Creating Steel Armature Industry Through Export Ban on Metal Scrap: The Case of Armenia

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Abstract

In spite of strong traditions in non-ferrous metallurgy, steel production was non-existent in Armenia. Steel armatures, total sales of which are equivalent of at least 0.5 percent of GDP, are exclusively imported. Situation is about to change with a large investment project by a private firm that aims at substituting imports of steel armatures by domestic production. This firm plans to use the scrap of ferrous metal that had been previously exported to large regional markets. As an effective pre-condition for investing in a new plant the firm lobbied export restriction on scrap metal to ensure sustained and affordable access to this raw material. As a result, the Government introduced an effective ban on exports of metal scrap in January 2013 by setting a hefty export duty equivalent to an estimated 50 percent of regional ferrous scrap price.

In order to offer conditions when this policy can be welfare enhancing, we setup a stylized model. We show that there exist parameter values where this policy may enhance welfare. We show also that for some of those values lifting the export ban in a short time can further improve welfare. The possibility of setting such a sun-set on this policy seems to have escaped the focus of policy makers in Armenia.

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1 Introduction

After independence Armenia adopted free market strategy, and for many years explicit interventionism and protectionism were ruled out from policy menu. At times government resorted to supporting certain businesses and industries but mostly as idiosyncratic acts rather than part of a formal industrial policy. The term "industrial policy" itself was absent, if not banned, from the formal language of policy making. Situation changed with the crisis when the economy went into a free fall raising questions about Armenia’s fundamental ability to grow and develop. The Government felt that a shift toward more pro-active economic policies could be the right response. This was also supported by the global shift in prevailing economic paradigm.

As a response to the crisis the Government went on to establish a window of various form of financial support for private companies based on merits of proposed business plans. This eventually developed into an umbrella industrial policy that was adopted in 2011. It defines a dozen of priority sectors, types of support potentially available for businesses and (albeit vaguely) circumstances under which state aid would be possible. Since formalization of industrial policy the government has initiated a number of major interventions. This paper is concerned with one of them, which is aimed at establishing a new industry of steel armature production.

Metallurgy is one of priority sectors identified in the industrial policy. In spite of strong traditions in non-ferrous metallurgy, steel production was non-existent in Armenia, which can be explained by lack of high grade iron ore deposits and the small size of market that did not allow metal processing based in imported raw materials. Armenia imports virtually all its ferrous metal products including steel armatures, which is a prominent product given the large share of construction in total value added in Armenia. At the same time Armenia exports relatively large quantities of metal scrap to Turkey and Iran that could have been potentially recycled and used for domestic metal fitting industry, including production of steel armatures. Therefore, from an industrial policy perspective this seemed as a low hanging fruit. Thus, it is not perhaps surprising that the government and the private sector came up with a plan to create a domestic production of steel armatures for import substitution.

What appears as an effective pre-condition for investing in a new plant the firm that became the main stakeholder of this initiative lobbied restrictions on scrap metal

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exports. As a result, the Government introduced an equivalent of USD 200 per ton export duty on metal scrap. This is estimated to be around 50 percent of global and regional price for ferrous scrap. As a result, domestic prices for scrap have declined substantially since the beginning of 2013. From trade policy perspective this intervention is unprecedented for Armenia as export duties, including for raw materials, had never been used in previous two decades of country’s independence. The new plant has been under construction for past two years, and it is expected that by end of 2013 the production of steel armatures will be fully launched. The capacity of the plant would allow the company to fully cover domestic demand for the product, although it is rather small compared to plants in Ukraine and Russia.

Overall, there are two reasons why we believe this is an important case for study. First, this case concerns a very large product market in Armenia relative to the size of the economy, thus possible implications of this initiative could be significant. Second, as in other instances of policies targeted at changing the structure of production, certain conditions must be present to make this intervention welfare enhancing. The paper analyzes this intervention offering conditions under which this could be welfare enhancing.

In the following section we provide detailed description of market structures prior intervention, as well as the intervention and expected results. The section is followed by a stylized model that well fits the market structures of metal scrap and steel armature industries in Armenia before and after the policy and offers conditions when this measure can be welfare enhancing. We derive parameter values where the new market structure in metal scrap and steel armature industries delivers higher welfare than the previous market structure. We further offer parameter values where no monopolist would enter into the production of steel armature and the ban of metal scrap export is necessary for welfare improvement (if there are no other policy instruments). However, lifting this ban in a short time can further improve welfare. The possibility of setting such a sun-set on this policy seems to have escaped the focus of policy makers in Armenia.
2 Market Structure, the Rationale for Intervention and Expected Results

2.1 The Market of Steel Armature Prior Intervention

The market of steel armature is an important product segment in Armenia due to the prominence of construction sector relative to output. The share of construction in GDP in recent years has been on average around three-fold higher than, for example, in the US (Figure 1). Constriction is also an important sector in terms of employment. At the peak the sector employed around 9 percent of country’s labor force (2008), which is very high considering that 1/3 of labor force is still employed in subsistence agriculture. The ratio has since decline due to the crisis and currently fluctuates around 7 percent. Due to significance of construction sector, the market of steel armature has become an important product market. Import bill of steel armatures has been fluctuating between USD 60 to 90 million or 0.5 and 0.7 percent of GDP in recent years.

![Figure 1: Construction as percent in GDP](image)

The product is mostly imported from Ukraine although there have been limited imports from Georgia in recent years as well. There is very high concentration in the market of steel armature: according to the state commission for protecting economic competition as of 2011 there were only four companies operating in this product market.
The share of the largest company had been growing in recent years reaching to an estimated 2/3 of the sales in 2012 (Table 1).

