

KDI Journal of Economic Policy

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Learning-to-export Effect as a Response to Export Opportunities: Micro-evidence from Korean Manufacturing[†]

By CHIN HEE HAHN AND YONG-SEOK CHOI*

This paper aims to investigate whether there is empirical evidence supporting the learning-to-export hypothesis, which has received little attention in the literature. By taking full advantage of plant-product level data from Korea during 1990–1998, we find some evidence for the learning-to-export effect, especially for the innovated product varieties with delayed exporters: their productivity, together with research and development and investment activity, was superior to their matched sample. On the other hand, this learning-to-export effect was not significantly pronounced for industries protected by import tariffs. Thus, our empirical findings suggest that it would be desirable to implement certain policy tools to promote the learning-to-export effect, whereas tariff protection is not justifiable for that purpose.

Key Word: Learning-to-export, Difference-in-differences, Matching
JEL Code: F13, F14

I. Introduction

One of the most widely accepted stylized facts in the field of international trade is that exporters tend to outperform non-exporters in many respects. Since Bernard and Jensen (1995), substantial empirical literature has documented these findings for a large number of countries. In explaining this observed phenomenon, two alternative (but not mutually exclusive) hypotheses have been proposed in the literature.¹ The first is what is known as the *self-selection hypothesis*, which states that exporting is a consequence of a firm's productive capacity. Entry into the export market is profitable, but firms must incur irreversible entry costs in order to enter. Thus, only firms with sufficiently productive capacity self-select into the export

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¹See Greenaway and Kneller (2007) and Wagner (2012) for an extensive literature review on this issue.

market. Such interaction between the export market entry cost and firm productivity is an essential component of the heterogeneous firm theory developed by Melitz (2003) and others, such as Bernard *et al.* (2003) and Bernard, Jensen, and Schott (2006).

The second explanation is the *learning-by-exporting hypothesis*, which maintains that a firm's productive capacity is a consequence of its entering the export market. Once a firm enters the export market, it undergoes faster growth as a result of fiercer yet more informative international competition and greater access to advanced technology. Under this hypothesis, firm productivity grows *after* entry into the export market.

As emphasized in Bernard and Jensen (1999), understanding how plants perform before and after exporting is of great importance in selecting appropriate policies. For example, if there are no post-entry rewards from exporting (i.e., no learning-by-exporting effect), then policies designed to increase the number of exporters may be wasting resources. On the other hand, if gains accrue to firms once they become exporters, then reducing the entry cost into foreign markets would be an appropriate policy stance. Many empirical studies have found that pre-entry differences present substantial evidence in favor of the self-selection hypothesis, but evidence regarding the learning-by-exporting hypothesis is mixed (Wagner, 2012).²

Yet another plausible argument can explain the pre-entry differences between exporters and non-exporters, although the literature has paid little attention to this facet. This argument is referred to as the learning-to-export or conscious self-selection hypothesis in López (2004); Alvarez and López (2005); Greenaway and Kneller (2007); and Eliasson, Hansson, and Lindvert (2012).

The main idea of this hypothesis is related to the timing of learning, arguing that learning takes place not when export sales begin but when the export decision is made. The export decision is usually made before export market entry. Once this decision is made, firms make conscious efforts to enhance their performance and improve the quality of their products to become exporters, thereby increasing their productivity endogenously.

If this effect is found to be empirically important, it can contribute to the existing literature from at least two standpoints. First, it may explain (at least some of the reasons) why firm productivity increases before export market entry. In contrast to previous heterogeneous firm theories where each firm's productivity is assumed to be drawn from an exogenous distribution, productivity change can be understood as an endogenously determined process under the learning-to-export mechanism. Second, the effect can shed light on related policy issues as well. If firms enhance innovative and productive activities for the purpose of entering export markets, rewarding exporting *ex post* may then increase such activities at current non-exporters and successfully increase economic growth (Bernard and Jensen, 1999).

