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Abstract

This article aims to examine the deindustrialization in the post-Soviet economies from the perspective of the premature deindustrialization hypothesis, and also to investigate the factors that cause the deindustrialization: a comparative advantage in manufacturing, the Dutch Disease factor, human capital and institutions. This study takes the following two steps: first, to show the degree of the deindustrialization by their country-specific fixed effect in the estimation of manufacturing-population-income relationships, and second, to reveal the contributions of the deindustrialization factors to the country-specific fixed effect. The main findings from the empirical estimations are summarized as follows. First, the result of the fixed-effect model estimation suggested the existence of the deindustrialization in the ten middle-income countries out of the total 15 post-Soviet countries. Second, the outcomes of the factor-analyses revealed that the deindustrialization in the ten countries is fully explained by their comparative disadvantages in manufacturing as the overall contributor, and further by the sub-factors: the lack of human capital, the Dutch Disease effect (mainly in Azerbaijan, Kazakhstan, Russian Federation, and Uzbekistan) and immature institutions (mainly in Kyrgyz, Tajikistan, Ukraine, and Uzbekistan).

Keywords: Deindustrialization, Post-Soviet economies, Dutch Disease, Human capital, Institutions, and Manufacturing.
JEL Classification: O14, O57

1. Introduction

The 15 post-Soviet countries were formed after the disintegration of the Soviet Union in 1991. In the early stages of their independence, their economies went through severe hardships in a number of large-scale market-oriented reformations. They have made significant progresses, however, in their economic transformations and in their linkage with the world economy, as all of them at present are classified into the high- or middle-income groups according to the World Bank income classification in 2020.[1] Although they have commonalities of history, geographical closeness, culture and language, their profile represents heterogeneities among them as shown in Table 1: The population and surface area differ widely; the natural resource are well-endowed in Azerbaijan, Kazakhstan, Russia, Turkmenistan and Uzbekistan while the others are not; and regarding the development stages, Estonia, Latvia and Lithuania belong to high-income class and joins the member of European Union (EU) and Organization for Economic Co-operation and Development (OECD), where the others stay at middle-income class (Kyrgyz, Tajikistan, Ukraine and Uzbekistan are still classified into the lower-middle).

One of the key issues common in the 15 post-Soviet countries is the underdevelopment of the manufacturing sector. Figure 1 shows the trends in manufacturing as a percentage of GDP along with real GDP per capita for 2001-2020 in the post-Soviet countries[2] in comparison with China, Korea and Japan. It suggests that the manufacturing shares in the post-Soviet countries have been lower than those of China, Korea and Japan at any levels of real GDP per capita. In particular, it should be noted that even in the middle-income economies, their manufacturing shares have been far below the one of China, and have no clear symptom to catch up with China's share. The manufacturing sector is, as Kaldor (1967) demonstrated the eponymous Kaldor's law, is considered to be an engine of economic growth especially for developing countries. Rodrik (2013) also argued that the manufacturing sector shows unconditional labor productivity convergence, absorbs more unskilled labor than other sectors, and does not face the demand constraints of a home market due to its tradability in international markets. Thus, the sluggish manufacturing in the middle-income post-Soviet countries might be a detrimental factor for their sustainable economic development.

The underdevelopment of the manufacturing sector in emerging-market economies has been explained by the following two kinds of hypotheses: the "premature deindustrialization" and the "Dutch Disease" (e.g., Palma 2014). The premature

[1] See the website: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519.
[2] Turkmenistan is not included due to the lack of its manufacturing data.

deindustrialization is defined in the literature as the economic phenomenon wherein developing countries transition into service economies without having undergone a comprehensive industrialization experience (Dasgupta and Singh 2007; Rodrik 2016). The theoretical underpinning was provided by Rodrik (2016) such that the developing countries opening up to trade tend to be price-takers in global markets for manufacturing, and those who lack a strong comparative advantage in manufacturing have to become net importers of manufacturing under a decline in the relative price of manufacturing and the rise of China, thereby leading to deindustrialization in both employment and output. The empirical studies have identified the existence of the premature deindustrialization especially in Latin American and sub-Saharan African economies (e.g., Castillo and Neto 2016; Imbs 2013). However, there have been no studies targeting transition economies such as the post-Soviet countries.

Another argument on the deindustrialization is the Dutch Disease hypothesis specific for resource-rich economies. The Dutch Disease was initially named by the *Economist* on November 1977 by being inspired by repercussions of natural gas discoveries by the Netherlands in the late 1950s. The theoretical ground for this disease was described by Corden and Neary (1982) as the resource reallocation from tradable sector to non-tradable sector caused by the shocks from natural resource sector. From the empirical perspective, there have been enormous number of quantitative studies to verify the existence of the Dutch Disease for resource-rich economies. Though the post-Soviet countries contains those well-endowed with natural resources, however, there have been a limited number of empirical studies examining the existence of the disease (e.g., Horvath and Zeynalov 2016; Egert 2013).

This article aims to examine the deindustrialization in the post-Soviet economies from the perspective of the premature deindustrialization hypothesis, and also investigates the factors that cause the deindustrialization: a comparative advantage in manufacturing, the Dutch Disease factor, human capital and institutions. To be specific, this study takes the following two steps: first, to show the degree of the deindustrialization in the post-Soviet countries by their country-specific fixed effect in the estimation of manufacturing-population-income relationships as presented in Rodrik (2016), and second, to reveal the contributions of the aforementioned deindustrialization factors to the country-specific fixed effect by replacing the fixed effect with these factors in the estimation. As the industrialization-related factors, a comparative advantage in manufacturing expressed by net exports in manufacturing is applied as the overall factor to affect the deindustrialization following Rodrik (2016); and the Dutch Disease factor, human capital and institutions are adopted as the sub-factors to explain a comparative advantage in manufacturing. The reasons for choosing these sub-factors are as follows: the Dutch Disease hypothesis suggests that a boom in natural resource sector crowds out manufacturing (Corden and Neary 1982); and human capital and institutions are key dynamic factors as fundamental capabilities for sustaining industrialization (Rodrik 2014; Meon and Sekkat 2004; Van der Ploeg 2011; and Amiri et al. 2019). The factor of institutions is of vital importance in the post-Soviet economies, because their frameworks have been transformed dramatically from a centrally planned economy to a market-based economy over the past three decades, and the modality of the transformations has differed from the high-income countries joining EU to the lower-middle-income countries.

