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Petrochemical export taxation as energy-industrial policy in Iran: a product-specific value-chain analysis

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ABSTRACT

As a hydrocarbon-rich economy, Iran faces an energy-policy challenge in deciding whether to export oil and gas feedstocks as basic petrochemical products or convert them into higher-value materials. Iran's petrochemical exports remain concentrated in basic and intermediate products, while downstream exports are limited. Using a descriptive-analytical design, documentary analysis, financial scenario analysis, and a comparative policy case study, this article examines the evolution of Iran's petrochemical tax and export-duty policy from 2021 to 2025. The findings show that the initial approach sought to reduce the attractiveness of exporting basic and intermediate products by removing tax exemptions or imposing export duties. Evidence from the quantitative analysis reveals a structural imbalance between export volumes of raw materials (US\$11.24 billion) and upstream and intermediate petrochemicals (US\$11.43 billion) and the exports of downstream industry, which stood at US\$0.36 billion in 2018. Import volumes of downstream industry were about US\$0.56 billion and thus exceeded its export volumes. Policy projections for the modified tariff system generated about US\$200 million in revenue. Taxes and tariffs can only support value chain upgrading if there is downstream capacity, comparative advantage, market demand, technological capability, and justifiable economies of scale. A comparative assessment of urea, methanol, and polyethylene shows that a one-size-fits-all policy is not appropriate for all these products. Overall, urea was eliminated, methanol was encouraged, and polyethylene needs support. The study concludes that export duty policy should move towards a more precise, product-oriented, and value chain-based regulation.

1. Introduction

In recent decades, countries with natural resources, especially those with oil and gas reserves, have increasingly focused their industrial development policies on improving their position in global value chains [1]. In such an approach, the main goal of policymaking is not simply to increase the production or export of raw materials. It is also to move toward higher-value-added products, develop downstream industries, create sustainable employment, and reduce dependence on single-product exports [2-4]. As one of the most important links between hydrocarbon resources and chemical manufacturing, the petrochemical industry plays a central role in achieving these objectives [5]. From an energy-

policy perspective, the petrochemical sector also helps determine how gas, crude-oil derivatives, and condensates are allocated among direct energy uses, bulk chemical production, and higher-value material conversion. The way in which taxes are applied and export incentives are provided can affect, in addition to the trade mix and the level of industrial development, the economic productivity of hydrocarbon feedstocks. Therefore, taxation of petrochemical exports should be considered a common issue among energy economics, industrial policy, trade policy, and public finance. Despite such capacity, the bulk of Iran's petrochemical exports still consist of primary and intermediate products. In fact, a large share of exported goods are produced in the

primary and intermediate links of the value chain, and downstream products play a limited role in total exports. On the other hand, the dependence of some domestic industries on imports of final products indicates that the country's petrochemical value chain is not structurally balanced; a situation that is referred to in the industrial policy literature as an incomplete value chain [6,7].

This issue has gained particular importance from a policy perspective because continuing to export basic and semi-processed products, while importing higher value-added goods, can reduce the country's industrial depth, limit the path of domestic technology development, and eliminate job opportunities in downstream industries. For this reason, designing tools that encourage firms to develop the value chain has become an important axis of Iran's industrial and financial policies [8,9]. Within this framework, policymakers have used tools such as setting feedstock prices, granting tax exemptions, and, especially, imposing taxes and duties on the export of raw and semi-processed materials. The initial logic was that by reducing the profitability and attractiveness of basic product exports, firms' economic incentive to invest in downstream industries would increase and incomplete links in the domestic value chain would be completed [10,11]. However, the experience of implementing these policies shows that export taxes and duties are not simply a means of generating revenue or restricting exports. Their effectiveness depends on conditions such as the real possibility of developing downstream industries, the country's comparative advantage, access to technology, the availability of appropriate economies of scale, and the existence of stable domestic or export markets. If these preconditions are not met, such instruments may only increase production and export costs rather than strengthening the value chain [12,13]. Accordingly, the main research question is to determine to what extent Iran's tax and export duties policies for crude and semi-processed petrochemical products have been designed with the logic of the value chain and how these policies have moved from a general and classification-based approach to a more precise, product-oriented approach relying on value chain analysis.

Studies related to raw material export restrictions and value chain development can be categorized into three main axes: first, the political economy of export restrictions; second, policies to promote the value chain and expand downstream industries; and third, the evaluation of punitive instruments in industrial policy. Fung and Korinek [14] have shown that governments widely use export duties, quantitative restrictions, and export bans in the raw materials sector. In their view, the geographical concentration of production, firms' high market power, and the existence of monopoly structures have made mineral and energy markets more susceptible to government intervention than other sectors. However, these researchers warn that such policies may distort global markets, reduce the efficiency of resource allocation, and have complex distributional consequences for governments, producers, and consumers.

Bouët et al. [15] examine the effect of differential export taxes along a value chain. Using a partial-equilibrium model, they show that higher rates on raw materials combined with lower rates on processed products may increase government revenue and encourage production at downstream stages.

Their simulation results nevertheless indicate that policy effectiveness depends heavily on market structure and the supply and demand elasticities associated with each link in the chain; consequently, uniform outcomes cannot be expected across industries. Similarly, Östensson [16], in examining domestic-processing requirements, concludes that instruments such as export bans or export duties do not necessarily generate sustainable downstream development. In many countries, export restrictions reduced raw-material exports but failed to establish competitive downstream industries unless infrastructure, technology, and comparative advantage were also present.