Thus, the main objective of this paper is to investigate whether empirical evidence supports the learning-to-export hypothesis by using manufacturing data from Korea during 1990-1998. However, identifying the learning-to-export effect is not an easy

²A growing body of studies has found some evidence for the learning-by-exporting hypothesis in developing countries, particularly Girma, Greenaway, and Kneller (2002) for the United Kingdom; Van Biesebroeck (2005) for sub-Saharan African countries; De Loecker (2007) for Slovenia; Albornoz and Ercolani (2007) for Argentina; Aw, Roberts, and Xu (2011) for Taiwan; Ma, Tang and Zhang (2014) for China; and Hahn (2005; 2012) for Korea.

task owing to the unobservable nature of the time at which the decision to start to export is made, as mentioned in López (2004) and Greenaway and Kneller (2007). Recent empirical works investigating the learning-to-export effect, such as Eliasson, Hansson, and Lindvert (2012), rely on the assumption that the decision to start to export is made several years before engaging in actual exports.

As we will discuss in the next section, however, our rich plant-product matched dataset with yearly information on domestic and export market sales allows us to make another plausible assumption about the timing of the export decision. The main idea is that we focus our analyses on plants which innovate and introduce a new product variety only for the domestic market in the pertinent innovation year.³ In other words, when a new product variety is introduced for the domestic market, it will open a new opportunity for the plant to export this variety in the international market. Therefore, at the time of the introduction of the new product variety, plants can decide whether to export this product variety later by improving its productivity. If this is the case, we should observe plants' conscious efforts to improve the quality of their product variety to become an exporter.

Another interesting issue that is worthwhile to analyze is the effectiveness of trade protection policies regarding the learning-to-export effect because, amongst the three different hypotheses between productivity and exports, learning to export is more closely related to the trade protection argument and can provide justification for such policies. For example, with the existence of the self-selection mechanism where intra-firm productivity is exogenously determined, trade protection cannot play any role with regard to changes in intra-firm productivity. At the same time, the learning-by-exporting effect implies that productivity increases only after international market participation and that trade protection therefore cannot be justified as well. As described in Slaughter (2004), dynamic arguments for infant industry protection tell us that trade protection can buy protected industries the time they require to learn before participating in the international market and to correct inefficiencies. Thus, for infant industry protection to be justified, we should observe the profound effect of learning-to-export in protected industries. Therefore, in our empirical analyses we will also investigate this possibility as much as our data allow us to do so.

The rest of this paper is organized as follows. In the next section, we explain our datasets and some definitions regarding product varieties. In section 3, we present our empirical methodologies and their main results to investigate the existence of the learning-to-export effect. In section 4, we investigate whether those learning-to-export effects arise disproportionately between protected and unprotected industries. Section 5 will provide some additional empirical results regarding the conscious efforts of firms to learn to export. The final section summarizes the results and concludes the paper.

³Thus, we exclude plants which introduce a new product variety into the domestic and export market simultaneously in our main empirical analyses. These plants may already have productivity high enough to pay the entry cost and therefore have little incentive for learning to export.

II. Data and Definitions Regarding Product Variety

A. Data

This study utilizes three datasets. The first contains the unpublished plant-level data underlying the *Mining and Manufacturing Census* published by Statistics Korea for 1990-1998. It is an unbalanced panel dataset and covers all plants with five or more employees in the mining and manufacturing sector. The dataset has information on various plant characteristics, such as production, shipments, production and non-production workers, tangible fixed assets, and R&D expenditures.

The second dataset contains unpublished plant-product level data for the same period, which can be matched to the plant-level dataset through the plant identification number. A product is identified by an eight-digit product code which is constructed by combining the five-digit Korean Standard Industrial Classification (KSIC) code to which the product belongs and the three-digit code based on Statistics Korea's internal product classification scheme. The product code is consistent over time during the period of analysis. For each plant-product observation, the values of total shipments (domestic plus export shipments) and export shipments are available. The plant-product dataset covers roughly 70%-80% of plants in the plant-level dataset.⁴ The coverage ratio is much higher for total and export shipments. Yearly total shipments and exports from the plant-product dataset account for more than 84.1% of shipments and virtually all (99.9%) of the exports in the plant-level dataset. Using the information on the plant-product level total and export shipments, we can identify which plant introduces a new product variety for the first time and amongst them which plant begins exporting the same product variety later, or not.⁵ This is crucial information in our analyses, as discussed below.