Table 1: Market concentration in 2007, 2008, 2011 and 2012 (data for 2009 and 2010 not available)

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of companies</td>
<td>11</td>
<td>N/A</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>The share of largest company (Mikmetal)</td>
<td>28</td>
<td>29</td>
<td>46</td>
<td>65</td>
</tr>
<tr>
<td>The share of largest three companies</td>
<td>N/A</td>
<td>N/A</td>
<td>94</td>
<td>97</td>
</tr>
</tbody>
</table>

Note: The data for 2007-2011 are from the Commission for protection of economic competition of Armenia. As no official data for 2012 are available the estimate is based on interviews with market participants.

There is substantial difference between the export price of steel armature in country of origin and in Armenia. For example, the average export FOB price of the Ukrainian armature in 2012 was around USD 650 per ton, while the final price in Armenia was around USD 1000, inclusive of taxes and customs duties which combined are estimated to be around 200 dollars. The remaining difference that is still quite large may reflect high transportation costs and possibly markups in Armenia.

2.2 Exports of Scrap Metal Prior Intervention

Armenia was systematically exporting various scrap metals until introduction of an prohibitive export ban in 2013. The volumes of exports increased sharply since 2010 and in the last three years before the ban annual exports of ferrous scrap averaged 175 thousands ton, amounting to around USD 12 million. This is significant compared to estimated 10 thousand ton processed domestically. Iran and Turkey were the main markets for scrap metal. Due to soviet industrial legacy of capital intense development the production of scrap metal in Armenia in past two decades of transition has been disproportionately large. Armenia shares this feature with many other transition economies. Relatively large supplies of the scrap will be available for the years to come (as the economy continues to reorganize) before it stabilizes at lower level in line with the volumes of contemporaneous economic activity. Turkey and Iran were the main markets for Armenian ferrous scrap. Both countries are prominent players in global scrap market. In fact, Turkey is one the largest importers of scrap metal in the world with estimated imports in 2012 at around 15 million tons.

http://kpl.net.ua/en/Current_Commodity_Prices_in_Ukraine.html#Reinforcing Bar (Armature)
Although scrap collecting industry is fairly decentralized and many businesses and individuals participate in it, export was concentrated with few firms, which is explained by reported red tape for export permits.\textsuperscript{4} There is evidence of substantially lower export prices of scrap reported at the border compared to international prices. For example, the average price of ferrous scrap exported from Ukraine in 2012 was between USD 350 and 400 (according to Ukraine’s Tax Ministry), while the reported price for Armenian scrap at the border was below USD 100.\textsuperscript{5} High transportation costs for land-locked Armenia especially for scrap metal that is relatively high volume low cost product seems as the main factor contributing to the large difference. Abuse of market power by foreign buyers cannot be fully ruled out although existence of two destinations – Turkey and Iran- suggests that buyer’s collusion is not very likely.

\textbf{Figure 2: Ferrous Scrap Exports in Armenia}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{ferrous_scrap_exports.png}
\caption{Ferrous Scrap Exports in Armenia}
\end{figure}

\textsuperscript{4}Interviews with market participants
\textsuperscript{5}www.armstat.am
2.3 Use of Scrap Metal by Domestic Industry Prior Intervention

There has been very little scrap metal processing in Armenia. It is estimated that only around 10 thousand ton of ferrous scrap per annum had been used domestically until recently, which is around 20 times less than exported quantity of ferrous scrap. The absence of specialized manufacturing capacities was an apparent reason for negligible quantity of domestic recycling in spite of availability of large supplies of scrap. Limited processing took place in two or three former tool producing plants that have metal smelting capacities. The scrap was mostly processed into iron "balls" used by the mining companies for mineral ore processing. A number of attempts have been made to produce more elaborate metal products but they mostly failed. Users of metal scrap were traditionally the main advocates for an export ban.\(^6\) It was industry’s longstanding argument that export restrictions are necessary for them to invest as they will be always out-competed by foreign buyers. It is interesting that local production prospects were considered not realistic even against the background of relatively low domestic price for scrap compared to the international and regional price.

2.4 Investment Project and Government’s Intervention

As discussed above, domestic production of steel armatures has been in the agenda of stakeholders - the Government and interested major businesses - for a number of years. In 2008 a loose project has been put together by the dominant importer of steel armature to use domestic deposits of low grade iron ore deposits for ferrous metallurgy and produce steel armature.\(^7\) The business project was even briefly considered for government backed financing. The proposal, however, failed to gain traction.

The business turned to scrap metal as a potential base for future metal fitting industry. It is believed that there is substantial stock of ferrous scrap in Armenia that would allow producing steel armatures that meets Armenia’s demand for the years to come.\(^8\) The ASCE Group, a company that in 2010 became part of the business group that dominates in the market of steel armatures (led by MIKMETAL company), initiated USD 30 million investment project to create a modern steel armature production on the basis of an obsolete machine producing factory that had done limited processing of

\(^6\)Parliamentary discussion regarding the amendment in the Law, www.parliament.am.

\(^7\)Hrazdan iron ore deposits.