Bobylev et al. [17], in a study of Russian policies governing exports of crude oil and petroleum products, show that changes in export-duty structures altered production and export patterns throughout the oil and petrochemical chain. Their analysis shows that changes in upstream and downstream taxes can directly affect firms' decisions and behavior; however, the magnitude and direction of these effects vary by case and depend largely on domestic market structure. More broadly, industrial policy studies suggest that value chain promotion is possible only through coordination among trade policies, technology policies, and investment incentives. Using a systematic literature review and bibliometric analysis, Tsani et al. [18] examined domestic content policies in natural resource-based industries. Their findings showed that these policies can help create jobs, transfer technology, and strengthen domestic firms' linkages to the supply chain. However, their success depends on policy design, institutional capacity, and alignment with the Sustainable Development Goals. This study emphasizes that restrictive or supportive policies should not be implemented in isolation from other instruments but should be designed and implemented as part of an evidence-based policy package.

Jennings et al. [19] examined the structure of the petrochemical industry in 152 countries and classified countries into eight structural patterns based on their degree of dependence on the production, trade, and consumption of petrochemical products. The findings showed that, because countries differ in production structure, supply chains, and economic conditions, a single policy is not effective for all. This result supports the need to design policies tailored to each country's characteristics and, at a more granular level, to each product and value chain link. In this regard, Xu et al. [20] combined value chain accounting and a system dynamics model to examine different development paths of the coal-to-olefin chain in Inner Mongolia. The results showed that increasing the depth of the chain, especially moving toward polymers and final products, usually creates more economic value; however, the effects of carbon pricing, production cost, and oil price fluctuations differ across paths. Therefore, selecting the downstream link should be based on a simultaneous assessment of value added, cost, market, and risk.

By studying the domestic content policy of the Brazilian oil industry from 2003 to 2017, Trojebicz and Françoso [21] showed that industrial policy design is not only subject to technical and economic calculations but is also affected by stakeholder interests, the government's executive capacity, and political conditions. This policy was implemented with

the aim of increasing domestic profits from the development of oil resources; however, factors such as corruption, bankruptcy of several companies, and weak implementation institutions reduced its effectiveness. This research shows that a distinction should be made between a policy's formal design and the country's actual capacity to implement it.

A review of the literature shows that most previous studies have examined taxes, duties and other export restrictions using trade theoretical models or partial equilibrium simulations. In contrast, the actual process of policy changes over time and at the national and industry levels has received less attention. Also, the existing literature does not provide clear practical criteria for determining which products should be considered raw or semi-processed, or when they should be removed from this classification, because most analyses have relied solely on the order of processing steps. This article attempts to fill this gap by examining Iran's petrochemical policies between 2021 and 2025. The main argument is that the success of export duties cannot be measured solely by a product's apparent position in the value chain. What matters is the real possibility of developing downstream links, the existence of comparative advantages, technological capability, and the availability of appropriate economies of scale. The most important achievement of the research is also the shift in the analytical approach from simple product classification into raw and semi-processed categories to a reverse analysis of the value chain. The results show that tax and duty policies can support industrial development only when they are designed separately for each product and are commensurate with the actual capacity of that product chain. Accordingly, this article examines the evolution of tax and duty policies for exports of Iranian petrochemical products between 2021 and 2025. Its main objective is to clarify why the initial classification of products as raw or semi-processed gave way to a value chain approach and to analyze the reverse. In addition, the research identifies the limitations of using tax instruments to promote value chain development.

2. Methodology

This is an applied, analytical-descriptive study conducted through a policy case-study approach. Its principal objective is to analyze the evolution of Iran's tax and export-duty policy for raw and semi-processed petrochemical materials from a general deterrent policy toward a product-specific approach based on value-chain analysis. Because the research concerns a real policy process within a defined period, a case-study design was selected to examine policy evolution, the underlying decision logic, and its analytical implications. The policy period covered by the study extends from 2021 to 2025. The year 2021 marks the point at which the taxation and export-duty treatment of raw and semi-processed petrochemical products became a major issue in budget legislation and fiscal policy. By 2025, the policymaker's approach to reviewing the list of raw and semi-processed products had shifted toward a more detailed value-chain assessment. For the baseline analysis and fiscal-effect estimates, however, trade and financial data from 2018 and 2019 were used because these data underpinned the initial estimates of the effects of removing export and regional tax exemptions in the petrochemical industry.