The last dataset we use in our analyses contains yearly import tariff data from the Korea Customs Service at the ten-digit level Harmonized System (HS) code for 1991-1998. This provides data on the value of the applied tariffs and imports for each HS category, and the import tariff rate can be directly calculated by dividing the value of the applied tariff by the value of the import. These tariff data with the HS code system have been converted into the four-digit International Standard Industrial Classification (ISIC) and in turn into KSIC codes. The trend of Korea's import tariffs during 1991-1998 is reported in Table 1. As can be seen, the mean value of import tariffs across industries declined up to 1994 and stabilized after that year.

⁴Only those plants that are included in the plant-product dataset are included in the sample.

⁵It may be more desirable to conduct firm-level analyses rather than plant-level analyses because the export decision itself can be made at the firm level. A recent paper by Chun, Hur, Son, and Yoon (2019) for the period of 2007-2013 found some indirect spillover effects at the plant level within firms in terms of export decisions. However, the current data we have do not contain firm-IDs, making it impossible to conduct a firm-level analysis in our empirical part.

TABLE 1—KOREA'S IMPORT TARIFFS, 1991-1998

Year	Mean	Standard Deviation
1991	0.106	0.061
1992	0.096	0.066
1993	0.083	0.065
1994	0.076	0.068
1995	0.080	0.082
1996	0.078	0.065
1997	0.079	0.060
1998	0.078	0.059
1991-1998	0.084	0.067

Note: The table reports the means and standard deviations of import tariffs across 128 industries according to the four-digit level of the International Standard Industrial Classification (ISIC).

Source: Author's calculations.

B. Definitions Regarding Product Variety

Before proceeding to explain our empirical strategies in more detail, first we explain briefly the structure of the plant-product level dataset and the definitions that we will use in our empirical part.

A *product* is defined at the eight-digit product code, which can be produced by multiple plants. We define *product variety* or *variety* as a product produced by a certain plant. *Innovated product variety* is defined from the viewpoint of plants for the period of 1992-1998. Specifically, an innovated product variety is a product variety which was not produced by a plant during 1990-1991 and which began to be produced by that plant for the first time during the period of 1992-1998. All other product varieties are *existing* or *non-innovated* product varieties. The product variety innovation year is the first year the innovated product variety was produced such that each innovated product variety has a unique product variety innovation year. We can define the new export (product) variety and new variety export year analogously. A new export product variety is a product variety which was not exported by a plant during 1990-1991 and which began to be exported by that plant for the first time during the period of 1992-1998. The new variety export year is the first year of exporting the new export variety.

Combining the definitions of innovated product variety and exported product variety (and product variety innovation year and new variety export year), we can categorize all of the product varieties into five different product types, as summarized in Table 2. First, the innovated product varieties can be categorized into the first three types: innovated product varieties with simultaneous export (IN_SE), that with delayed export (IN_DE), and that without export (IN_NE). Second, the non-innovated product variety can be categorized into the next two types: non-innovated product variety with export (NI_E) and that without export (NI_NE).

As shown in Table 3, the total number of product varieties is 402,312, amongst which the IN_NE type of product variety takes the highest share of 58.5%, followed by NI_NE 29.7%), IN_SE (8.8%), IN_DE (1.9%), and NI_E (1.1%).⁶ The basic

⁶The share of exported varieties (i.e., IN_SE, IN_DE and NI_E) appears to be low (11.8% in total in Table 3)

TABLE 2—CLASSIFICATION OF PRODUCT VARIETY TYPES

Product variety type	Description
IN_SE	Innovated product variety with simultaneous export (innovation year = export year)
IN_DE	Innovated product variety with delayed export (innovation year < export year)
IN_NE	Innovated product variety without export
NI_E	Non-innovated product variety with export
NI_NE	Non-innovated product variety without export