\(^8\)Various estimates put the stock at around 1.2-1.5 million tons.
scrap in the past. The planned production capacity is 120 thousand ton annually, which is double of Armenia’s current consumption and even exceeds the peak consumption level of 2008. The project included securing a loan from a commercial bank, as well as lobbying the government to introduce an effective export ban of scrap metal, which eventually took the form of export duty in amount of around USD 200 per ton of scrap metal.\textsuperscript{9}

The rationale of the intervention presented by the Government and the company follows in a form of a synthesis of statements by various stakeholders. "Instead of exporting scrap metal at low price (because of high transportation costs) and importing steel armatures at relatively high price (again, because of high transportation costs) Armenia should use available supplies of scrap metal to produce its own steel armatures. This is socially beneficial but not feasible under market conditions because of foreign competition and initial unfavorable conditions such as lack of existing recycling capacities that require high fixed costs. Government intervenes with a custom duty in amount of USD 200 to eliminate exports of scrap. The resulting lower domestic prices for scrap will improve competitiveness of the new industry, which still needs to learn to produce and improve its productivity and compete with foreign producers of steel armatures. The company wouldn’t have invested in the new factory without export restrictions. Among other possible support to the industry, including higher tariffs on imported steel armature or direct support to the company, this measure was found as the best option both economically and politically. The project is not one-off production based on temporary availability of large quantities of scrap - the company will reach such productivity levels that allow purchasing scrap metal from neighboring countries. There is recognition of possible distributional impact of export restrictions but the Government and the company believes that the country as a whole will benefit.\textsuperscript{10}"

\subsection*{2.5 Aftermath and Expectations}

The tariff on scrap export was introduced in January 2013. It led to substantial decline in domestic prices of ferrous metal scrap. According to the interviews with market participants metal scrap lost around half of the market value in the local market (declining

\textsuperscript{9}Amendments to the Law on Customs duties, December 19, 2012.

\textsuperscript{10}This is a synthesis of interviews with various stakeholders, including the Ministry of Economy, Industrial Development Fund, and the investor, as well as information available from published argumentation during the parliamentary discussions of the proposed amendments to the Law on Custom Duties.
from around USD 120-140 per ton to 60-80), which, to large extent, is explained by the ban, and to lesser extent by the decline international price for scrap since the beginning of the year. Production of steel armature is expected to be fully launched toward end of 2013. The company claims that it will be able to offer locally produced high quality armatures with around 10 percent discount compared to imported ones. The company expects that consumers will fully switch to locally produced armatures because of price advantage. The company will not produce size 8mm armature so there will still be a need for imports (although negligible since this specific size has less than 5 percent share in the market).

2.6 Other Instances of Introduction of Scrap Metal Ban – International Evidence

Introduction of various export restrictions on exports of scrap metal for protectionist reasons has been widespread in developing countries in recent years (Russia, Ukraine, Ghana, Kenya, Tanzania, etc).\textsuperscript{11} In many instances these restrictions are a result of stronger political power of already existing metallurgical industry versus that of collecting businesses that eventually bear the cost of export ban. Thus, in many cases, export ban of metal scrap amounts to a re-distributional measure, sometimes without clear welfare enhancing rationale. Armenia’s case might be somewhat different as the formal rationale for the measure is to support investments in a new industry that had not existed in the country before. Essentially, the ban of export of metal scrap in Armenia leads to import substitution, which in such a small and land-locked country might be welfare enhancing under certain assumption.

In spite of the recent wave of introduction of various forms of export restriction to our knowledge there have not been done much research in this area looking at conditions under which such interventions can be welfare enhancing. We develop a stylized model below that fits market structures present in these product segments in Armenia to examine if and when this policy can be welfare enhancing.

\textsuperscript{11}There has been a wave of export restrictions in several countries due to negative externalities present in scrap exports due to vandalism and robbery of public infrastructure in the search of scrap. This paper does not look at those instances.
3 The Model

Time \((t)\) is discrete and there are 3 periods \((t = 1, 2, 3)\).

3.1 Households

There is a continuum of mass one of identical households. The representative household has a linear utility from consuming amount \(c\) of final goods. The household owns intermediate inputs \(k\) and \(l\), which have fixed supply and can be broadly interpreted as capital and labor. Moreover, it owns all firms in the economy.

The household transfers income across periods using bonds \((b)\). Its inter-temporal budget constraint is given by

\[
\begin{align*}
ct + bt &= pkkt + pltk + \pi_t + (1 + rt)bt-1 - T_t,
\end{align*}
\]

where the price of consumption/final goods is normalized to 1, \(p_k\) and \(p_l\) are the prices of \(k\) and \(l\), \(\pi\) is the sum of the profits of the firms, \(r\) is return on bonds, and \(T\) is lump-sum transfer.

The households discounts time at rate \(\rho > 0\) and maximizes its lifetime utility subject to the budget constraint

\[
\begin{align*}
\max_{\{ct\}_{t=1}^3} U &= \sum_{t=1}^{3} \beta^{t-1}ct \\
\text{s.t.} & \\
(1), \; b_0 = 0,
\end{align*}
\]

where \(\beta = \frac{1}{1+\rho}\) and \(b_0 = 0\) means that the household holds no debt at the beginning of the first period \((t = 1)\). The optimal rules that follow from this problem are

\[
\begin{align*}
1 - (1 + r_2) \beta &= 0, \\
1 - (1 + r_3) \beta &= 0, \\
b_3 &= 0.
\end{align*}
\]

Meanwhile, market clearing of the loanable funds market requires that

\[
bt \equiv 0.
\]
The paths of consumption, bonds, and interest rate can be solved from (1), (2), and (3), given \( p_{k,t}k + p_{l,t}l + \pi_t - T_t \).