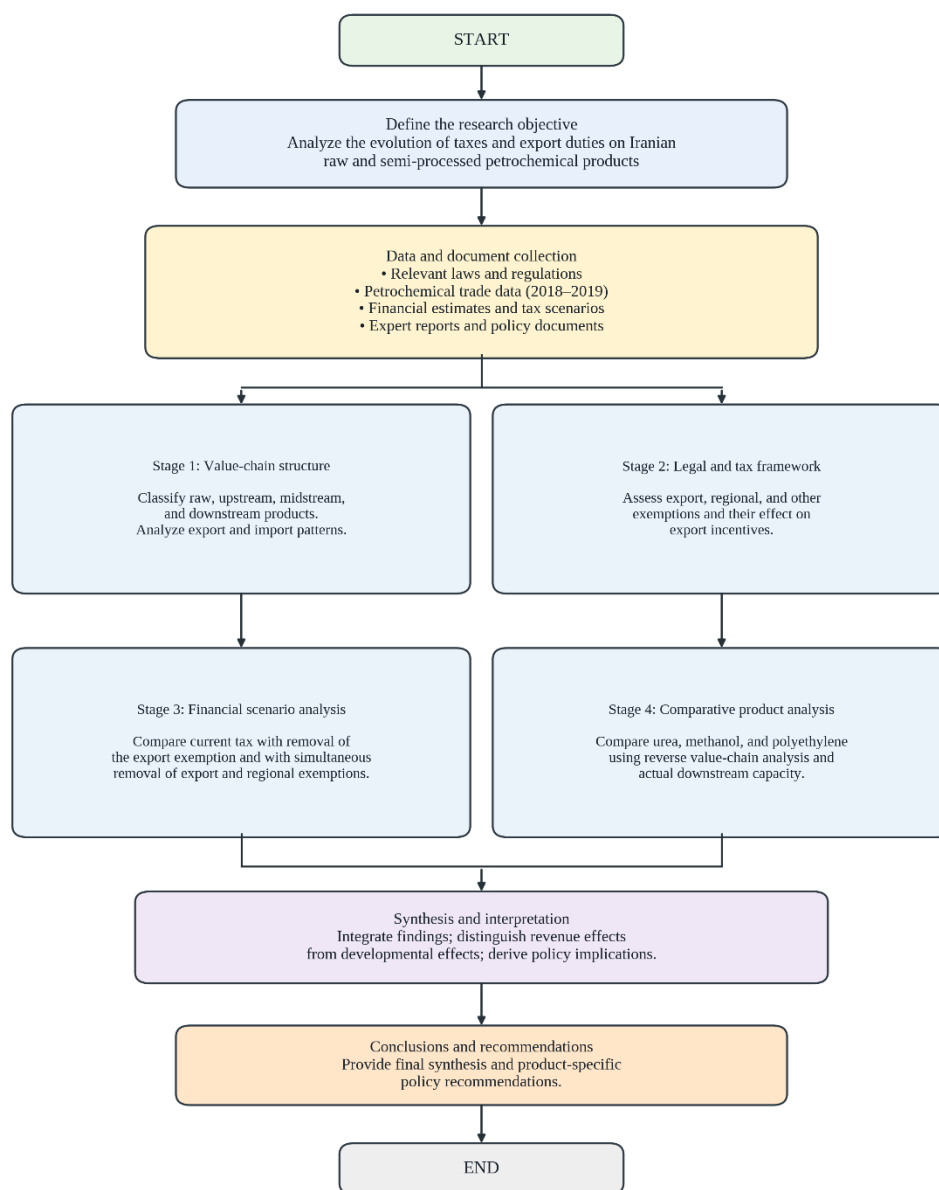
The primary unit of analysis is the tax and export-duty policy applied to petrochemical products. At a more detailed level, urea, methanol, and polyethylene were selected as comparative cases because of their prominent role in the initial policy, their substantial contribution to petrochemical exports, and their fundamentally different downstream-development potential. Urea represents a product that was removed from the raw and semi-processed list during policy revision. Methanol represents a product for which high duties were replaced by minimal duties and targeted incentives. Polyethylene represents a product for which policy must distinguish between the export of polymer resin and the development of downstream conversion industries. The research draws on evidence from four groups of sources. First, the evidence comes from laws and regulations relating to taxes, export taxes, and export and regional exemptions. Second, the evidence comes from statistics on exports of raw products and upstream, midstream, and downstream petrochemical products. Third, evidence comes from financial estimates of existing and potential taxes in two scenarios: removal of export exemptions only, and removal of export and regional exemptions together. Lastly, evidence comes from expert opinions and documents on the classification of raw and semi-processed products and their respective duty rates.

The analysis process was carried out in four stages. In the first stage, the structure of the Iranian petrochemical value chain was examined by separating raw, upstream, midstream, and downstream products, and the export and import pattern of each sector was analyzed. The goal of this stage was to identify the structural concentration of exports in the initial and middle links of the chain and to demonstrate the relatively poor performance of downstream products in exports. In the second stage, the legal and fiscal framework preceding the policy intervention was assessed. This stage examined the effect of export exemptions, regional exemptions, and other tax incentives on the attractiveness of exporting basic and semi-processed petrochemical products. The analysis explains why, in 2021, policymakers adopted taxes and export duties to reduce the attractiveness of raw and semi-processed exports. In the third stage, the analysis examined financial scenarios. The analysis compared the current tax rates paid by petrochemical companies with two hypothetical scenarios. In the first scenario, the export tax exemption was eliminated; in the second, the export and regional exemptions were eliminated simultaneously. This comparison showed the policy's potential to generate revenue and revealed differences among petrochemical units with gas, liquid, and intermediate feed.

In the fourth stage, the three products urea, methanol, and polyethylene were evaluated comparatively. In this study, we considered not only each product's apparent position in the value chain, but also the feasibility of developing downstream industries, the domestic market's absorption capacity, the state of export markets, technological needs, economies of scale, and the country's comparative advantage. On this basis, the study used reverse value chain analysis: first identifying the final product or downstream link with development potential, then evaluating the base product's role in forming and completing that chain.

To strengthen the analysis, the study compared findings from different sources and levels of investigation. Financial and export data illustrated the quantitative dimensions of the problem, while analysis of laws and policy documents explained the logic of decision-making. Comparing the three products also prevented generalizing a single conclusion to all petrochemical products and showed that export duty policy should be designed in accordance with each product's characteristics and the actual capacity of its downstream sector. Therefore, the research design consists of three complementary methods: document analysis, examination of financial scenarios, and comparative case study. Together, these methods allow examination of the legal and institutional environment, estimation of potential financial impacts, and analysis of product differences from the perspective of value chain development.

To clarify the analysis, the tax leverage ratio used in the subsequent parts of the research is obtained by dividing the potential tax in each scenario by the current tax of the same year. This index indicates the relative severity of the financial impact of removing exemptions but is not a suitable measure of the policy's industrial or developmental effectiveness alone. Figure 1 illustrates the process of methodology of this study. The process starts with formulating the research aim, then collecting data, and continues through four steps: analysis of the value chain, legal and financial analyses, financial scenario evaluation, and product comparison. Finally, the research is concluded with the conclusion and policy suggestions.



