. They are sub-national spatial units ideally at the level of geographic aggregation, which is appropriate to capture proximate relations in innovation. Besides intraregional interactions, the model captures interregional connections such as knowledge flows exceeding the regional border (scientific networking or spatially mediated spillovers), interregional trade connections and migration of production factors.

The ‘macro’ level is also important when the impact of development policies is modeled: fiscal and monetary policy, national regulations or various international effects are all potentially relevant factors in this respect. As a result, the model system simulates the effects of policy interventions both at the regional and the macroeconomic levels. With such an approach different scenarios can be compared on the basis of their impacts on (macro and regional) growth and interregional convergence.

The GMR framework is rooted in different traditions of economics (Varga 2006). While modeling the spatial patterns of knowledge flows and the role of agglomeration in knowledge transfers, it incorporates insights and methodologies developed in the geography of innovation field (e.g., Anselin et al. 1997; Varga 2000). Interregional trade and migration linkages and dynamic agglomeration effects are modeled with an empirical general equilibrium model in the tradition of the new economic geography (e.g., Krugman 1991; Fujita et al. 1999). Specific macroeconomic theories are followed while modeling macrolevel impacts.

The first realization of the GMR approach was the EcoRET model built for the Hungarian government for ex-ante and ex-post evaluation of the Cohesion policy (Schalk and Varga 2004). This was followed by the GMR-Hungary model, which is currently used by the Hungarian government for Cohesion policy impact analyses (Varga 2007). GMR-Europe was developed within the IAREG and GRINCOH FP7 projects (Varga et al. 2011, 2015) and was applied for policy simulations for DG Regional Policy (LSE 2011).

5.3 GMR-Turkey: geographic and temporal dimensions, policy variables

GMR models reflect the challenges of incorporating regional, geographic and macroeconomic dimensions in development policy impact modeling by structuring the system around the mutual interactions of three sub-models such as the total factor productivity (TFP), spatial computable general equilibrium (SCGE) and macroeconomic (MACRO) model blocks. Following this approach the macroeconomic model of GMR-Turkey calculates policy impacts at the national level, while the 26 NUTS 2-level regional models provide results at the regional level. The model system provides policy simulation results for the 2015–2030 time period.

Some of the policies subject of this paper is modeled in the macroeconomic block (such as changes in international trade) via policy shocks affecting specific macroeconomic equations. However, most of the policies stimulate the regional base of economic growth such as investment support, infrastructure building, human capital development, R&D subsidies, promotion of (intra- and interregional) knowledge flows. In the following sub-section, we focus on mechanisms of these latter policies.

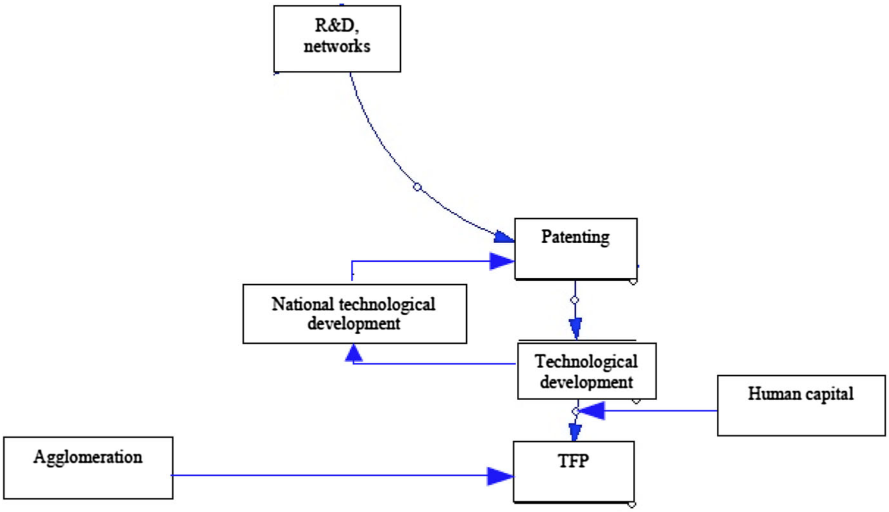

Fig. 4 The impact mechanisms of R&D and knowledge networks and human capital promotion

5.4 Regional impact mechanisms of the main policy variables

5.4.1 R&D support, interregional knowledge networks and human capital

Figure 4 provides a schematic illustration on the way the impacts of policies targeting R&D support, interregional knowledge networks and human capital are modeled in the TFP block.