### 3.2 Final Goods Sector

Final goods producers are competitive and produce homogenous goods \( y \). They have a Cobb-Douglas production technology which combines steel armature \( x \) and intermediate inputs \( k \):

\[
y = \lambda_y x^\alpha k^{1-\alpha},
\]

\( \alpha \in (0, 1), \lambda_y > 0. \)

Final goods producers maximize their profits,

\[
\max_{x, k} \pi_y = y - (1 - \tau_x) p_x x - p_k k,
\]

where \( p_x \) is the price of \( x \), and \( \tau_x \in (-1, 1) \) is a proportional tax/subsidy on purchases of steel armature. Optimal rules that follow from this optimal problem are final goods producers’ demand for steel armature \( x \) and intermediate inputs \( k \):

\[
(1 - \tau_x) p_x = \alpha \frac{y}{x},
\]

\( p_k = (1 - \alpha) \frac{y}{k}. \)

### 3.3 Intermediate Goods Sector

There are two types of intermediate goods: metal scrap \((z)\) and steel armature. In order to mimic market structures of these goods before and after policy we consider two setups. In the first setup, which mimics before policy situation, there is no domestic demand for metal scrap. Metal scrap is exported to the world market at a fixed price \( \frac{p^*_z}{1 + C_z} \), where \( C_z \) captures transportation costs and we use star \((*)\) to denote foreign/world prices. In turn, there is no domestic production of steel armature, but there is inelastic foreign supply of it at effective price \((1 + C_x) p^*_x\), where \( C_x \) captures transportation costs. A domestic firm makes the purchases of steel armature and supplies its purchases to final goods producers as a monopolist.

In the second setup, which mimics after policy situation, metal scrap is solely supplied to a firm which acts as a monopsonist. This firm uses metal scrap in order to
produce steel armature and can supply its output to final goods producers as a monopolist (i.e., there is a two-directional monopoly in metal scrap and steel armature markets). If its price is higher than \((1 + C_x) p^*_x\) it faces competition from abroad/importers.\(^\text{12}\) In turn, if its price is lower than \(\frac{p^*_x}{1 + C_x}\) it can export its produce. We further assume that to establish itself this firm has incurred entry (fixed) cost \(f\) in terms of final goods at the beginning of period 1 and there are learning-by-doing externalities in this firm, which augment its productivity.

To focus on insightful cases, we maintain parameter values such that closed economy price of this firm is greater than \(\frac{p^*_x}{1 + C_x}\) and lower than \((1 + C_x') p^*_x\).\(^\text{13}\) In such a circumstance this firm does not export and closed economy outcomes prevail.\(^\text{14}\)

We also consider a setup where a domestic monopolist produces steel armature using metal scrap as input. We consider this setup to identify parameter values where a monopolist would not start producing steel armature but a two-directional monopolist would.

**Metal Scrap**

Metal scrap producers are competitive and produce homogenous goods \(z\). They have a Cobb-Douglas production technology which combines final output and intermediate inputs \(l\),

\[
\begin{align*}
    z &= \lambda_z \bar{y} \gamma l^{1-\gamma}, \\
    \gamma &\in (0, 1), \lambda_z > 0, \\
    \bar{y} &= s_y y, s_y \in (0, 1).
\end{align*}
\]

Metal scrap producers maximize their profits,

\[
\max_{\bar{y}, l} \pi_z = p_z z - \bar{y} - p l,
\]

\(^\text{12}\)We assume that after implementation of the policy either the producer of steel armature and monopolist importer engage in price competition or there are many competitive firms which can import steel armature.

\(^\text{13}\)For lower than \(p^*_x/(1 + C_x)\) price the monopolist faces an unlimited demand and is constraint only by endowments in the economy. Given the same amount of inputs it can increase its price up-to \(p^*_x/(1 + C_x)\) and have unlimited demand. It will sell at home also at \(p^*_x/(1 + C_x)\) assuming away discriminatory pricing.

\(^\text{14}\)We abstract from the possibility that this firm might also import metal scrap.
where $p_z$ is the price of $z$. Optimal rules that follow from this optimal problem are

$$
1 = \gamma p_z \frac{z}{y},
$$

$$
pl = (1 - \gamma) p_z \frac{z}{l}.
$$

In the first setup (S.1) metal scrap is exported and $p_z$ needs to be replaced by $\frac{p_z^*}{1 + C_z}$,

$$
p_z \equiv \frac{p_z^*}{1 + C_z}.
$$

Steel Armature

**Setup 1 (S.1):** In this setup steel armature is imported by a monopolist, which solves the following problem:

$$
\max_{x} \pi_{x}^{S.1} = p_x x - (1 + C_x) p_{x}^* x
$$

s.t.

$$
(5).
$$

Optimal rule that follows from this problem is

$$
(1 + C_x) p_{x}^* = \frac{1}{1 - \tau_x} \alpha^2 \frac{y}{x},
$$

which is equivalent to

$$
p_x = \frac{(1 + C_x) p_{x}^*}{\alpha},
$$

where $p_x$ is the domestic price of steel armature. The profits of the importer-monopolist are then

$$
\pi_{x}^{S.1} = (1 - \alpha) p_x x.
$$

**Setup 2 (S.2):** In this setup a two-directional monopolist produces steel armature. Its input is metal scrap $z$ and it has a production function

$$
 x = \Lambda z^\sigma,
$$

where $\sigma \in (0, 1]$. In order to model learning-by-doing externalities we assume that the productivity of the monopolist in periods 2 and 3 (i.e., $\Lambda_2$ and $\Lambda_3$) increases with its
output in period 1 and that this process is exogenous for the firm. In particular we assume that

\[ \Lambda_1 = 1, \]  
\[ \Lambda_2 = x_1^\mu, \]  
\[ \Lambda_3 = x_1^\mu, \]  

and that the values of \( k \) and \( l \) are such that \( x_1 > 1 \). Parameter \( \mu \) measures the magnitude of these externalities, \( \mu \in [0, 1] \).