Research design: documentary analysis + financial scenario analysis + comparative policy case study

Figure 1. Flowchart of research methodology

3. Results

3.1 Semi-processed exports in Iran's petrochemical value chain

From an industrial policy perspective, the petrochemical industry is a key tool for increasing the economic value of a country's oil and gas resources. In this chain, resources such as natural gas, crude oil, and condensates are first converted into basic chemicals, then into intermediate products, and finally into final products with specific applications. Moving from the initial links of the chain to the final stages usually increases value added, product diversity, job creation, technological development, and reduces export vulnerability. In the conventional classification of the petrochemical value chain, the upstream sector includes basic chemicals directly derived from oil and gas products. Methanol, ammonia, aromatic compounds such as benzene, toluene, and xylene, as well as olefins such as ethylene, propylene, and butylene, fall into this group. In the midstream sector, upstream chemicals are consumed as feedstocks and converted into industrial and intermediate products.

Ethylene glycols, acetic acid, MTBE, styrene, formaldehyde, acetone, phenols, urea, and polymers such as polyethylene, polypropylene, and PVC are among this sector's products. The downstream chain also includes industries that produce rubber, plastics, detergents, paints, resins, packaging, components, pipes, profiles, fibers, textiles, and other industrial and consumer goods. Despite this capacity, 2018 statistics show that Iran's petrochemical exports were mainly concentrated in the primary and intermediate links of the chain. In that year, raw material exports reached \$11.24 billion, upstream and intermediate products were exported at \$11.43 billion, and downstream product exports totaled only \$0.36 billion. In contrast, downstream imports were about \$0.56 billion, higher than the sector's exports. This pattern shows that Iran, despite its extensive exports of primary and intermediate products, still imported a portion of its final products. In such circumstances, the main question for policymakers was why an upstream producer should supply its product domestically or invest in completing the value chain, when tax breaks, lower feed prices, regional exemptions, and access to foreign markets made exporting the same product more profitable. In the initial response, export taxes and duties were used to reduce the attractiveness of exporting raw and semi-processed products.

3.2 The legal framework before 2021: the effect of exemptions

Before 2021, Iran's petrochemical industry tax system was shaped by exemptions and incentives that reduced the effective tax rate and made exports of basic and semi-processed products more attractive. According to Article 105 of the Direct Taxes Law, the standard corporate income tax rate was 25 percent. However, Article 141 provided for a zero-tax rate for exports of non-oil goods, effectively exempting a significant portion of petrochemical exports from tax. Although the same article stipulated that 20 percent of revenue from raw material exports would be subject to tax, the 2017 Cabinet Resolution did not classify any petrochemical products as raw materials. Thus, exports of petrochemical products were effectively fully exempt from tax. Regional incentives also played an important role in

reducing the effectiveness of tax policies. Free trade zones were granted 20-year exemptions, less developed zones 10-year exemptions, special economic zones and industrial estates 7-year exemptions (extendable to 13 years in some cases), and other areas 5-year exemptions. Such a structure could counteract the effects of policies designed to discourage exports. The capital market-related exemptions and Article 143 of the Direct Taxes Law, especially the incentives related to supply through the commodity exchange, were intended to increase transparency and strengthen domestic supply. However, policy analysis focused mainly on export and regional exemptions, as these had the greatest impact on reducing export costs and strengthening the export pattern of semi-processed products in the petrochemical chain.

3.3 Adoption of taxes and duties on urea, methanol, and polyethylene in 2021

In 2021, simultaneously with the formulation of the annual budget law, the issue of exporting crude and semi-processed petrochemical products officially entered the policy agenda. The decision was based on the view that existing tax exemptions, particularly those covering exports of basic and intermediate products, made exports more attractive than domestic supply and consequently weakened the incentive to complete the domestic value chain. Accordingly, Paragraph (Th) of Note 6 of the 2021 Budget Law made exports of raw and semi-processed mineral, petroleum, gas, and petrochemical materials subject to taxes and duties. Methanol, urea, and polyethylene were treated as major examples under this policy. To evaluate the effect of the approach, a limited scenario was developed in which only methanol, ammonia and urea, and polyethylene were subject to removal of the export exemption. As shown in [Figure 2](#), applying the scenario to 2018 data could have generated 3,613 billion tomans in potential tax revenue: 1,621 billion tomans from methanol, 597 billion tomans from ammonia and urea, and 1,395 billion tomans from polyethylene. The source analysis reported that removing the export and regional exemptions simultaneously would increase the aggregate amount to 5,673 billion tomans. These figures were presented as support for the policy decision and indicated that even a limited focus on several key products could have a substantial fiscal effect, while also highlighting the role of regional exemptions in weakening the policy's effective impact.

3.4 Aggregate financial estimates: the effect of removing exemptions in 2018 and 2019

The aggregate financial estimates show that removing export and regional exemptions in Iran's petrochemical industry would create a substantial difference between current tax payments and potential tax revenue. As shown in [Figure 3](#), in 2018 the current tax paid by gas-feedstock, liquid-feedstock, and midstream units totaled 563 billion tomans. Without the export exemption, this amount would have increased to 8,113 billion tomans, and with the simultaneous removal of export and regional exemptions, it would have reached 10,459 billion tomans. The same pattern was repeated in 2019: current tax amounted to 1,642 billion tomans, compared with 10,790 billion tomans with the removal of the export exemption and 12,677 billion tomans with the simultaneous removal of both exemptions.