Economically useful new technologies are measured by number of patents in the model. R&D support and interregional networks affect the economy via its impact on patenting. Increasing patenting activity affects positively regions' general technological levels (measured by the stock of patents), which determines productivity measured by total factor productivity. In the model, the extent to which technological development affects TFP is influenced by human capital in the region. The impacts of the promotion of R&D, networking and human capital on economic variables (prices of quantities of inputs and outputs, etc.) are calculated in the SCGE block. Economic impacts of increased productivity are modeled in the SCGE block in the following steps.

1. Short-run effects
   The impact in the short-run results from the interplay between the substitution and output effects. Assuming that the level of production does not change the same amount of output can be produced by less inputs that is the demand for capital (K) and labor (L) decrease as a result of the interventions. However, increased TFP makes it also possible to decrease prices to keep firms more competitive, which positively affects demand. This latter effect is called the output effect. The interaction of output and substitution effects might result in the increase of the demand for factor inputs (K and L) but also the impact can be just the opposite. What will actually happen is an empirical question. In case output effect exceeds substitution

effect wages will increase in the short run, which together with the relative decrease in prices will result in increasing consumption and higher utility levels.

2. Long-run effects
Increased utility levels result in in-migration of labor and capital into the region, which will be the source of further cumulative effects working via centripetal and centrifugal forces. Labor migration increases employment concentration, which is a proxy for positive agglomeration effects in the model. According to findings in the literature localized knowledge spillovers intensify with the concentration of economic activity in the region (e.g., Varga 2000). A higher level of employment thus increase TFP (as shown also in Fig. 4), which further reinforces in-migration of production factors following the mechanisms described above. However increasing population also affect the average size of flats negatively which works as a centrifugal force in the model. The balance between centrifugal and centripetal forces will determine the long-term cumulative effect of policies at the regional, interregional and macroeconomic levels.
3. Changes resulting from interventions on the quantities and prices of outputs and factors are calculated in the SCGE model both in the short run as well in the long run.

5.4.2 Infrastructure investments

Infrastructure investments increase the level of public capital in the region. It is modeled via a Cobb-Douglas production function where the inputs are labor, private and public capitals. Thus infrastructure investments are modeled as externalities, which eventually affect regional TFP levels. Public investments are also modeled in the macromodel via the increase of public capital.

5.4.3 Private investment support

One of the policies suggested is the support of investment by small- and medium-sized enterprises. The mechanism of this policy instrument affects the model via the increase in private capital, which has further impacts on several other variables both in the region where the intervention occurs and in other regions connected by trade or migration linkages. Private investment support is also modeled in the macromodel via the increase of private capital.

5.5 Macroeconomic impacts

The effects of policies are communicated to the macromodel by changes in TFP (aggregated from the regional level) and changes in fiscal variables (such as the demand and supply impacts of investment support and physical infrastructure construction). Changing TFP results in an increase of GDP growth rate which, will increase factor demand resulting from their higher marginal productivities. As a result the level of GDP will be higher than what would be observed in its long-run equilibrium path. Infrastructure investments and private investment support induce both demand and supply side effects. The demand side (e.g., increased government expenditures) effect on GDP is temporary, while the supply side effects (via increased public and private capitals) stabilize in the long run.

5.6 Impact mechanisms in the GMR model

The mutually connected three model-block system is depicted in Fig. 5 below. Without interventions, TFP growth rate follows the national growth rate in each region. The impacts of interventions run through the system according to the following steps.

1. Resulting from R&D-related interventions as well as human capital and physical infrastructure investments (which increase public capital and eventually impact the level of TPF as well) regional total factor productivity increases.
2. Changing TFP induces changes in quantities and prices of output and production factors in the short run, while in the long run (following the mechanisms described above) the impact on in-migration of production factors implies further changes in TFP not only in the region where the interventions happen but also in regions which are connected by trade and factor migration linkages.
3. Increased private investments expand regional private capital which affects further changes in regional variables (output, prices, wages, prices, TFP, etc) in the SCGE model block. The impact of private investment support affects the macromodel as well via increased private capital.
4. For each year changes in TFP are aggregated to the national level then this increases TFP in the macromodel as time specific shocks. The macroeconomic model calculates the changes in all affected variables at the national level.
5. Changes in employment and investment calculated in the MACRO block are distributed over the regions following the spatial pattern of TFP impacts.