TABLE 3—NUMBER OF PRODUCT VARIETIES ACCORDING TO TYPE

Product variety type	Frequency	Share (%)	Cumulative share (%)
IN_SE	35,363	8.8	8.8
IN_DE	7,729	1.9	10.7
IN_NE	235,195	58.5	69.2
NI_E	4,531	1.1	70.3
NI_NE	119,494	29.7	100.0
Total	402,312	100.0	-

Source: Author's calculations.

statistics of the major variables for each product type are summarized in Table 4.⁷ For example, the initial value of total factor productivity (TFP) is highest for simultaneous exporters, while those of the other two innovated variety types are nearly the same. The initial TFP level is lowest for non-innovated product variety producers (NI_E and NI_NE).

With regard to our empirical interest here, plants with the IN_DE type of product variety are most likely to demonstrate the learning-to-export effect. Because they introduce a newly innovated product variety first and then export it later with a delay, they are most likely to make conscious efforts to increase their productivity during these two time periods to become an exporter. Table 5 shows the number of years from innovation to export participation amongst the IN_DE type of product varieties. It takes only one year for the innovated variety to become an exported variety for around 53.1% of the IN_DE type of variety, two years for 23.7% of the IN_DE type of variety, and so on. Those years could be thought of as the periods during which the learning-to-export effect is most pronounced if it exists.

Regarding the other two types of innovated product varieties (IN_SE and IN_NE), the learning-to-export effect may not be profound compared to the results for the delayed exporters. For simultaneous exporters (IN_SE), the fact that they can

because in this table we counted the numbers of product varieties of each type, while the quantities of production and export were not taken into account. If we calculate the share of export value out of total shipments using the same dataset for 1990–1998, it ranges from 23.4 to 36.4% (not reported here but available upon request). This means that exported products are concentrated within a small set of product varieties. We would like to thank an anonymous referee for clarifying this point.

⁷The figures in Table 3 and 4 are reported from the viewpoint of “product varieties,” not “plants.” In other words, a multi-product plant that produces both IN_SE and NI_E, for example, is included in both product type categories. In our main empirical analyses below in section 3, we excluded these multi-product plants that belong to both a treatment group and a control group for product type. Because the share of these multi-product plants is relatively small, whether or not they are included in the sample does not change our main empirical results substantially. Section 3 contains more details on this issue. We would like to thank an anonymous referee for pointing this out.

TABLE 4—SUMMARY STATISTICS OF VARIABLES ACCORDING TO PRODUCT VARIETY TYPE

Major Variables	Product Variety Type	Observation	Mean	Standard Deviation	Minimum	Maximum
TFP (log of Levinsohn and Petrin's total factor productivity)	IN_SE	35,146	2.56	1.01	-1.66	7.39
	IN_DE	7,686	2.35	0.94	-1.05	5.90
	IN_NE	234,000	2.37	0.88	-2.63	7.39
	NI_E	4,503	2.30	0.97	-1.52	6.11
	NI_NE	119,000	2.28	0.94	-1.80	6.62
Size (log of number of worker)	IN_SE	35,363	3.60	1.48	0.69	10.33
	IN_DE	7,729	3.35	1.32	0.69	10.33
	IN_NE	235,000	2.54	0.88	0.69	10.33
	NI_E	4,531	3.75	1.37	1.61	10.33
	NI_NE	119,000	3.06	1.22	1.39	10.33
Age (log of plants' age)	IN_SE	31,650	1.84	1.05	0.00	4.71
	IN_DE	6,763	1.77	1.05	0.00	4.65
	IN_NE	197,000	1.49	0.96	0.00	4.72
	NI_E	4,302	2.03	0.99	0.00	4.50
	NI_NE	110,000	1.77	0.99	0.00	4.66
K/L (log of capital-labor ratio)	IN_SE	35,340	2.55	1.35	-5.02	10.44
	IN_DE	7,725	2.65	1.32	-3.24	7.44
	IN_NE	235,000	2.25	1.29	-5.02	10.44
	NI_E	4,528	2.57	1.21	-1.82	7.10
	NI_NE	119,000	2.19	1.23	-3.07	10.23
R&D (dummy)	IN_SE	35,363	0.09	0.29	0.00	1.00
	IN_DE	7,729	0.08	0.27	0.00	1.00
	IN_NE	235,000	0.05	0.21	0.00	1.00
	NI_E	4,531	0.02	0.13	0.00	1.00
	NI_NE	119,000	0.01	0.09	0.00	1.00