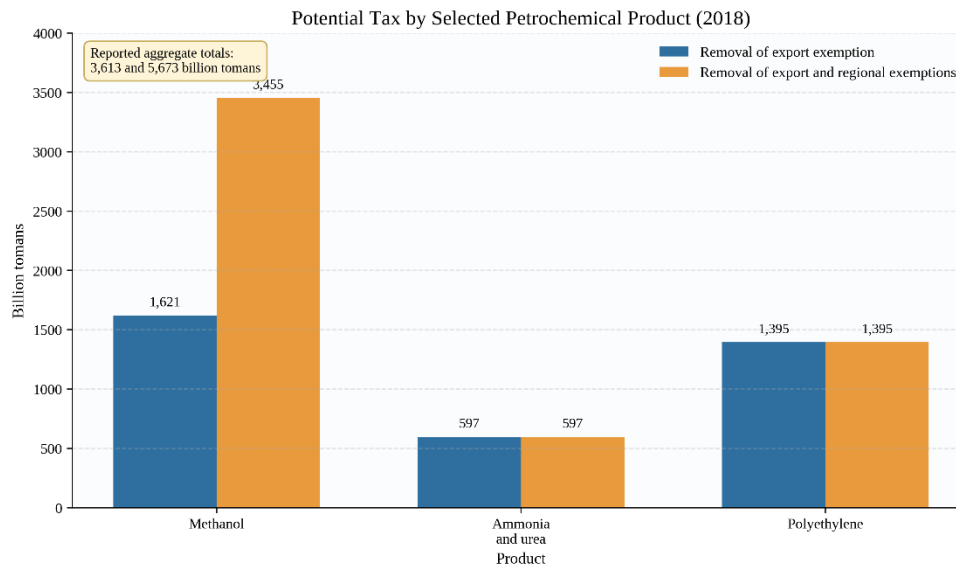


Figure 2. Potential tax contributions of selected petrochemical products under alternative exemption-removal scenarios

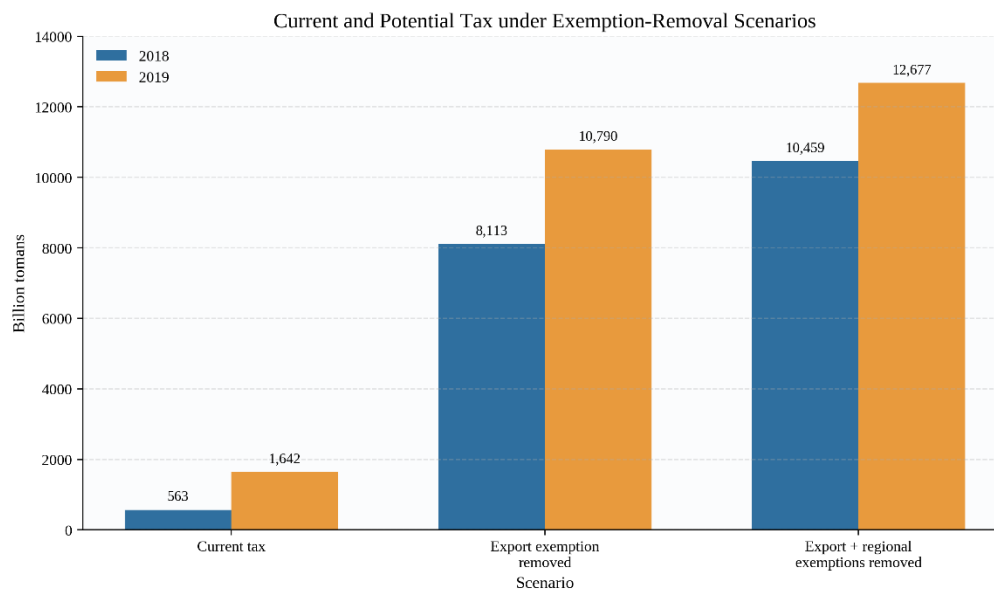


Figure 3. Comparison of current and potential tax under scenarios involving the removal of export and regional exemptions

These results reveal a very large gap between current payments and potential tax capacity. A breakdown by feedstock type indicates that the greatest fiscal effect would occur in gas-feedstock units. In 2018, their tax payments would have increased from 83 billion tomans to 4,940 billion tomans under removal of the export exemption and to 7,024 billion tomans under simultaneous removal of both exemptions. In 2019, the corresponding values would have risen from 774 billion tomans to 6,270 and then 8,005 billion tomans. For liquid-feedstock units, tax would have increased from 443 to 2,008 billion tomans in 2018 and from 816 to 2,962 billion tomans in 2019. Midstream units also increased substantially, from 37 to 1,165 billion tomans in 2018 and from 52 to 1,558 billion tomans in 2019. Profitability analysis shows that the policy effect would not be uniform across these groups. In gas-feedstock units, profit margins would remain high despite increased taxation, declining from

approximately 54.8% to 43.8% in 2018 and from 44.3% to 35.1% in 2019. Exports would therefore remain economically attractive. Liquid-feedstock units had lower margins, which would decline from 19.9% to 16.4% and from 17.6% to 14.4%, indicating greater sensitivity to tax policy. Although the absolute tax amounts associated with midstream units were lower, their strategic importance in connecting the value chain is high; increased taxation could therefore have structural effects on the continuity and expansion of downstream industries.