The remainder of the paper is structured as follows. Section 2 reviews the literature focusing on the hypotheses of the premature deindustrialization and the Dutch Disease and clarifies this study's contribution. Section 3 illustrates the empirical analysis performed to examine the deindustrialization in the post-Soviet economies and to investigate the factors that cause the deindustrialization. Section 5 summarizes and concludes the paper.

2. Literature review and contributions

This section starts with reviewing the literature on the premature deindustrialization hypothesis for emerging-market economies. The term "premature deindustrialization" was first used by Dasgupta and Singh (2007). They focused only on employment, not output, and argued that the decline in manufacturing is not necessarily a pathological phenomenon. In Latin America and Africa, pathological deindustrialization occurred because of a focus on current, rather than long-term, dynamic competitive advantage. Conversely, the information technology-driven service sector was regarded as a new engine of India's growth; similarly, East Asian countries benefited from a focus on knowledge-based industries under their industrial policies.

Rodrik (2016) refined the arguments of the premature deindustrialization and described it as the early shrinking of manufacturing in terms of both employment and output in developing countries. Rodrik (2016) constructed a simple two-sector theoretical model with manufacturing and non-manufacturing, and derived a different outcome between a closed economy for advanced countries (exogenous in net manufacturing exports x and endogenous in manufacturing price Pm) and a small open economy for developing countries (exogenous in Pm and endogenous in x, that means price takers in in global manufacturing markets) as shown in Table 2. The premature deindustrialization could be explained in this model by the case of a small open economy for developing countries who liberalize trade. Suppose that the global supply of manufactures exceeds that of non-manufactures with technological progress in manufacturing, and the relative price of manufactures ($Pm < 0$) declines for all countries under globalization. In this case, developing countries with less technological progress in manufacturing (an increase in $\theta m - \theta n$ is smaller than a decline in Pm) witness a decline in the output and employment share of manufacturing; only countries with a manufacturing productivity growth sufficient to offset the relative-price decline (having a comparative advantage in manufacturing) can avoid premature deindustrialization. Rodrik (2016) also provided the following empirical evidence based on the theoretical framework above: late industrializers attain peak levels of industrialization (measured by manufacturing employment and output shares) lower than those experienced by early industrializers, at lower income levels (the post-1990 peak incomes are around forty percent of the pre-1990 ones); from the geographical perspective, Latin America and sub-Saharan Africa have been hard hit by premature deindustrialization, whereas Asian countries have managed to avoid this trend; and in line with the geographical results above, the countries with a comparative advantage in manufacturing expressed by its net exports have tended to avoid premature deindustrialization.

Applying the method of Rodrik (2016) to their estimation with an expanded sample, Sato and Kuwamori (2019) found that both the peak level of the share of manufacturing employment and output and the corresponding income are lower for developing countries (non-OECD) than for developed countries (OECD), suggesting premature deindustrialization. For the region- and country-specific studies, Castillo and Neto (2016) argued that Argentina, Brazil, and Chile faced premature deindustrialization, increasing their specialization in commodities, resource-based manufactures, and low-productivity services. Imbs (2013) pointed out that deindustrialization in sub-Saharan Africa has been correlated with the rising importance of extractive activities in its economy. The existence and symptoms of premature deindustrialization were also identified by country-specific studies for Malaysia (Rasiah 2011), Indonesia (Islami and Hastiadi 2020), and Pakistan (Hamid and Khan 2015). When it comes down to transition economies such as the post-Soviet countries, however, there have been no empirical studies for examining the existence of premature deindustrialization in quantitative ways.

As for the Dutch Disease hypothesis, the theoretical framework was initially provided by Corden and Neary (1982). They described the disease mechanism in the following way: the effects of a boom in natural resource sector are decomposed of "resource movement effect" and "spending effect"; the former effect represents "direct de-industrialization" such that the rise in the resource sector's labor demand causes labor to move out of the manufacturing sector; and the latter effect stands for "indirect de-industrialization" such that the higher real income resulting from the boom causes extra spending on services that raises an appreciation of real exchange rate and thus requires further adjustments towards reducing manufacturing employment.

Rodrik (2016) also illustrated the Dutch Disease in the context of premature deindustrialization: a resource boom denotes an increase in productivity growth and/or prices in non-manufacturing (it corresponds to $\theta m - \theta n < 0$ and/or $Pm < 0$ in Table 2) so that the Dutch Disease magnifies the deindustrializing consequences on countries with comparative advantage in a resource sector.

As for the empirical studies on the Dutch Disease, there has been a vast literature to identify its effect for resource-rich economies (e.g., Edwards 1986; Sachs and Warner 2001; Ismail 2010; Harding and Venables 2013). However, there have been a limited number of studies for the post-Soviet countries, though many of them are resource-rich economies. Horvath and Zeynalov (2016) examined the effect of natural resource exports on economic performance for the 15 post-Soviet countries, and suggested that natural resources crowd out manufacturing unless the quality of domestic institutions is sufficiently high. Egert (2013) investigated the extent to which Asian and European countries of the former Soviet Union were suffering from the Dutch Disease, and identified a clear sign of the disease such that oil prices caused nominal and real currency appreciation thereby leading to deindustrialization.

This study follows the concept and empirical framework of premature deindustrialization as proposed by Rodrik (2016) and the subsequent studies, although the analytical concerns are somewhat different from those in the aforementioned literature. The contributions of this study are highlighted as follows. First, this study targets the post-Soviet countries, which have never been analyzed in the context of premature deindustrialization. Second, this study explicitly investigates the deindustrialization factors including institutions as well as examining the status of the deindustrialization. Targeting the post-Soviet countries and investigating the institutional factor would add a meaningful contribution to the literature. It is because the development paths of the post-Soviet countries are much different from those of usual developing countries in Asia, Latin America and sub-Saharan Africa, in the sense that the transition economies have experienced an institutional transformation from a centrally planned economy to a market-based economy, and the institutional factor matters in manufacturing development.

3. Empirical Analysis

This section illustrates the econometric analysis for examining the deindustrialization in the post-Soviet economies and for investigating the deindustrialization factors. It starts with the methodology and data.