Note: 1) Innovated varieties are categorized into IN_SE (simultaneous exporter), IN_DE (delayed exporter), and IN_NE (non-exporter), 2) Non-innovated varieties are categorized into NI_E (non-innovated exporter) and NI_NE (non-innovated non-exporter), 3) All basic statistics are calculated at the first year of each product variety, 4) TFP is measured using the method devised by Levinsohn and Petrin (2003), 4) Size is the natural logarithm of the number of employees, 5) Age is the log value of a plant's age, 6) K/L is the ratio of capital to the number of workers in the log, 7) R&D is a dummy variable that takes a value of 1 if the value of research and development is positive and a value of 0 otherwise.

Source: Author's calculations.

TABLE 5—YEARS FROM INNOVATION TO EXPORT PARTICIPATION
AMONGST INNOVATED PRODUCT VARIETIES WITH DELAYED EXPORT (IN_DE)

Years from innovation to export participation	Frequency	Share (%)	Cumulative share (%)
1 year	4,103	53.1	53.1
2 years	1,834	23.7	76.8
3 years	898	11.6	88.4
4 years	484	6.3	94.7
5 years	306	4.0	98.7
6 years	104	1.4	100.0
Total	7,729	100.0	-

Source: Author's calculations.

innovate and export a specific product variety at the same time may imply that they are already capable of paying the fixed cost to participate in the export market and thus have little need to learn to export. In the case of innovators without exports (IN_NE), some of them may have the intention to become an exporter and make the necessary efforts to improve their productivity yet fail to export, while others may not even have such an intention.

III. Main Empirical Analyses

A. Methodology

As mentioned above, the most difficult part of our empirical investigation stems from the fact that the actual time of the decision to export is unobservable. Thus, we will take two different approaches in our empirical implementation, the choice of which depends on our assumptions of the timing of the decision to become an exporter.

The first approach assumes that the decision to become an exporter is directly related to the actual export participation time, which is the approach taken in most other papers on learning to export (e.g. López, 2004; Greenaway and Kneller, 2007; Eliasson, Hansson, and Lindvert, 2012). Put differently, given the observed export participation year, this approach assumes that the decision to become an exporter is made some years before the export participation year and investigates whether there is a learning-to-export effect between the decision year and the export year. To estimate the learning-to-export effect in the first approach, we compare the performance outcome (TFP) of plants with innovated product variety with delayed export (IN_DE) to that of plants with innovated product variety without export (IN_NE).⁸

The second approach assumes that the decision to become an exporter is directly related to the actual innovation time at which plants have a new opportunity to become an exporter. Because this approach requires not only export participation year data but also new innovation year data for each variety, we can take full advantage of our plant-product level data to investigate this issue. Under this approach, given the observed product variety innovation year, we assume that the decision to become an exporter is made at the product variety innovation year and investigate whether there are learning-to-export effects after this year. In this approach, we compare the performance outcome (TFP) of the innovated product variety to that of delayed export (IN_DE) with non-innovated product variety without export (NI_NE).

In either approach, the decision to become an exporter can be correlated with the data-generating process for the plant TFP. In this case, propensity score matching is a popular way to reduce the estimation bias associated with an endogenous participation decision. This can be done by comparing the outcome variable of the treated group (actual exporters amongst plants with innovated products) with that of

⁸We can also compare other pairs of product variety types, e.g. IN_SE and IN_NE. Although this is not our major interest, it is reported in our empirical results for comparison.

the control group (non-exporters with innovated products or non-exporters without innovation), which are as similar to the treated group as possible. However, as explained by Heckman, Ichimura, and Todd (1997), when there is selectivity of the export decision based on unmeasured characteristics or if there are time-invariant level differences in outcome variables between treated and control groups, the difference-in-differences propensity score matching (DID PSM) estimator becomes a more appropriate econometric methodology. In this paper, we use a DID PSM estimator to estimate the effect of the export decision on TFP to measure the learning-to-export effect.