3.5 Limitations of tax policy in developing the petrochemical value chain

After adopting the 2021 budget provision and completing the related tax and export-duty calculations, it became clear that removing exemptions or imposing duties, although potentially necessary to modify export behavior,

was not sufficient to develop the value chain. In gas-feedstock units, where the initial profit margin was approximately 54%, the economic attractiveness of exports would not disappear even after removal of the exemption. A margin reduction of around ten percentage points would not prevent firms from continuing to export. In liquid-feedstock and midstream units, the impact was likewise limited and heterogeneous because of differences in profitability and chain characteristics. Regional exemptions also emerged as an important factor that could neutralize tax policy. For some units, exemptions associated with free zones and special economic zones effectively offset the removal of the export exemption. In addition, insufficient domestic downstream capacity demonstrated that greater tax pressure or tighter export restrictions would not necessarily guarantee value-chain development and might instead reduce competitiveness. Policymakers therefore concluded that tax instruments could be effective only when applied alongside an assessment of actual downstream capacity and a simultaneous redesign of incentives.

3.6 Reforming the logic of export-duty determination under the seventh development plan

At this stage, policy focus shifted from an annual budget-based approach to a medium-term structural framework under the Seventh Development Plan. Duties on exports of raw and semi-processed materials were defined not only as part of value-chain development policy but also as a possible source of financing for innovation, and the policy entered a more detailed implementation phase. During expert meetings in 2025, the basis of assessment shifted from the general product name to the customs tariff code, and duty rates ranging from 0.1% to 2.5% were examined separately for each code. It was also proposed that the revenue from these duties, estimated at approximately USD 200 million, be divided between the Vice Presidency for Science and Technology and the Innovation and Prosperity Fund to support technology and downstream development. As the investigation continued, it became clear that setting the rate was not simply a matter of choosing a number; the real issue was the logic and basis for setting the duty rate. Given that the export value of petrochemical products was about \$13 billion, even small changes in the duty rate could have a significant financial impact on companies. The initial approach ranked products based on the processing steps from raw materials to finished products, but this method was ultimately found to be inappropriate because the number of processing steps alone is not an accurate measure for valuing products within a policy framework. The alternative logic of reverse value-chain analysis was introduced: the desired final product is identified first, and the duty applied to each preceding link is then determined according to its role in completing the chain, the feasibility of downstream expansion, and the country's comparative advantage.

3.7 Reform of the policy toward urea

Under the initial 2021 approach, urea, together with methanol and polyethylene, was treated as an important product potentially subject to removal of the export exemption or to an export duty. In the minimum scenario presented in the tax-exemption report, ammonia and urea together would have generated 597 billion tomans in

potential tax revenue in 2018, both under removal of the export exemption and under simultaneous removal of export and regional exemptions. From a revenue perspective, applying the policy to urea therefore appeared attractive to the government. In 2025, however, the change in analytical perspective led to urea being removed from the list of raw and semi-processed products. The rationale was that, under Iran's actual conditions, imposing an export duty on urea would not necessarily develop the domestic value chain. Urea is predominantly consumed in the global market as a chemical fertilizer, and much of its function is final consumption in agriculture. Although there are some chemical derivatives and industrial applications for urea, the development of these routes on a scale commensurate with Iran's urea production capacity and with the reliability of export remains limited and uncertain.

If urea had remained on the list of raw and semi-processed products, export duties might have simply reduced export competitiveness and increased firms' costs, without creating a meaningful downstream chain within the country. This case illustrates the difference between revenue policy and industrial policy. Urea could generate revenue for the government through duties, but including it in the policy would not necessarily lead to the expected outcome in value chain development. Removing urea from the list signaled greater policy maturity, as policymakers accepted that high export volume does not automatically place a product in the raw or semi-processed category from a policy perspective. The crucial question is whether restricting exports or increasing the cost of exporting a product can stimulate the development of its domestic chain. In the case of urea, the policy response in 2025 was negative.

3.8 Methanol policy reform

Methanol was initially considered one of the most important examples of semi-processed product exports. The logic was clear: methanol is a basic product with high production volume, Iran has significant production capacity, and a large share of its production is exported. In the 2018 minimum scenario, eliminating the methanol export exemption alone could generate 1,621 billion tomans of potential tax revenue. If regional exemptions were also eliminated, this figure would increase to 3,455 billion tomans. Thus, in the scenario of simultaneous elimination of export and regional exemptions, methanol alone would account for more than 60 percent of the total potential tax calculated for the four selected product groups. Subsequent studies showed that the domestic development of the methanol chain faces significant limitations. Converting Iran's entire methanol production capacity to downstream products is not economically and technologically feasible. Routes such as methanol to olefins, methanol to propylene, formaldehyde, acetic acid, MTBE, DME, and other derivatives each require their own technology, production scale, market, feedstocks, investment conditions, and export competitiveness. Therefore, the development of the methanol chain should be limited, targeted, and focused on economically and technically defensible links, rather than treated as a general requirement for the country's entire methanol production capacity. In 2025, after reviewing the decision-making logic, the methanol duty rate was set at a minimum level. This

decision did not mean that methanol was no longer considered a basic or semi-processed product from a value-chain perspective.

The point was that imposing high duties on methanol exports would not necessarily spur downstream development. Without competitive and economically justifiable downstream capacity, high duties tend to reduce export margins, increase companies' financial liabilities, or facilitate a shift toward informal and non-transparent routes. Accordingly, the new policy logic was that methanol remains a commodity and some downstream links should be developed, but this development should be limited and selective. Consequently, rather than imposing high duties on all methanol exports, a more appropriate policy would be to apply minimum duty rates along with targeted incentives for technologically and economically defensible downstream links.

3.9 From punitive policy to incentives for the methanol chain

The 2025 policy reform was not limited to reducing methanol export duties; it represented a fundamental shift in policy logic, moving away from penalizing exports to encouraging the development of defensible value chain links. Instead of focusing on preventing methanol exports, policymakers first identified end products and downstream links with real development potential, then targeted these sectors with incentives such as feedstock rebates and financial and technological support. According to this reverse logic, value chain development should not be pursued in a mandatory, all-encompassing manner but should be targeted and proportionate to the economy's real capacity. As a result, a combination of minimal duties, targeted feedstock rebates, and support for selected downstream projects replaced a purely punitive policy. In this way, only projects justified by market demand, technology, and economies of scale were allowed to proceed.