3.1 Methodology and Data

The baseline regressions for this study is based on Rodrik (2016) and the subsequent studies, modified in line with its analytical concerns as follows:

$$man_{it} = \alpha_0 + \alpha_1 \ln pop_{it} + \alpha_2 (\ln pop_{it})^2 + \alpha_3 \ln ypc_{it} + \alpha_4 (\ln ypc_{it})^2 + f_i + \varepsilon_{it} \quad (1)$$
$$man_{it} = \beta_0 + \beta_1 \ln pop_{it} + \beta_2 (\ln pop_{it})^2 + \beta_3 \ln ypc_{it} + \beta_4 (\ln ypc_{it})^2 + \beta_5\, mnx + \varepsilon_{it} \quad (2)$$
$$man_{it} = \gamma_0 + \gamma_1 \ln pop_{it} + \gamma_2 (\ln pop_{it})^2 + \gamma_3 \ln ypc_{it} + \gamma_4 (\ln ypc_{it})^2 + \gamma_5\, nrr + \gamma_6\, hcp + \varepsilon_{it} \quad (3)$$
$$man_{it} = \delta_0 + \delta_1 \ln pop_{it} + \delta_2 (\ln pop_{it})^2 + \delta_3 \ln ypc_{it} + \delta_4 (\ln ypc_{it})^2 + \delta_5\, nrr + \delta_6\, dob + \varepsilon_{it} \quad (4)$$

where the subscripts i and t denote countries and years, respectively; *man* represents the GDP ratios of manufacturing; *pop* and *ypc* show a country's population size and real GDP per capita (purchasing power parity, constant 2017 international US dollars); f_i shows a time-invariant country-specific fixed effect; *mnx* denotes net exports in manufacturing (export divided by imports); *nrr* represents the natural resource rents as a percentage of GDP; *hcp* shows human capital index; *dob* denotes "Doing Business" scores; ε represents a residual error term; $\alpha_{0\ldots4}$, $\beta_{0\ldots5}$, $\gamma_{0\ldots6}$ and $\delta_{0\ldots6}$ show estimated coefficients, respectively; and ln shows a logarithm form, which is set to avoid scaling issues.

The data sources of the variables and the sample size for the estimation are shown as follows. The data for *man*, *pop*, *ypc*, and *nrr* are retrieved from the World Bank Open Data database[3]; those for *mnx* and *hcp* are from UNCTAD Stat[4]; and *dob* is from the World Bank[5] with the total indicator of "Ease of doing business" and ten components: "Starting a business" (*dobsb*), "Dealing with construction permits" (*dobcp*), "Getting electricity" (*dobge*), "Registering property" (*dobrp*), "Getting credit" (*dobgc*), "Protecting minority investors" (*dobpm*), "Paying taxes" (*dobpt*), "Trading across borders" (*dobta*), "Enforcing contracts" (*dobec*), and "Resolving insolvency" (*dobri*). As for the sample size, the estimation targets 17 countries: the 14 post-Soviet countries (Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyz, Latvia, Lithuania, Moldova, Russian Federation, Tajikistan, Ukraine, and Uzbekistan) and additional three Asian

3 See the website: https://data.worldbank.org/.
4 See the website: https://unctadstat.unctad.org/EN/.
5 See the website: https://www.doingbusiness.org/en/doingbusiness.

countries (China, Japan, and Korea). The sample period is 2001–2020 for Equation (1) and (2)[6], and 2015–2019 for Equation (3) and (4) due to the data constraints. The study then constructs a set of panel data of the sample countries and periods. The descriptive statistics for the data of all the variables are displayed in Table 3.

For the subsequent estimation, this study investigates the stationary property of the constructed panel data by employing panel unit root tests: the Levin, Lin, and Chu test (Levin et al. 2002) as a common unit root test; and the Fisher-ADF and Fisher-PP tests (Maddala and Wu 1999; Choi 2001) as individual unit root tests. The common unit root test assumes that there is a common unit root process across cross-sections, and the individual unit root test allows for individual unit root processes that vary across cross-sections. These tests are conducted based on the null hypothesis that a level of panel data has a unit root, by including the trend and intercept in the test equations. Table 3 shows that both of the common and individual unit root tests (the Levin, Lin, and Chu test and the Fisher-PP test) identify the rejection of the null hypothesis of a unit root at the conventional significance levels in all the variables. Therefore, this study uses the level of panel data for the estimation.

The notes on the specifications of the estimation models are described as follows. All the equations are controlled by the variables for a country's population size and real GDP per capita. The ordinary hypothesis of the premature deindustrialization proposed by Rodrik (2016), postulating the inverted-U-shaped path between a country's manufacturing GDP ratio and real GDP per capita, would be verified if α_3, β_3, γ_3, and $\delta_3 > 0$ and α_4, β_4, γ_4, and $\delta_4 < 0$ are significant. Equation (1) applies a fixed-effect model represented by f_i for the panel estimation to examine the degree of the deindustrialization in the post-Soviet countries.[7] The estimation sets China and Japan as the benchmark countries for estimating a country-specific effect because China and Japan achieve a manufacturing-driven development path as shown in Figure 1[8]. The significantly negative coefficient of the country-specific effect would suggest that the post-Soviet country's manufacturing GDP ratio is lower than those of China and Japan in their same development stages, implying the existence of their premature deindustrialization.

Equation (2), (3) and (4) replace the country-specific fixed effect above with possible industrialization-related factors contributing to the fixed effect. As the industrialization-

[6] The sample period excludes the 1990s to avoid the economic turbulences after the independence of the post-Soviet countries and the repercussion of the Russian economic crisis in 1998.

[7] The Hausman specification test (Hausman 1978) also supports the choice of a fixed-effect model since a random-effect model is rejected by over 99 percent with the Chi-Sq. Statistic being 75.113.