B. Empirical Results

1. Approach 1: Export Decision with Observed Export Participation

To apply the DID PSM method, we start by estimating the following probit model:

$$(1) \quad P(X_i) = \Pr(d_i = 1 | X_i) = E(d_i | X_i),$$

where $P(X_i)$ is the probability of becoming an exporter for plant i conditional on the vector of pre-exporting characteristics X_i and d_i is a dummy indicating export market participation. As pre-exporting characteristics, we include the variables considered to be important in other studies, for example the log of the plant TFP, the log of the number of employees as a proxy for the plant size, the log of the plant age, the log of the plant's capital-labor ratio and a dummy variable indicating whether the plant is engaged in R&D.

All of these explanatory variables are lagged by three years; accordingly, the plant characteristics in the probit model are the values three years before the plant begins to export. This approach allows us to examine whether there is a learning-to-export effect in the outcome variables up to two years before actual exporting started.⁹ The results of these probit estimations are reported in Table 6, which shows that more productive, larger, younger, more capital-intensive, and more R&D-engaged plants are more likely to become exporters.¹⁰

Next, based on the estimated propensity score, a set of plants categorized as 'innovated product variety without export' is matched with 'innovated product variety with delayed export'. Here, let T and C denote the set of treated (IN_DE) and control (IN_NE) units and y^T and y^C be the observed outcomes of the treated and control units, respectively, while i and j are correspondingly the indexes for the treated and control units. The subscript t_0 is some time before

⁹This empirical setup using explanatory variables with three-year lags implies that the decision to export is assumed to have been made three years before actual export participation. This assumption may seem to be ad hoc, but this has precedent, such as in Eliasson, Hansson and Lindvert (2012).

¹⁰This is the first procedure to apply the matching technique below. By running this probit regression, we find plants for the treated group and control group that are as similar as possible at the time of export decision (three years before the actual export participation). We then assume that learning-to-export takes place between the time of the export decision and actual export participation because at the time of export decision plants start endogenously to choose to learn to export. Self-selection is assumed to occur at the time of actual export participation. We would like to thank an anonymous referee for clarifying this point.

TABLE 6—PROBABILITY OF EXPORTING PARTICIPATION: PROBIT MODEL

Variables	(1) IN_DE vs. IN_NE	(2) IN_SE vs. IN_NE
TFP_{t-3}	0.023** (0.010)	0.064*** (0.009)
$Size_{t-3}$	0.155*** (0.009)	0.397*** (0.006)
Age_{t-3}	-0.040*** (0.011)	-0.024*** (0.008)
K/L_{t-3}	0.024*** (0.009)	0.036*** (0.006)
$R\&D_{t-3}$	0.100*** (0.029)	0.083*** (0.019)
Year dummy	Yes	Yes
Industry dummy	Yes	Yes
No. of obs.	332,808	313,069
Log likelihood	-8,636.7	-22,808.1

Note: 1) TFP is measured with the method of Levinsohn and Petrin (2003), 2) Size is the natural logarithm of the number of employees, 3) Age is the log value of the plant's age, 4) K/L is the ratio of capital to the number of workers in the log, 5) R&D is a dummy variable that takes a value of 1 if the value of research and development is positive and a value of 0 otherwise, 6) Robust standard errors are in parentheses, 7) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

exporting, which is set to three years before exporting in this case. The subscript s represents the number of years after exporting starts. We denote the set of control units matched to treated unit i by $C(i)$, the number of control units matched with $i \in T$ by N^C and the number of plants in the treated units by N^T . Then, the propensity score DID estimator at s -years after export market entry is given by

$$(2) \quad \hat{\alpha}^{PSMDID} = \frac{1}{N^T} \sum_{i \in T} \left((y_{i,s}^T - y_{i,t_0}^T) - \sum_{j \in C(i)} w_{ij} (y_{j,s}^C - y_{j,t_0}^C) \right),$$

where $w_{ij} = 1 / N_i^C$ if $j \in C(i)$ and $w_{ij} = 0$ otherwise.