This firm then solves the following problem:

\[
\max_z \pi_x^{S.2} = p_x x - (1 - \tau_z) p_z z - (1 - \tau_f) f \\
\text{s.t.} \\
(14), (8), (5),
\]

where \( f_1 > 0 \) and \( f_2 = f_3 = 0 \), and \( \tau_z \) and \( \tau_f \) are proportional taxes/subsidies on purchases of metal scrap and entry costs, \( \tau_z, \tau_f \in (-1, 1) \).

Optimal rule that follows from this problem is

\[
\alpha^2 \gamma \sigma \frac{y}{y} = (1 - \tau_x) (1 - \tau_z) \frac{1}{\gamma}. \tag{18}
\]

The profits of the two-directional monopolist are then

\[
\pi_x^{S.2} = (1 - \alpha \gamma \sigma) p_x x - (1 - \tau_f) f. \tag{19}
\]

**Setup 3 (S.3):** In this setup a monopolist produces steel armature and competes for metal scrap. This firm then solves the following problem:

\[
\max_z \pi_x^{S.3} = p_x x - (1 - \tau_z) p_z z - (1 - \tau_f) f \\
\text{s.t.} \\
(14), (5).
\]

Optimal rule that follows from this problem is

\[
\alpha^2 \sigma \frac{y}{z} = (1 - \tau_x) (1 - \tau_z) p_z. \tag{20}
\]
The profits of the producer-monopolist are

\[
\pi_x^{S3} = (1 - \alpha \sigma) p_x x - (1 - \tau_f) f. \tag{21}
\]

**Government**

Government subsidizes/taxes the purchases of goods and costs of entry \( f \) at rates \( \tau_x \), \( \tau_z \), and \( \tau_f \) and makes lump-sum transfers \( T \) to the household. It maintains balanced budget,

\[
T = \tau_x p_x x + \tau_z p_z z + \tau_f f. \tag{22}
\]

### 3.4 Features of Dynamic Equilibrium

In the first setup (S.1) metal scrap is exported and its price is fixed at \( \frac{p_s}{1+C_z} \) level. In turn, steel armature is imported and its price in domestic market is given by (12). From (4), (5), and (12) in this setup it follows then that

\[
x^{S,1} = \left[ \frac{\alpha^2 \lambda_y}{(1 - \tau_x) (1 + C_x) p_x^*} \right]^{\frac{1}{1-\alpha}} k, \tag{23}
\]

\[
y^{S,1} = \lambda_y \left[ \frac{\alpha^2 \lambda_y}{(1 - \tau_x) (1 + C_x) p_x^*} \right]^{\frac{1}{1-\alpha}} k. \tag{24}
\]

From (13) and (23) it follows that the profits of the importer-monopolist are

\[
\pi_x^{S,1} = (1 - \alpha) \left[ \frac{\alpha}{(1 + C_x) p_x^*} \right]^{\frac{1}{1-\alpha}} \left( \frac{\alpha \lambda_y}{1 - \tau_x} \right)^{\frac{1}{1-\alpha}} k. \tag{25}
\]

In turn, from (7), (8), and (10) it follows that

\[
\bar{y}^{S,1} = \left( \gamma \lambda_z \frac{p_z^*}{1 + C_z} \right)^{\frac{1}{1-\gamma}} l, \tag{26}
\]

\[
z^{S,1} = \lambda_z \left( \gamma \lambda_z \frac{p_z^*}{1 + C_z} \right)^{\frac{\gamma}{1-\gamma}} l. \tag{27}
\]

Manipulating expressions (6), (9), and (10) yields

\[
p_k^{S,1} k + p_l^{S,1} l = y^{S,1} - \frac{(1 + C_x) p_x^*}{\alpha} x + \frac{p_z^*}{1 + C_z} z^{S,1} + \tau_x \frac{(1 + C_z) p_x^*}{\alpha} x^{S,1}. \]
Combining this expression with the household’s budget constraint (1) and the budget constraint of the government (22) gives

\[ c^{S.1} = \bar{y}^{S.1} - y^{S.1} + \frac{p_x^*}{1 + C_z} z^{S.1} - (1 + C_x) p_x^* x^{S.1}. \]

Therefore,

\[ c^{S.1} = \frac{1 - \tau_x - \alpha^2}{1 - \tau_x} y + \frac{1 - \gamma}{\gamma} \bar{y}^{S.1}. \]

Assuming that foreign prices and tax/subsidy rates are fixed, total welfare is

\[ W^{S.1} = \left[ 1 + \beta(1 + \beta) \right] \times \left\{ \frac{1 - \tau_x - \alpha^2}{1 - \tau_x} \lambda_y \left[ \frac{\alpha^2 \lambda_y}{(1 - \tau_x)(1 + C_x)p_x^*} \right]^{\frac{\alpha}{1 - \alpha}} k + \frac{1 - \gamma}{\gamma} \left( \gamma \lambda_z \frac{p_x^*}{1 + C_z} \right)^{\frac{1}{1 - \gamma}} l \right\}. \]