3.10 The position of polyethylene in the policy process

Polyethylene was also treated under the initial 2021 approach as an important semi-processed or intermediate product. In the minimum 2018 scenario, removal of the polyethylene export exemption would have generated 1,395 billion tomans in potential tax revenue, and the amount remained 1,395 billion tomans under simultaneous removal of the export and regional exemptions. The estimate indicated that polyethylene was financially important in the exemption-removal policy. Polyethylene, however, has a distinct position. On the one hand, it is a polymer product and is more processed than methanol or ammonia. On the other hand, it serves as feedstock for downstream industries producing packaging, pipes, films, components, compounds, masterbatches, and plastic products. It cannot therefore be classified as either a final product or a raw material. Appropriate policy must take account of domestic market conditions, the absorption capacity of downstream industries, supply through the commodity exchange, the feasibility of conversion into compounds and masterbatches, and the capacity to export higher-value-added products. Based on this background, the expert report argues that export incentives could continue for certain polymers, such as polyethylene, until downstream industries absorb them. At

the same time, exports must improve through further processing and conversion into value-added products such as compounds and master batches. The difference with the methanol case is that the polyethylene case is not only about building a chemical chain from the product to downstream products but also about controlling domestic supply, improving exports, and preventing low value-added polymer exports.

3.11 Tax leverage ratio: elimination of exemptions

To measure the relative severity of the fiscal impact of eliminating exemptions, the tax leverage ratio was calculated as the ratio of potential tax in each scenario to current tax. In 2018, current tax was 563 billion tomans; eliminating the export exemption could increase this to 8,113 billion tomans, and eliminating both export and regional exemptions simultaneously would raise it to 10,459 billion tomans. Thus, the corresponding tax leverage ratios were 14.4 and 18.6, respectively. In 2019, current tax reached 1,642 billion tomans, while potential tax in the two scenarios was estimated at 10,790 and 12,677 billion tomans, respectively, creating leverage ratios of 6.6 and 7.7. Although the absolute potential tax rate was higher in 2019, the relative increase relative to the current tax rate was larger in 2018 because the initial tax base was lower that year. A high tax leverage ratio does not necessarily mean that the policy is developmentally effective. Increasing tax revenue can significantly change companies' financial burden, but it does not, by itself, lead to investment in downstream industries, increased production of final products, or a lasting change in the structure of exports. Therefore, the revenue function of the policy, i.e., increasing public resources, should be distinguished from its development function, i.e., completing the value chain. Converting revenue capacity from eliminating exemptions into actual value chain development depends on the capacity of downstream industries, technology, markets, economies of scale, and complementary incentives. Figure 4 provides an analytical picture of the relationship between the tax leverage ratio and development effectiveness. The shaded areas indicate different levels of policy effectiveness resulting from the interaction between financial leverage and effective downstream development capacity.

4. Discussion and future research

The findings show that eliminating export and regional exemptions in the petrochemical industry has significant potential to increase tax revenue. However, increasing government revenue alone cannot ensure value chain development. The tax leverage analysis shows that eliminating exemptions can increase tax revenue several times current levels, but converting this financial capacity into industrial development depends on complementary conditions such as a market for downstream products, access to technology, economically justified production scales, and targeted support policies. Therefore, tax policy can only help reduce exports of raw and semi-processed products when it is part of a comprehensive framework for value chain development and is not designed solely as a tool to increase public revenue. The results also emphasize the need to move away from a uniform approach to setting export duties and move towards product-specific policies.

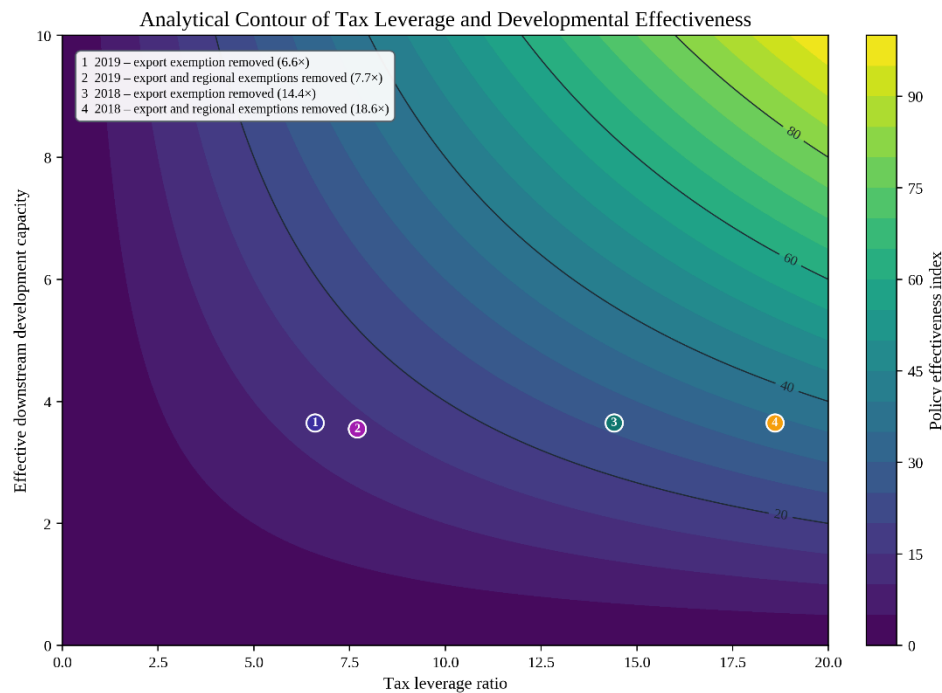


Figure 4. The relationship between the tax leverage ratio and the development effectiveness of eliminating exemptions