[8] Although Korea also shows a manufacturing-driven development path, it is excluded from the benchmark because its manufacturing GDP ratio is beyond those of China and Japan as in Figure 1.

related factors, this study adopts a comparative advantage in manufacturing expressed by net exports in manufacturing (*mnx*) as the overall factor to affect the deindustrialization, and the Dutch Disease factor (*nrr*), human capital (*hcp*) and institutions (*dob*) as the sub-factors to explain a comparative advantage in manufacturing. As Rodrik (2016) argued, avoiding premature deindustrialization depends on the country's comparative advantage in manufacturing expressed by its net exports, and thus the coefficient of *mnx* (β_5) is expected to be significantly positive. The Dutch Disease factor means that a boom in natural resource sector squeezes manufacturing (Corden and Neary 1982), thereby *nrr* being considered to be negatively correlated with *man* at a significant level (γ_5, $\delta_5 < 0$). The human capital and institutions are key dynamic factors to sustain industrialization (Rodrik 2014), and thus the coefficients of *hcp* and *dob* (γ_6 and δ_6, respectively) are supposed to be significantly positive. As the variable of the institutions, the reason why this study chooses the Doing Business index is that the index contains the detailed components to represent market-based system and business environments, so that it could get the precise picture of institutional transformations for the post-Soviet countries. In Equation (2), (3) and (4), *mnx*, *hcp*, *dob* and ten components of *dob* are separately inserted as independent regressors since their variables have a multicollinearity problem. Table 5 reports the bivariate correlations and the variance inflation factors (VIF), a method of measuring the level of collinearity between the concerned regressors. It shows that *mnx*, *hcp*, *dob* and ten components of *dob* (but not *nrr*) have a high bivariate correlation in each combination and high values of VIF that are far beyond the criteria of collinearity, namely, ten points.

3.2 Estimation Results

Table 6 reports the estimation outcomes of Equation (1) – (4): Column (i) corresponds to the results of the fixed-effect model in Equation (1); Column (ii) to the alternative model with the comparative advantage in manufacturing (*mnx*) in Equation (2); Column (iii) to the model with the Dutch Disease factor (*nrr*) and human capital (*hcp*) in Equation (3); and Column (iv) – (xiv) to the model with the Dutch Disease factor (*nrr*) and institutions (*dob* and ten components of dob). The findings from the estimation outcomes are summarized as follows.

First, the inverted-U-shaped path between a country's manufacturing GDP ratio and real GDP per capita is not identified in all the cases from Column (i) to (xiv) as shown in α3, β3, γ3, and δ3 < 0 and α4, β4, γ4, and δ4 > 0, which is against the hypothesis of the premature deindustrialization proposed by Rodrik (2016). There seem to be the following two reasons for the result: the majority of sample countries belong to emerging market economies classified by middle incomers, and has been on the way of industrialization; and the sample period after 2001 is too short to form a clearly inverted-U-shaped path. This finding leads the discussion to focus on the location of the manufacturing-income paths among sample countries rather than the shape of their paths.

Second, focusing on the fixed-effect model in Column (i), the coefficients of the country-specific dummies are significantly negative in the following ten middle-income countries except Belarus: Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz, Moldova, Russian Federation, Tajikistan, Ukraine, and Uzbekistan; and insignificant or weakly positive in the three high-incomers: Estonia, Latvia, and Lithuania. This means that the middle-income post-Soviet countries have lower manufacturing GDP ratios than the benchmark countries of China and Japan have in their same development stages, thereby suggesting the deindustrialization in the middle-income post-Soviet countries. From the perspective of the premature deindustrialization hypothesis, the lower location of a country's manufacturing-income path could be interpreted as the existence of premature deindustrialization "risk", because the country's manufacturing ratio is going to peak out with its lower ratio and at a lower income level from the period onwards.

Third, the alternative models replacing the country-specific dummies with possible industrialization-related factors produces the expected results as follows: the comparative advantage in manufacturing (*mnx*) has a significantly positive coefficient in Column (ii); the Dutch Disease factor (*nrr*) has a significantly negative one in Column (iii) – (xiv); human capital (*hcp*) has a significantly positive one in Column (iii); total institutions (*dob*) have a significantly positive one in Column (iv); and institutional components have significantly positive coefficients in six indicators (out of ten): "Getting electricity" (*dobge*), "Registering property" (*dobrp*), "Protecting minority investors" (*dobpm*), "Trading across borders" (*dobta*), "Enforcing contracts" (*dobec*), and "Resolving insolvency" (*dobri*). This result suggests that the degree of industrialization is affected by the comparative advantage in manufacturing as the overall factor, and also the Dutch Disease factor, human capital, total institutions and the majority of institutional components as the sub-factors. The joint estimation outcomes of the country-specific fixed effect and the possible industrialization-related factors lead to the question of the degree of contributions of the industrialization-related factors to the country-specific deindustrialization in the post-Soviet countries.

3.3 Factor Compositions

The final step is to clarify the factor compositions of the country-specific deindustrialization in the post-Soviet countries. Table 7-1, 7-2, and 7-3, and Figure 2-1, 2-2, and 2-3 shows the country-specific fixed effect and its contributing factors in the ten post-Soviet countries: the contributing factors are the comparative advantage in manufacturing expressed by its net exports (*mnx*), the Dutch Disease factor by natural resource rents (*nrr*), human capital (*hcp*), total institutions by the score of "Ease of doing business" (*dob*); and the sample countries exclude three high-incomers and Belarus with insignificant or positive fixed effects. In Table 7-1, 7-2, and 7-3, Column (a) shows the coefficients of the country-specific fixed-effect dummies; Column (b) and (e) present the period-average values of the contributing factors (*mnx*, *nrr*, *hcp*, and *dob*); Column (c) and (f) compute their deviations from the average of those of China and Japan (the benchmark countries); and Column (d) and (g) obtain the factors' contributions by multiplying the factors' deviations by their estimated coefficients in Table 6. Figure 2-1, 2-2, and 2-3 visualize the contributions of each factor expressed by bar graphs to the country-specific fixed-effect shown by white dots.

The analytical results are summarized as follows. First, Table 7-1 and Figure 2-1 show that the negative country-specific fixed-effects in the middle income post-Soviet countries are fully covered by the comparative disadvantages in manufacturing expressed by its negative net exports as the overall contributor. It means that the deindustrialization in the sample countries could be explained by the lack of the comparative advantage in manufacturing, which is consistent with the theoretical argument of Rodrik (2016) shown in Section 2. Second, Table 7-2 and Figure 2-2 indicate that the negative fixed-effects are mostly contributed to by the two sub-factors: the Dutch Disease factor and the negative values of human capital index. The lack of the human capital is a dominant factor for the deindustrialization, and the Dutch Disease effect reveals additional contributions in Azerbaijan, Kazakhstan, Russian Federation, and Uzbekistan. Third, Table 7-3 and Figure 2-3 display rather weak contributions of the two sub-factor combination: the Dutch Disease factor and the negative values of "Ease of doing business" index. It seems to be because the total index of "Ease of doing business" contains the ten components, all of which do not necessarily exhibit positive correlation with industrialization as shown in Table 6. The negative contribution of "Ease of doing business" is relatively larger in Kyrgyz, Tajikistan, Ukraine, and Uzbekistan than the other sample countries. The verified contributions of the Dutch Disease effect, and the lack of human capital and institutional quality to the deindustrialization in the sample countries are in line with the arguments of Corden and Neary (1982), Palma (2014), Horvath and Zeynalov (2016), Egert (2013), Rodrik (2014), Meon and Sekkat (2004), Van der Ploeg (2011), and Amiri et al. (2019).