In turn, in the second setup (S.2) from (4), (5), (7), (8), (14), and (18) it follows that

\[ \bar{y}^{S.2} = \left\{ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_x)(1 - \tau_z)} \lambda_y \left[ (\lambda_z l^{1-\gamma}) \sigma \right]^{\alpha} k^{1-\alpha} \right\}^{\frac{\gamma^2 \sigma}{\sigma - 1 - \alpha \gamma} \lambda_z}, \]

and \( z^{S.2}, x^{S.2}, y^{S.2}, p_x^{S.2}, \) and \( p_x^{S.2} \) are given by (7), (14), (4), (5), and (8) respectively. Therefore, the requirements that \( x_1^{S.2} > 1 \) and \( p_x^{S.2} \in \left( \frac{p_x^*}{1 + C_x}, (1 + C_x) p_x^* \right) \) are equivalent to parameter restrictions

\[ \left( \lambda_z l^{1-\gamma} \sigma \right)^{\alpha} \left\{ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_x)(1 - \tau_z)} \lambda_y \left[ (\lambda_z l^{1-\gamma}) \sigma \right]^{\alpha} k^{1-\alpha} \right\}^{\frac{\gamma^2 \sigma}{\sigma - 1 - \alpha \gamma} \lambda_z} > 1, \]

\[ \frac{1}{1 - \tau_x} \alpha \lambda_y \left[ \frac{k}{\Lambda (\lambda_z l^{1-\gamma} \sigma) (\bar{y}^{S.2})^{\gamma \sigma}} \right]^{1-\alpha} \in \left( \frac{p_x^*}{1 + C_x}, (1 + C_x) p_x^* \right). \]

From (6), (6), and (6) it follows that the profits of two-directional monopolist are

\[ \pi_x^{S.2} = \frac{1}{1 - \tau_x} (1 - \alpha \gamma \sigma) \alpha \lambda_y \left[ \Lambda (\lambda_z l^{1-\gamma} \sigma) \right]^{\alpha} k^{1-\alpha} \times \left\{ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_x)(1 - \tau_z)} \lambda_y \left[ (\lambda_z l^{1-\gamma} \sigma) \right]^{\alpha} k^{1-\alpha} \right\}^{\frac{\gamma + \sigma}{\sigma - 1 - \alpha \gamma} \lambda_z} \]

\[ - (1 - \tau_f) f. \]
Combining (1), (22), (6), (9), and (10) gives

\[ c^{S.2} = y^{S.2} - \tilde{y}^{S.2} - f. \]

This implies that when steel armature is produced domestically by a two-directional monopoly total welfare is

\[ W^{S.2} = y_{1}^{S.2} - \tilde{y}_{1}^{S.2} + \beta (1 + \beta) (y_{2}^{S.2} - \tilde{y}_{2}^{S.2}) - f_{1} \]

\[ = \left[ 1 - \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \right] \left[ \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \right]^{\frac{\alpha \gamma \sigma}{1 - \alpha \gamma \sigma}} \lambda \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} k^{1-\alpha} \frac{1}{1 - \alpha \gamma \sigma} \]

\[ \times \left[ 1 + \beta (1 + \beta) \left\{ \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} \left[ \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \right] \lambda \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} k^{1-\alpha} \right\}^{\frac{\gamma \sigma}{1 - \alpha \gamma \sigma}} \right]^{\frac{1}{1 - \alpha \gamma \sigma}} \]

\[ - f_{1} \]

Finally, in the third setup (S.3) from (4), (5), (7), (8), (14), and (20) it follows that

\[ \tilde{y}^{S.3} = \left\{ \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \lambda \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} k^{1-\alpha} \right\}^{\frac{1}{1 - \alpha \gamma \sigma}}, \]

(34)

and \( x^{S.3}, y^{S.3}, p^{S.3}, \) and \( p_{x}^{S.3} \) are given by (7), (14), (4), (5), and (8) respectively. Clearly, \( x_{1}^{S.2} > 1 \) implies that \( x_{1}^{S.3} > 1. \)

From (6), (9), (10), (1), and (22) it follows that

\[ c^{S.3} = y^{S.3} - \tilde{y}^{S.3} - f. \]

This implies that when steel armature is produced domestically by a monopolist total welfare is

\[ W^{S.3} = y_{1}^{S.3} - \tilde{y}_{1}^{S.3} + \beta (1 + \beta) (y_{2}^{S.3} - \tilde{y}_{2}^{S.3}) - f_{1} \]

\[ = \left[ 1 - \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \right] \left[ \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \right]^{\frac{\alpha \gamma \sigma}{1 - \alpha \gamma \sigma}} \lambda \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} k^{1-\alpha} \frac{1}{1 - \alpha \gamma \sigma} \]

\[ \times \left[ 1 + \beta (1 + \beta) \left\{ \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} \left[ \frac{\alpha^{2} \gamma \sigma}{(1 - \tau_{x})(1 - \tau_{z})} \right] \lambda \left( \lambda z l^{1-\gamma} \right)^{\alpha \sigma} k^{1-\alpha} \right\}^{\frac{\gamma \sigma}{1 - \alpha \gamma \sigma}} \right]^{\frac{1}{1 - \alpha \gamma \sigma}} \]

\[ - f_{1} \]

From (33) and (35) it follows that if tax rates are zero a sufficient condition to have wel-
fare higher when steel armature is produced by a monopolist than when it is produced by a two-directional monopolist is
\[
\alpha^2 \gamma \sigma < \frac{1 - \gamma^{1-\alpha \gamma \sigma}}{1 - \gamma^{1-\alpha \gamma \sigma}}.
\]

### 3.5 Comparisons

It is evident from (33) that \( W^{S.2} \) increases with the magnitude of learning-by-doing externalities \( \mu \) when (30) holds. In turn, from (28) and (33) it follows that
\[
W^{S.1} < W^{S.2}
\]  
(36)

for relatively high values of the price of steel armature imports \((1 + C_x) p^*_x\) and/or relatively low values of the price of metal scrap exports \(\frac{p^*_z}{1+C_z}\).

For such parameter values, clearly, motivating domestic production of steel armature (i.e., import substitution) is welfare improving. Given that \( f_1 > 0 \) the domestic producer has to earn positive profits.