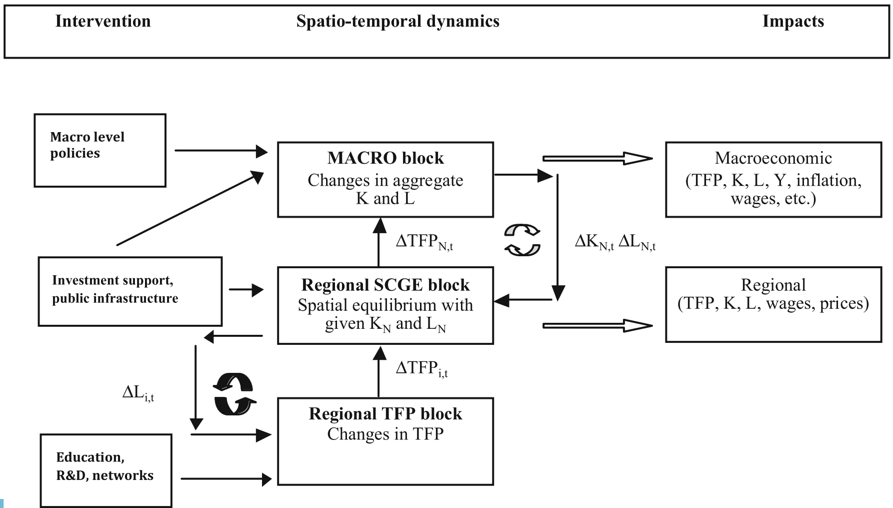

Fig. 5 Regional and macroeconomic impacts of the main policy variables in the GMR-Turkey model

6. The SCGE model runs again with the new employment and capital values to calculate short-run and long-run equilibrium values of the affected variables.
7. The process described in steps 5 and 6 run until aggregate values of regional variables calculated in the SCGE model get very close to their corresponding values calculated in the MACRO model.

6 Traditional or technology-based development? Scenario results

In this section we present our Conservative and Technology development scenario results on three policy outcomes: the impact on TR72 regional GDP, on the national GDP and on interregional inequalities in Turkey.

As a benchmark case we first calculated the likely impacts at the regional level of a policy that would follow the 2007–2013 planning period distribution of the IPA budget across the three main categories (i.e., the Default IPA scenario). Figure 6 presents scenario results on regional GDP. The values are percentage differences between GDP calculated following the Current IPA scenario and the GDP, which is assumed in the case of no intervention (i.e., the baseline scenario). The red line depicts the temporal pattern of policy impacts. Interventions are equally distributed across the years of the planning period. The first year when a small impact already observed is 2015. Starting with this year the impacts on regional GDP increases until it saturates in 2021 and 2022 at about 0.12 %. After 2022 the impact decreases with a decreasing speed until it reaches its long-term level (not shown in Fig. 6). This long-term impact reflects changes induced by policy actions in the production structure of the regional economy. A higher stock of capital, some increase in the regional knowledge base and more educated people bring regional output to a higher level.

Figure 7 presents the results of the Conservative scenario. It is assumed that the total IPA budget is allocated to investment support in traditional industries. As shown in the figure the highest impact of investment support (denoted by the dotted green line) is estimated for 2022 at a value of about 0.045 %. Following the policy suggestions in the literature, we also assumed that the Central government of Turkey successfully