Petrochemical products, even within a single industry, differ significantly in terms of downstream development capacity, target markets, technological sophistication, and domestic value-added creation. Thus, applying similar duty rates to urea, methanol, and polyethylene could produce very different outcomes. In a future export duty regime, a combination of indicators, including the level of downstream chain development, domestic value added, technological intensity, and strategic importance of the product, could be used to allocate policy instruments more efficiently. Several avenues for future research are suggested. First, empirically assessing the impact of changes in export duties on producer behavior, export volume, investment in downstream industries, and export product mix could provide a more accurate picture of the policy's effectiveness. Second, a dynamic model of the petrochemical value chain could examine how tax policy, investment decisions, and the development of downstream industries interact over time. Third, multi-criteria decision-making methods could rank petrochemical products and identify the most appropriate policy instrument for each, contributing to a more accurate, evidence-based policymaking system. Future research could also use AI and machine learning methods, including supervised and unsupervised learning, to identify hidden patterns and nonlinear relationships between export duties, feedstock allocation, downstream investment, export mix, and value-added creation. Unsupervised methods could be particularly useful for clustering petrochemical products based on technological, market, and energy and water requirements. These methods could improve product-specific policy design and support evidence-based decision-making in the energy, water, petrochemical, and other resource-intensive industries [22-25].

5. Conclusion

This article examined Iran's experience with taxes and export duties on petrochemical products from 2021 to 2025 and traced the evolution of industrial policy from a general, classification-based approach toward a value-chain-oriented framework grounded in reverse value-chain analysis. The literature review showed that previous studies have concentrated primarily on the theoretical effects and modeling of export restrictions within international-trade frameworks or partial-equilibrium simulations, while paying less attention to the actual evolution of policy at the national and industrial levels. The existing literature also lacks a clear and operational criterion for distinguishing raw and semi-processed products from products that should be removed from these categories, as most analyses rely on a simple sequence of processing stages. Therefore, the main research gap was the lack of an empirical examination of the gradual process of policy evolution, as well as the lack of an operational framework for product-specific decision-making in export policy. The findings showed that the initial policy adopted in 2021 to address exports of raw and semi-processed products focused mainly on imposing duties or removing export tax exemptions for products such as methanol, urea, and polyethylene. The existing structural imbalance was significant: in 2018, Iran exported about \$11.24 billion in raw materials and \$11.43 billion in upstream and intermediate petrochemical products, while exports of downstream products were only \$0.36 billion. Downstream imports also exceeded exports in this sector by about \$0.56 billion. This showed that the country exports a high volume of basic and intermediate products but still depends on imports in parts of the final product chain. Fiscal estimates also showed the policy's significant revenue-generating capacity. In 2018, the estimated tax revenue under the current system was about \$134 million. With the elimination of the export tax

exemption, this figure could increase to about \$1.93 billion, and with the simultaneous elimination of export and regional exemptions, to \$2.49 billion. The corresponding figures for 2019 were about \$391 million, \$2.57 billion, and \$3.02 billion, respectively. However, the overall analysis showed that a significant increase in fiscal revenue does not necessarily lead to value chain development. The policy's effectiveness depended on the existence of real downstream capacity, technological capability, economically justified production scales, market demand, and comparative advantage. Thus, the study achieved its main objective of explaining why policymakers moved from the crude and semi-processed classification to a value chain analysis, as well as identifying the limitations of tax instruments as a stand-alone mechanism for downstream development. The results also showed that under the Seventh Development Plan, policymakers moved toward using customs tariff codes, duty scale rates, and, most importantly, reverse value chain analysis in 2025. In this approach, policymakers first identified a final product or downstream link with credible development potential, then adjusted the duties on each upstream or intermediate product based on its role in completing that chain. Reforms such as removing urea from the list of raw and semi-processed materials, reducing duties on methanol, and replacing mainly punitive instruments with downstream incentives such as targeted feed rebates demonstrate the practical implementation of this shift in policy direction. Overall, the article contributes an empirical analysis of policy evolution and clarifies the operational logic of reverse value-chain analysis. It concludes that tax and export-duty instruments can support industrial development only when they are product-specific, aligned with actual value-chain capacity, and combined with appropriate market, technology, and investment policies. From an energy-policy perspective, petrochemical export taxation should not be regarded solely as a fiscal or trade-policy instrument. It also influences how natural gas, liquid hydrocarbons, and other energy-derived feedstocks are allocated between bulk production of export-oriented basic chemicals and their domestic conversion into higher-value materials and final products. Export-duty policy should therefore be coordinated with national energy planning, feedstock-pricing policy, technological development, energy-efficiency objectives, and investment support for commercially viable downstream industries. Product-specific regulation can improve the economic value obtained from hydrocarbon resources when domestic conversion is technologically feasible and internationally competitive. Conversely, blanket export restrictions imposed without adequate downstream capacity may reduce export competitiveness without producing a corresponding improvement in the productivity or value-added contribution of the national energy-resource base.

Ethical issue

The authors are aware of and comply with best practices in publication ethics, specifically regarding authorship (avoidance of guest authorship), dual submission, manipulation of figures, competing interests, and compliance with research ethics policies. The authors adhere to publication requirements that the submitted work is original and has not been published elsewhere in any language.

Data availability statement

The manuscript contains all the data. However, more data will be available upon request from the corresponding author.

Conflict of interest

The authors declare no potential conflict of interest.

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