For motivating domestic production it would be necessary to (effectively) ban the exports of metal scrap and create a two-directional monopolist if a producer-monopolist does not have sufficient profits to cover its entry costs whereas a two-directional monopolist has. Denoting by \( E_{t=1,\{\Lambda\}; \pi_t} \) producer’s expected value at entry date \( t = 1 \) of profit stream \( \pi_t \), given its perceived evolution of \( \Lambda \), this situation can be written as
\[
\sum_{t=1}^{3} \beta^{(t-1)} E_{t=1,\{\Lambda\}; \pi_t} > 0 > \sum_{t=1}^{3} \beta^{(t-1)} E_{t=1,\{\Lambda\}; \pi_t} \]  
(37)

where \( \pi_t^{S.2} \) and \( \pi_t^{S.3} \) are given by (19) and (21), respectively.

The evolution of \( \Lambda \) is an exogenous process for the producer of steel armature. Let its expected realizations of \( \Lambda \) be \( \Lambda_1 = 1, \Lambda_2, \) and \( \Lambda_3 \). In such a case, (37) is equivalent

\footnote{If before the policy change the firm was the importer of metal fittings then 0 in (37) should be replaced by \( \sum_{t=1}^{3} \beta^{(t-1)} \pi_t^{S.1} \). This can be approximated by varying the costs of entry.}
to

\[(1 - \tau_{f,1}) f_1 < \sum_{t=1}^{3} \beta^{t-1} \frac{(1 - \alpha \gamma) \alpha}{1 - \tau_{x,t}} \left[ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_{x,t})(1 - \tau_{z,t})} \right]^{\frac{\alpha - \gamma}{1 - \alpha \gamma}} \right\}

\times \left\{ \lambda_y \left[ \tilde{A}_t \left( \lambda_{z, t}^{1-\gamma} \right)^\alpha \right]^{k^{1-\alpha}} \right\}^{\frac{1}{1 - \alpha \gamma}}

and

\[(1 - \tau_{f,1}) f_1 > \sum_{t=1}^{3} \beta^{t-1} \frac{(1 - \alpha \gamma) \alpha}{1 - \tau_{x,t}} \left[ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_{x,t})(1 - \tau_{z,t})} \right]^{\frac{\alpha - \gamma}{1 - \alpha \gamma}} \right\}

\times \left\{ \lambda_y \left[ \tilde{A}_t \left( \lambda_{z, t}^{1-\gamma} \right)^\alpha \right]^{k^{1-\alpha}} \right\}^{\frac{1}{1 - \alpha \gamma}}.

**Alternative Market Structures**

Although welfare is higher when two-directional monopolist produces steel armature than when a monopolist imports it if (36) holds, it could be that welfare when there is two-directional monopoly in $t = 1$ and producer-monopolist afterwards is higher than $W^{S.2}$. Moreover, even if (38) holds it could be that a firm which has two-directional monopoly in $t = 1$ and monopoly afterwards still can cover its costs of entry. Such a situation holds if the values of parameters are such that

\[W^{MIX} = y_1^{S.2} - \tilde{y}_1^{S.2} + \beta (1 + \beta) [y_2^{S.3} (\Lambda = x_1^{S.2}) - \tilde{y}_2^{S.3} (\Lambda = x_1^{S.2})] - f_1 \quad (39)\]

and

\[\frac{(1 - \alpha \gamma) \alpha}{1 - \tau_{x,t}} \left[ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_{x,t})(1 - \tau_{z,t})} \right]^{\frac{\alpha - \gamma}{1 - \alpha \gamma}} \right\}

\times \left\{ \lambda_y \left[ \tilde{A}_t \left( \lambda_{z, t}^{1-\gamma} \right)^\alpha \right]^{k^{1-\alpha}} \right\}^{\frac{1}{1 - \alpha \gamma}}

\[+ \sum_{t=2}^{3} \beta^{t-1} \frac{(1 - \alpha \gamma) \alpha}{1 - \tau_{x,t}} \left[ \frac{\alpha^2 \gamma^2 \sigma}{(1 - \tau_{x,t})(1 - \tau_{z,t})} \right]^{\frac{\alpha - \gamma}{1 - \alpha \gamma}} \right\}

\times \left\{ \lambda_y \left[ \tilde{A}_t \left( \lambda_{z, t}^{1-\gamma} \right)^\alpha \right]^{k^{1-\alpha}} \right\}^{\frac{1}{1 - \alpha \gamma}}

\[> (1 - \tau_{f,1}) f_1 \quad (40)\]

If parameter values satisfy (30), (31), and (36)-(38), as well as (39) and (40), lifting the ban on exports of metal scrap from $t = 2$ onward is welfare improving. Such
parameter values are, for example,

\[ l = 75, k = 1, f_1 = 0.5, \]
\[ \lambda_z = \lambda_y = 1, \alpha = \gamma = 0.75, \sigma = 1, \mu = 0.01, \]
\[ \Lambda_1 = \Lambda_2 = \Lambda_3 = 1, \]
\[ p_x^* = 2.5, C_x = 5, \frac{p_x^*}{1 + C_z} = 0.1, \]
\[ \beta = 0.75. \]

For

\[ \lambda_z = \lambda_y = 1, f_1 = 0.5, \]
\[ \Lambda_1 = \Lambda_2 = \Lambda_3 = 1, \]
\[ \frac{p_x^*}{1 + C_z} = 0.1, \]

our numerical simulations, further, reveal that parameter values which satisfy (30), (31), and (36)-(40) conditions are from the following intervals:

\[ l \in (25, 100), k \in (1, 100), \]
\[ \alpha \in (0.5, 1), \gamma \in (0, 0.75), \sigma \in (0.5, 1), \mu \in (0, 1), \]
\[ p_x^* \in (0.1, 10), C_x \in (2.5, 10), \]
\[ \beta \in (0, 1). \]