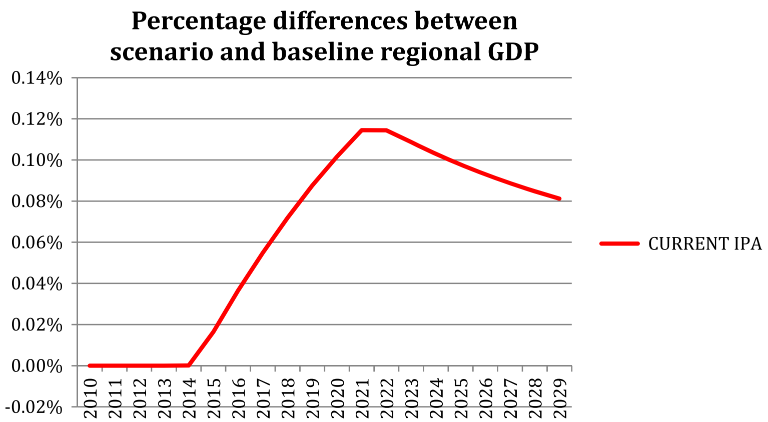

Fig. 6 The effect of the Default IPA scenario on TR72 GDP

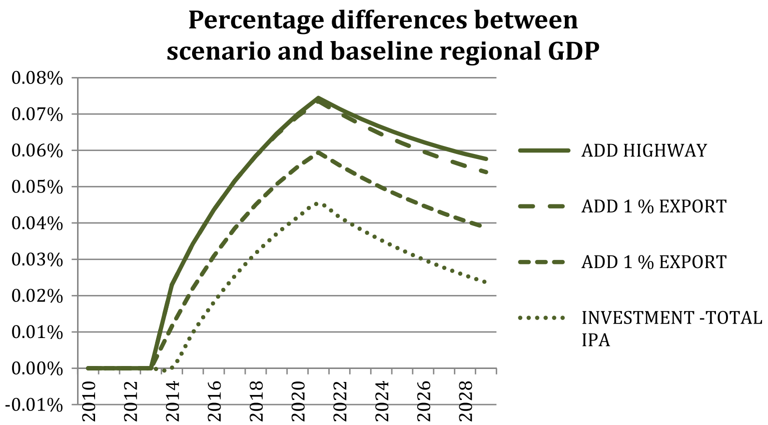

Fig. 7 The effect of the Conservative scenario on TR72 GDP

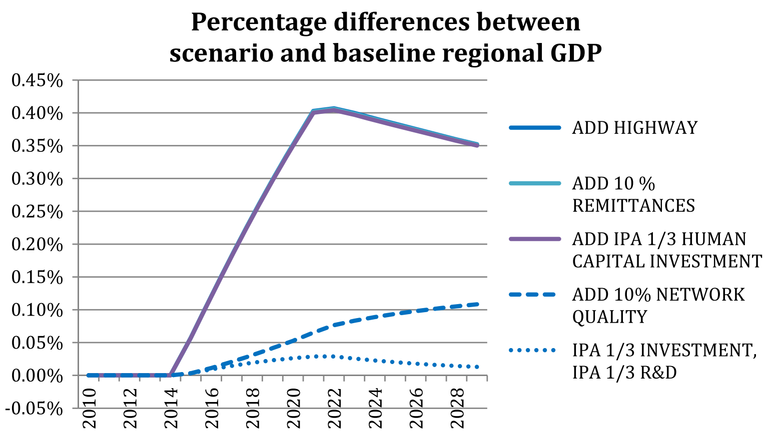

Fig. 8 The effect of the Technology development scenario on TR72 GDP

introduces policy measures to increase export demand. As indicated by the top dashed green line in Fig. 7 a 2 % increase in export will likely increase the peak impact in 2022 to about 0.075 %. In case accessibility to the Black Sea port in Samsun is improved by a highway investment, it will start increasing regional GDP in 2022. As Fig. 7 shows the highway will increase the impact of export promotion policies over time. The peak total impact of all the policies included in the Conservative scenario is about 0.075 estimated for the year 2022.

Figure 8 depicts simulation results of the Technology development scenario. Investment support paired with R&D funding has a relatively minor impact compared to impacts observed in the previous two scenarios. The peak year is 2021 with an about 0.0025 % improvement on regional GDP (as shown by the blue dotted line). However, it seems that policies aiming at improving HORIZON 2020 participation help bring new knowledge into the TR72 region and with this new knowledge the utilization of