In sum, the deindustrialization in the ten middle-income post-Soviet countries is fully explained by their comparative disadvantages in manufacturing as the overall contributor, and further by the sub-factors: the lack of human capital, the Dutch Disease effect (mainly in Azerbaijan, Kazakhstan, Russian Federation, and Uzbekistan) and immature institutions (mainly in Kyrgyz, Tajikistan, Ukraine, and Uzbekistan).

3.4 Discussions

4. Conclusions

This article examined the deindustrialization in the post-Soviet economies from the perspective of the premature deindustrialization hypothesis, and also investigated the factors that cause the deindustrialization: a comparative advantage in manufacturing, the Dutch Disease factor, human capital and institutions. This study took the following two steps: first, to show the degree of the deindustrialization by their country-specific fixed effect in the estimation of manufacturing-population-income relationships as presented in Rodrik (2016), and second, to reveal the contributions of the aforementioned deindustrialization factors to the country-specific fixed effect by replacing the fixed effect with these factors in the estimation.

The contributions of this study are highlighted as follows. First, this study targets the post-Soviet countries, which have never been analyzed in the context of premature deindustrialization. Second, this study explicitly investigates the deindustrialization factors including institutions. Targeting the post-Soviet countries and investigating the institutional factor would add a meaningful contribution to the literature. It is because the development paths of the post-Soviet countries are much different from those of usual developing countries in Asia, Latin America and sub-Saharan Africa, in the sense that the transition economies have experienced an institutional transformation from a centrally planned economy to a market-based economy, and the institutional factor matters in manufacturing development.

The main findings from the empirical estimations are summarized as follows. First, the result of the fixed-effect model estimation suggested the existence of the deindustrialization in the ten middle-income countries out of the total 15 post-Soviet countries. This result also implied the risk of premature deindustrialization since the countries are going to face the earlier peaking-out in the lower manufacturing ratio from the period onwards. Second, the outcomes of the factor-analyses revealed that the deindustrialization in the ten countries is fully explained by their comparative disadvantages in manufacturing as the overall contributor, and further by the sub-factors: the lack of human capital, the Dutch Disease effect (mainly in Azerbaijan, Kazakhstan, Russian Federation, and Uzbekistan) and immature institutions (mainly in Kyrgyz, Tajikistan, Ukraine, and Uzbekistan).

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Table 1 Profile of 15 Post-Soviet Countries

	Population thousand in 2000	Surface Area thousand sq. km in 2018	Natural Resource Rents % of GDP in 2019	GDP per capita USD in 2020	Income Class in 2020
Armenia	45,377	30	2.111	4,267	Upper Middle
Azerbaijan	10,110	87	25.461	4,232	Upper Middle
Belarus	9,399	208	1.773	6,398	Upper Middle
Estonia	1,331	45	1.143	23,036	High
Georgia	3,714	70	0.117	4,275	Upper Middle
Kazakhstan	18,754	2,725	17.625	9,071	Upper Middle
Kyrgyz	6,592	200	0.553	1,189	Lower Middle
Latvia	1,902	65	0.979	17,549	High
Lithuania	2,795	65	0.366	19,981	High
Moldova	2,618	34	0.227	4,523	Upper Middle
Russian	144,104	17,098	13.098	10,115	Upper Middle
Tajikistan	9,538	141	2.792	844	Lower Middle
Turkmenistan	6,031	488	24.072	7,674	Upper Middle
Ukraine	44,135	604	1.820	3,741	Lower Middle
Uzbekistan	34,232	449	8.794	1,767	Lower Middle

Sources:

Population, Surface Area and Natural Resource Rents: World Bank Open Data,
https://data.worldbank.org/

GDP per capita: World Economic Outlook Database, IMF,
https://www.imf.org/en/Publications/WEO/weo-database/2021/October

Income Classification: World Bank,
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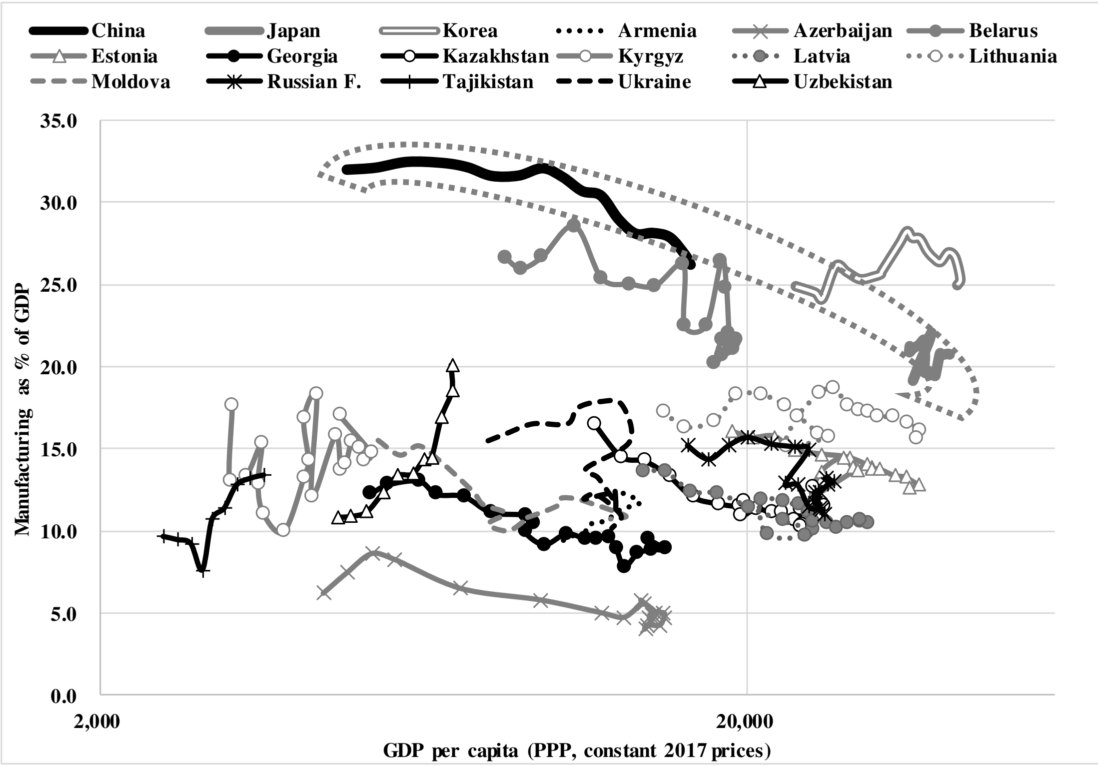
Figure 1 Manufacturing-Income Relations in Post-Soviet countries for 2001-2020