### 3.6 Social Optimum

To derive policies which in decentralized equilibrium with two-directional monopolist deliver the first best allocations we maximize the household’s utility subject to resource constraint given production technologies:

\[
\max_{\{c_t\}_{t=1}^3} U = \sum_{t=1}^3 \beta^{t-1} c_t \\
\text{s.t.} \]
\[ c_t = y_t - \bar{y}_t, \]
\[ (4), (7), (14), \]
\[ \Lambda_1 = 1, \Lambda_2 = \Lambda_3 = x_1^\mu. \]
Optimal rules that follow from this problem are

\[ \tilde{y}_1 = \alpha \gamma \sigma \lambda_y (z_1^{\sigma})^\gamma k^{1-\gamma} + \alpha \gamma \sigma \mu \beta \lambda_y (z_1^{\sigma} z_2^{\sigma})^\gamma k^{1-\gamma} + \alpha \gamma \sigma \mu^{2} \lambda_y (z_1^{\sigma} z_3^{\sigma})^\gamma k^{1-\gamma}, \]
\[ \tilde{y}_2 = \alpha \gamma \sigma \lambda_y (z_1^{\sigma} z_2^{\sigma})^\gamma k^{1-\gamma}, \]
\[ \tilde{y}_3 = \alpha \gamma \sigma \lambda_y (z_1^{\sigma} z_3^{\sigma})^\gamma k^{1-\gamma}. \]

This implies that

\[ \tilde{y}_1^{FB} = \alpha \gamma \sigma \lambda_y (z_1 l^{1-\gamma})^\alpha k^{1-\gamma} (\tilde{y}_1^{FB})^{\alpha \gamma \sigma} \]
\[ + \mu \beta (1 + \beta) (\alpha \gamma \sigma \lambda_y k^{1-\gamma})^{1-\alpha \gamma \sigma} (\lambda_z l^{1-\gamma})^{\alpha \gamma \sigma (1+\mu)} (\tilde{y}_1^{FB})^{\alpha \gamma \sigma - \alpha \gamma \sigma \mu}, \]
\[ \tilde{y}_2^{FB} = \tilde{y}_3^{FB} = (\lambda_z l^{1-\gamma})^{\alpha \gamma \sigma} \]...

It is clear from (41) and (29) that when \( \tau_x = \tau_z = 0 \) in decentralized equilibrium with two-directional monopolist \( \tilde{y}_1 \) is lower than the first best,

\[ \tilde{y}_1^{S,2} < \tilde{y}_1^{FB}. \]

This is because of two reasons. First, there are learning-by-doing externalities which imply that the private marginal value of \( z \) and \( \tilde{y} \) are lower than their marginal products. Second, two-directional monopoly creates relative price distortion, which reduces the production of steel armature and the demand for \( z \) and \( \tilde{y} \).

A policy in decentralized equilibrium that eliminates the effects of these distortions and frictions subsidizes the demand for steel armature setting in the first period

\[ 1 - \tau_{x,1}^{FB} = \frac{\alpha \gamma}{1 + \mu \beta (1 + \beta) [\alpha \gamma \sigma \lambda_y (\lambda_z l^{1-\gamma})^{\alpha \sigma} k^{1-\alpha}]^{1-\alpha \gamma \sigma} (\lambda_z l^{1-\gamma})^{\alpha \gamma \sigma (1+\mu)} (\tilde{y}_1^{FB})^{\alpha \gamma \sigma - \alpha \gamma \sigma \mu}, \]

and in next two periods

\[ 1 - \tau_{x,2}^{FB} = 1 - \tau_{x,2}^{FB} = \alpha \gamma. \]

Since the denominator in \( 1 - \tau_{x,1}^{FB} \) is greater than 1 this policy subsidizes less in the second and third periods. This is because there are no learning-by-doing externalities in those periods. An alternative policy uses the instrument \( \tau_z \) to subsidize the purchases of metal scrap.
4 Conclusions

This paper examines policy intervention to establish a new industry for substituting imports of steel armatures. The main rationale for the policy is that it would be socially beneficial if Armenia stops exporting scrap metal and importing steel armature with high transportation costs and instead produces its own steel armatures using ferrous scrap as raw material. As this had not taken place under market conditions, the Government decided to intervene by introducing export restrictions for scrap metal so that it becomes available and affordable for the potential domestic producer.

In order to offer conditions when this measure can be welfare enhancing, we setup a stylized model that well fits the market structures of metal scrap and steel armature industries in Armenia before and after the policy. We find that under certain parameter values the effective ban on exports of scrap that creates a two-directional monopolist (producer of steel armatures and buyer of scrap metal) can be welfare improving. It is hard to estimate whether these conditions hold in this particular case although the high transportation costs of exporting raw materials and importing final products, for example, may fall in the range that justifies this policy intervention.

We also find that within those parameter values there exists values where lifting the ban on exports in a short time delivers higher welfare. This is important in terms of its policy implication as export restriction on scrap metal introduced recently does not include a sunset clause.

Although because of presence of monopolistic distortions and learning-by-doing-externalities subsidizing demand for steel armatures or subsidizing purchases of scrap metal deliver higher welfare than achieved under two-directional monopolist created by export ban (first best) these options are of little policy relevance.

Concluding, our findings that export ban on raw materials can under certain parameter values be welfare enhancing may be relevant for cases similar to Armenia - absence of recycling metallurgical facilities before the intervention and high (to certain extent) transportation costs are important conditions underlying our model. Our findings do not apply to recent episodes of scrap export ban introduced in countries with well established metallurgical industries, such as Russia or India.
References


OECD. *The Economic Impact of Exports Restrictions on Raw Materials*, 2010