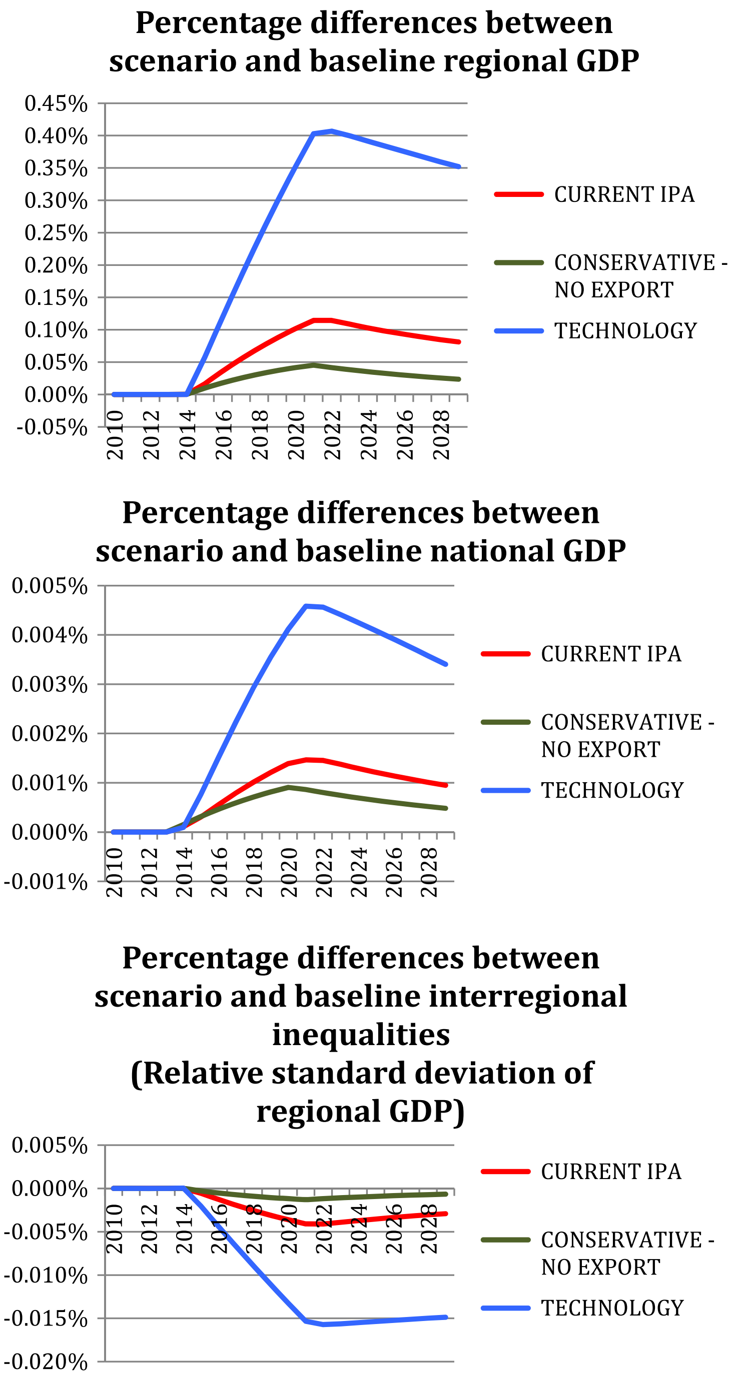

Fig. 9 Comparison of the effects of the three scenarios on regional GDP, national GDP and interregional inequalities

the budget spent on R&D becomes more efficient (depicted by the blue dashed line).[5] As indicated in Table 1 one-third of the IPA budget is allocated to human capital development. It seems that this policy is one of the most effective knowledge-based policies for the TR72 region. With investments in education, the peak impact in 2022 increases to 0.40 %. According to the simulations, the 10 % increase of remittances income in the TR72 region over the planning period does not have meaningful impacts on human capital and regional GDP. Also, improved accessibility by the construction of the new highway does not seem to improve meaningfully the GDP impact of knowledge-based policies over the observation period.

In Fig. 9 we compare the impacts of the three scenarios on regional GDP, national GDP and on interregional inequalities. Following previous notation, the Current IPA scenario results are marked by the red lines, the Conservative scenario impacts by the green lines and the Technology scenario effects by blue lines.[6] The figure indicates that the Conservative scenario does not reach the effectiveness of even the Current IPA scenario. That is a pure investment support even if it is paired with export promotion (as the comparison of the peak values of Figs. 6 and 7 suggests) does not seem to be more effective than the current policy governing the spending of the regional IPA budget. Figure 9 suggests that even in a less technologically advanced region as the Kayseri region technology development seems to be a realistic option for policy. R&D and investment support paired with increasingly better positions in EU knowledge networks and investments in human capital could transform the region to a more successful territory of Turkey in the longer run. National level impacts are also presented in Fig. 9. The Technology development scenario effect results in the highest impacts on both Turkey's GDP and on regional cohesion.

7 Summary

In this paper we presented our policy impact analysis results which we carried out with the application of the GMR-Turkey model. The policy measures incorporated into the simulations followed suggestions from the ENP literature. We grouped policy suggestions into two alternative sets of measures which became the bases of two alternative scenarios, the Conservative scenario and the Technology development scenario. The target region of our simulations was the Kayseri NUTS2 region (TR72) of Turkey. As argued in the paper, we can consider this region as being quite close to the economic characteristics of typical ENP regions. Policy impacts on regional GDP, Turkey's national GDP and interregional inequalities are estimated in the paper.

[5] The ENQ effect may appear quite significant in comparison with the R&D effect. In our observation it is because the relative weight of the change in ENQ is more significant than that of the change in R&D. While the allocated IPA funding increases R&D by about 2 %, the increase in ENQ by the end of the 7-year period is 10 %, which is in our observation a really significant improvement in the composition of research partners.

[6] Note that we depicted the impacts of the Conservative scenario without accounting for the effects of the 2 % increase in export. The specific reason is that the model is not capable of differencing between export increase impacts on a particular region and the impacts on all the regions at the national level. Consequently the export impact at the national level would include increased the effects of export activities in all the regions of Turkey and not only the impacts coming from the Kayseri region.

Our results suggest that a persistent and systematic long-term regional technology development-based economic policy which applies measures such as investment, education and R&D support, promotion of better connectedness to EU research networks and increased physical accessibility could in the longer run result in higher levels of regional and national production together with decreasing interregional differences than a scenario supporting the expansion of traditional industries in the region.

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