Source: Author's calculation based on World Bank Open Data

Table 2 Effects of Shocks on Manufacturing

A. Closed economy			
Effect on:	Technology shock	Trade shock	Domestic demand shock
	θm - θn > 0	*dx < 0*	
Employmeny share	-	-	-
Real output share	+	-	-
B. Small open economy	Technology shock	External price shock	Domestic demand shock
	θm - θn > 0	*Pm < 0*	
Employmeny share	+	-	0
Real output share	+	-	0

Notes: *θm* and *θn*: productivity of manufacturers and non-manufactures, respectively; *dx*: net exports of manufactured goods; and *Pm*: prices of manufactured goods
Sources: Extracted from Rodrik (2016)

Table 3 Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min.	Max
man	363	15.848	6.531	3.988	32.452
pop	450	101,000	299,000	1,315	1,400,000
ypc	448	14,805	10,840	1,170	42,719
mnx	340	0.687	0.559	0.041	2.058
nrr	431	7.678	12.727	0.009	87.459
hcp	342	53.251	10.951	36.937	89.128
dob	85	73.206	7.856	51.843	84.001
dobcp	85	70.637	11.421	39.566	84.870
dobec	85	69.562	8.766	47.639	84.149
dobgc	85	66.529	14.016	35.000	100.000
dobge	85	77.741	15.721	37.831	99.894
dobpm	85	60.235	12.841	38.000	84.000
dobpt	85	77.218	11.475	42.748	89.884
dobri	85	54.394	15.799	28.102	90.328
dobrp	85	81.395	9.067	60.783	92.971
dobsb	85	92.780	3.686	77.326	99.618
dobta	85	81.458	14.807	44.312	99.921

Sources: Author's calculation

Table 4 Panel Unit Root Tests

	Levin, Lin & Chu Test	Fisher ADF Chi-square	Fisher PP Chi-square
ln *man*	-2.029 **	49.924 **	48.819 **
ln *pop*	-7.402 ***	99.631 ***	63.623 ***
$(\ln pop)^2$	-7.223 ***	99.036 ***	63.120 ***
ln *ypc*	-5.058 ***	48.459 *	49.603 *
$(\ln ypc)^2$	-7.373 ***	69.107 ***	54.596 **
mnx	-2.400 ***	52.801 **	46.192 *
nrr	-2.797 ***	70.551 ***	58.267 **
hcp	-5.741 ***	52.703 **	65.215 ***
dob	-18.145 ***	89.416 ***	111.732 ***
dobcp	-386.468 ***	30.976	54.679 **
dobec	-8.709 ***	12.483	30.005 *
dobgc	-6.929 ***	7.369	16.346 *
dobge	-228.384 ***	92.577 ***	101.329 ***
dobpm	-6.696 ***	30.195 **	41.927 ***
dobpt	-35.952 ***	77.126 ***	85.948 ***
dobri	-22.930 ***	60.570 ***	64.880 ***
dobrp	-129.533 ***	88.615 ***	84.638 ***
dobsb	-167.312 ***	72.136 ***	88.492 ***
dobta	-232.062 ***	34.243	42.392 **

Note: ***, **, and * denote statistical significance at 99, 95, and 90 percent level, respectively.
Sources: Author's estimation

Table 5 Correlation Matrix and Variance Inflation Factors

	mnx	*nrr*	*hcp*	*dob*	*dobcp*	*dobec*	*dobgc*
mnx	1.000						
nrr	-0.466	1.000					
hcp	0.812	-0.390	1.000				
dob	0.394	-0.216	0.653	1.000			
dobcp	0.148	-0.108	0.505	0.686	1.000		
dobec	0.531	-0.086	0.526	0.661	0.331	1.000	
dobgc	-0.142	-0.092	0.083	0.496	0.310	0.070	1.000
dobge	0.458	-0.120	0.657	0.850	0.520	0.673	0.233
dobpm	0.345	-0.124	0.439	0.714	0.344	0.607	0.340
dobpt	0.193	-0.054	0.465	0.830	0.510	0.530	0.366
dobri	0.595	-0.034	0.787	0.665	0.416	0.483	0.043
dobrp	-0.066	-0.216	0.064	0.566	0.422	0.193	0.449
dobsb	-0.589	0.210	-0.256	0.306	0.335	-0.016	0.447
dobta	0.369	-0.504	0.472	0.732	0.462	0.335	0.235
VIF	49.319	5.084	344.652	$1.083*10^{6}$	$8.994*10^{3}$	$1.177*10^{4}$	$9.516*10^{3}$

	dobge	*dobpm*	*dobpt*	*dobri*	*dobrp*	*dobsb*	*dobta*
mnx							
nrr							
hcp							
dob							
dobcp							
dobec							
dobgc							
dobge	1.000						
dobpm	0.537	1.000					
dobpt	0.660	0.623	1.000				
dobri	0.680	0.501	0.453	1.000			
dobrp	0.359	0.198	0.325	0.095	1.000		
dobsb	0.202	0.095	0.389	-0.190	0.355	1.000	
dobta	0.541	0.322	0.670	0.358	0.592	0.211	1.000
VIF	$1.188*10^{4}$	$7.330*10^{3}$	$1.225*10^{4}$	$6.656*10^{3}$	$1.628*10^{4}$	$1.800*10^{4}$	$1.244*10^{4}$

Sources: Author's estimation

Table 6 Estimation Outcomes

	(i)	(ii)	(iii)	(iv)
ln *pop*	4.250 **	0.066	-10.274 ***	-10.461 ***
	(1.987)	(0.042)	(-7.467)	(-6.192)
$(\ln pop)^2$	-0.056	0.017	0.348 ***	0.368 ***
	(-1.093)	(0.358)	(0.131)	(7.320)
ln *ypc*	-3.867	-2.079	-28.111 ***	-55.588 ***
	(-0.804)	(-0.417)	(-5.325)	(-18.360)
$(\ln ypc)^2$	0.016	0.007	1.374 ***	2.893 ***
	(0.061)	(0.026)	(4.745)	(18.488)
mnx		9.913 ***		
		(22.505		
nrr			-0.132 ***	-0.265 ***
			(-7.054)	(-10.218)
hcp			0.288 ***	
			(10.061)	
dob				0.187 ***
				(4.480)
Country fix effects				
Armenia	-12.043 ***			
Azerbaijan	-13.608 ***			
Belarus	5.727 ***			
Estonia	3.247			
Georgia	-7.067 ***			
Kazakhstan	-6.394 ***			
Kyrgyz	-6.938 ***			
Latvia	-1.579			
Lithuania	3.638 *			
Moldova	-4.946 **			
Russian	-0.413 ***			
Tajikistan	-12.708 ***			
Ukraine	-8.939 ***			
Uzbekistan	-9.974 ***			
countries	17	17	17	17
observation	303	288	84	84

	(v)	(vi)	(vii)	(viii)	(ix)
ln *pop*	-10.189 ***	-9.834 ***	-10.323 ***	-10.065 ***	-11.670 ***
	(-8.510)	(-5.974)	(-5.858)	(-5.941)	(-8.836)
(ln *pop*)^2	0.343 ***	0.345 ***	0.356 ***	0.356 ***	0.391 ***
	(10.318)	(7.520)	(6.792)	(7.337)	(10.351)
ln *ypc*	-38.874 ***	-65.987 ***	-58.576 ***	-49.559 ***	-43.900 ***
	(-16.927)	(-24.190)	(-10.438)	(-18.916)	(-8.823)
(ln *ypc*)^2	2.104 ***	3.588 ***	3.036 ***	2.635 ***	2.360 ***
	(18.590)	(25.253)	(10.724)	(19.993)	(9.379)
nrr	-0.259 ***	-0.247 ***	-0.279 ***	-0.262 ***	-0.254 ***
	(-10.285)	(-6.817)	(-10.721)	(-7.715)	(-4.450)
dobsb	-0.292 ***				
	(-7.113)				
dobcp		-0.080 ***			
		(-11.709)			
dobge			0.132 ***		
			(8.880)		
dobrp				0.088 ***	
				(6.235)	
dobgc					-0.091 ***
					(-7.485)
countries	17	17	17	17	17
observation	84	84	84	84	84

	(x)	(xi)	(xii)	(xiii)	(xiv)
ln *pop*	-14.286 ***	-11.063 ***	-8.840 ***	-6.776 ***	-10.187 ***
	(-7.997)	(-7.518)	(-7.415)	(-4.529)	(-6.422)
$(\ln pop)^2$	0.474 ***	0.361 ***	0.322 ***	0.254 ***	0.355 ***
	(9,145)	(8.744)	(9.085)	(5.870)	(7.834)
ln *ypc*	-65.367 ***	-24.346 ***	-55.979 ***	-46.407 ***	-48.619 ***
	(-22.905)	(-2.946)	(-36.719)	(-12.256)	(-9.415)
$(\ln ypc)^2$	3.439 ***	1.493 ***	2.966 ***	2.439 ***	2.525 ***
	(24.169)	(3.683)	(39.951)	(12.724)	(9.446)
nrr	-0.232 ***	-0.273 ***	-0.226 ***	-0.343 ***	-0.311 ***
	(-9.267)	(-8.254)	(-7.315)	(-7.278)	(-12.152)
dobpm	0.096 ***				
	(11.296)				
dobpt		-0.258 ***			
		(-7.152)			
dobta			0.061 **		
			(2.347)		
dobec				0.162 ***	
				(18.930)	
dobri					0.120 ***
					(12.124)
countries	17	17	17	17	17
observation	84	84	84	84	84

Note: ***, **, and * denote statistical significance at 99, 95, and 90 percent level, respectively. T-statistics are in parentheses.
Sources: Author's estimation

Table 7-1 Factor Analysis: Comparative Advantage in Manufacturing

	Fixed Effects	*mnx*	(b) - ave. *mnx*	(c) × 9.913
	(a)	(b)	(c)	(d)
Armenia	-12.043	0.242	-1.477	-14.645
Azerbaijan	-13.608	0.112	-1.608	-15.938
Georgia	-7.067	0.242	-1.477	-14.643
Kazakhstan	-6.394	0.289	-1.430	-14.179
Kyrgyz	-6.938	0.265	-1.454	-14.419
Moldova	-4.946	0.353	-1.367	-13.553
Russia	-9.413	0.404	-1.316	-13.045
Tajikistan	-12.708	0.133	-1.587	-15.729
Ukraine	-8.939	0.988	-0.732	-7.258
Uzbekistan	-9.974	0.337	-1.383	-13.705
Ave. of China & Japan	0.000	1.720	-	-

Sources: Author's estimation

Figure 2-1 Factor Composition: Comparative Advantage in Manufacturing

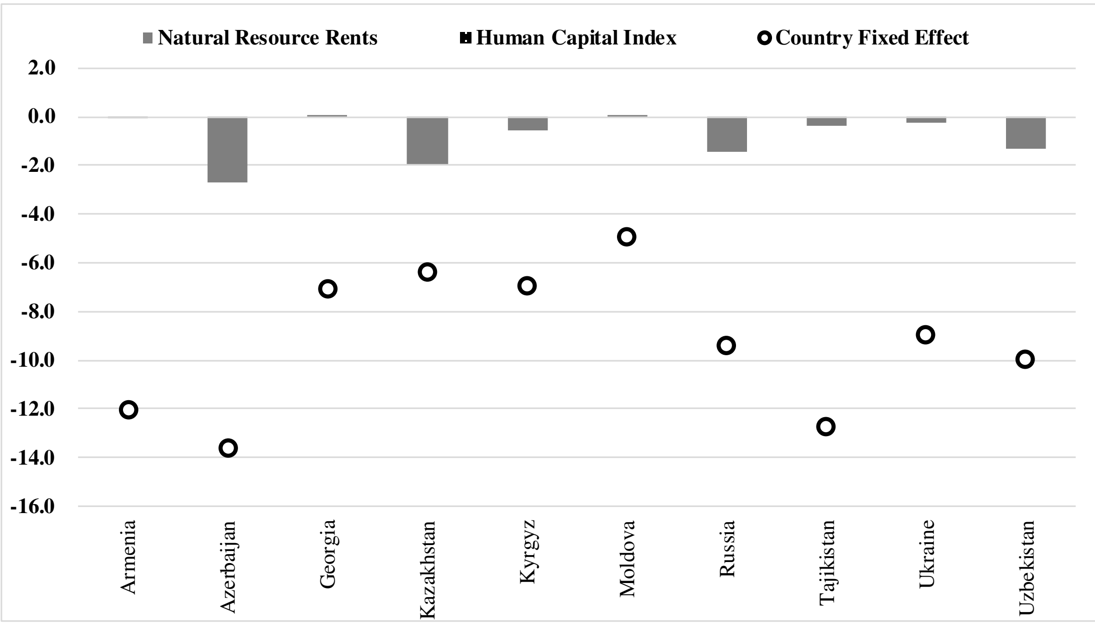
Sources: Author's estimation

Table 7-2 Factor Analysis: Dutch Disease and Human Capital

	Fixed Effects	*nrr*	(b) - ave. *nrr*	(c) × -0.132	*hcp*	(e) - ave. *hcp*	(f) × 0.288
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Armenia	-12.043	0.886	0.235	-0.031	47.842	-21.937	-6.308
Azerbaijan	-13.608	21.145	20.495	-2.715	46.647	-23.133	-6.652
Georgia	-7.067	0.447	-0.203	0.027	53.112	-16.668	-4.793
Kazakhstan	-6.394	15.227	14.577	-1.931	47.532	-22.247	-6.397
Kyrgyz	-6.938	4.789	4.138	-0.548	45.366	-24.413	-7.020
Moldova	-4.946	0.268	-0.383	0.051	51.659	-18.121	-5.210
Russia	-9.413	11.510	10.860	-1.439	60.141	-9.638	-2.771
Tajikistan	-12.708	3.483	2.833	-0.375	41.669	-28.110	-8.083
Ukraine	-8.939	2.459	1.809	-0.240	53.435	-16.344	-4.700
Uzbekistan	-9.974	10.304	9.654	-1.279	45.152	-24.627	-7.081
Ave. of China & Japan	0.000	0.650	-	-	69.779	-	-

Sources: Author's estimation

Figure 2-2 Factor Compositions: Dutch Disease and Human Capital



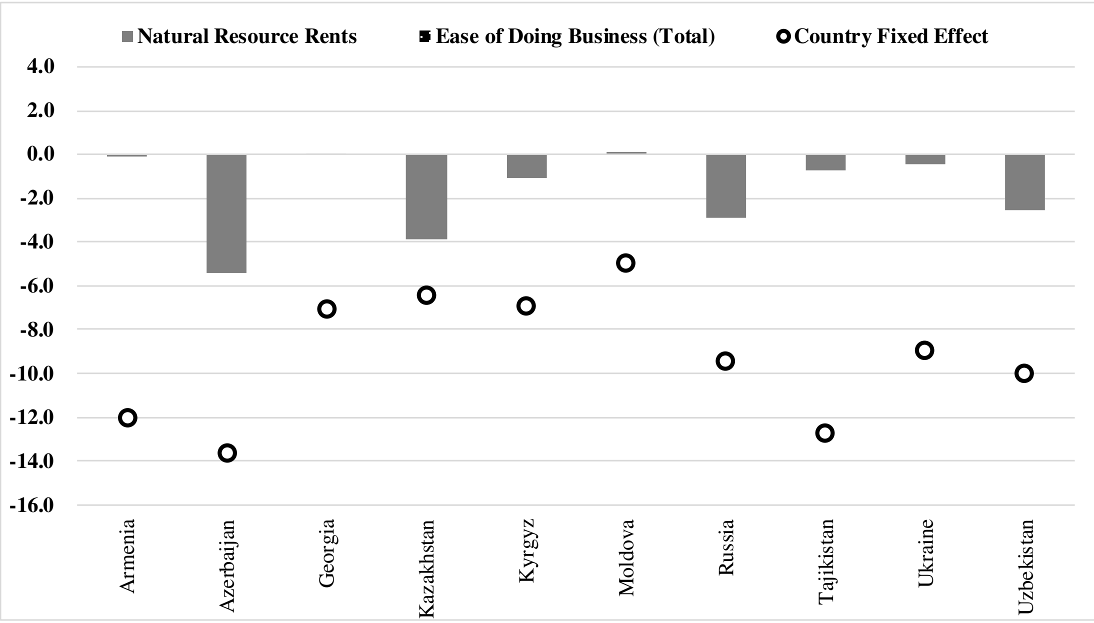
Sources: Author's estimation

Table 7-3 Factor Analysis: Dutch Disease and Ease of Doing Business

	Fixed Effects	*nrr*	(b) - ave. *nrr*	(c) × -0.265	*dob*	(e) - ave. *dob*	(f) × 0.187
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
Armenia	-12.043	0.886	0.235	-0.062	71.791	-1.646	-0.308
Azerbaijan	-13.608	21.145	20.495	-5.426	69.364	-4.073	-0.763
Georgia	-7.067	0.447	-0.203	0.054	81.868	8.431	1.579
Kazakhstan	-6.394	15.227	14.577	-3.859	76.049	2.612	0.489
Kyrgyz	-6.938	4.789	4.138	-1.096	63.636	-9.801	-1.835
Moldova	-4.946	0.268	-0.383	0.101	72.831	-0.605	-0.113
Russia	-9.413	11.510	10.860	-2.875	76.293	2.856	0.535
Tajikistan	-12.708	3.483	2.833	-0.750	55.255	-18.181	-3.404
Ukraine	-8.939	2.459	1.809	-0.479	67.394	-6.042	-1.131
Uzbekistan	-9.974	10.304	9.654	-2.556	65.603	-7.834	-1.467
Ave. of China & Japan	0.000	0.650	-	-	73.437	-	-

Sources: Author's estimation

Figure 2-3 Factor Compositions: Dutch Disease and Ease of Doing Business



Sources: Author's estimation