The results of the DID PSM estimates are reported in Tables 7 and 8.¹¹ Table 7 shows the results when plants of the IN_DE type (plants with innovated product variety with delayed export) are included as treated units and plants of the IN_NE type (plants with innovated product variety without export) serve as control units. As shown in Table 7, we find strong evidence to support self-selection: the cross-section PSM and DID PSM estimates tells us that the TFP of IN_DE type outperforms the IN_NE type by 11.4% and 7.5% respectively. Regarding the learning-to-export effect, the evidence is somewhat mixed. While the PSM estimates at $s = -2$ are statistically insignificant, those at $s = -1$ are statistically significant; the differences are 3.5% and 2.9% depending on the PSM methodology.

¹¹As mentioned in the footnote 6, our results in section 3.2 exclude the plants that belong to both the treated group and the control group. In the first column in both Table 6 and Table 7, where we analyze the performance outcomes of IN_DE and IN_NE, 3,585 (2.8%) out of 128,982 plants belong to both groups; the rest of them produce only one product variety. Similarly in the second column of Table 6 and Table 8, where we analyze the performance outcomes of IN_SE and IN_NE, 6,627 (5.0%) out of 131,986 plants belong to both groups; the rest of them produce only one product variety. Dropping these double-counted plants does not change our empirical results that much.

TABLE 7—ESTIMATED EFFECT OF PRODUCT VARIETY EXPORT
(TREATED: IN_DE, CONTROL GROUP: IN_NE)

Estimator	Learning-to-export		Self-selection	Learning-by-exporting		
	$s = -2$	$s = -1$	$s = 0$	$s = +1$	$s = +2$	$s = +3$
Cross-sectional PSM	0.046 (0.029)	0.090*** (0.028)	0.114*** (0.029)	0.123*** (0.035)	0.050 (0.043)	0.142*** (0.053)
DID PSM	0.004 (0.014)	0.065*** (0.017)	0.075*** (0.018)	0.076*** (0.023)	0.084*** (0.029)	0.091** (0.044)

Note: 1) Robust standard errors are in parentheses, 2) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

TABLE 8—ESTIMATED EFFECT OF PRODUCT VARIETY EXPORT
(TREATED: IN_SE, CONTROL GROUP: IN_NE)

Estimator	Learning-to-export		Self-selection	Learning-by-exporting		
	$s = -2$	$s = -1$	$s = 0$	$s = +1$	$s = +2$	$s = +3$
Cross-sectional PSM	0.068*** (0.018)	0.035* (0.018)	0.106*** (0.017)	0.085*** (0.019)	0.022 (0.025)	0.062** (0.026)
DID PSM	0.033*** (0.008)	0.029*** (0.010)	0.100*** (0.010)	0.068*** (0.014)	0.047*** (0.018)	0.082* (0.019)

Note: 1) Robust standard errors are in parentheses, 2) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

For comparison, we repeat the same procedure when plants of the IN_SE type (plants with innovated product variety with simultaneous export) are included as treated units (Table 8). In this case, we find better performance of the IN_SE type plants over their matched IN_NE type plants at $s = -1$ and $s = -2$. For example, if we look at the estimated results of DID PSM in Table 8, the IN_SE type plants' TFP outcome is higher than that of the IN_NE type plants by 3.3% at $s = -2$ and 2.9% at $s = -1$. However, because IN_SE plants simultaneously innovate and export at $s = 0$, the superior performances of $s = -1$ and $s = -2$ may reflect both the learning-to-export and learning-to-innovate effects.

At this point, we turn to the empirical results under our next (and preferable) approach, where we assume that the export decision is more directly related to the timing of new product variety innovation.

2. Approach 2: Export Decision with Observed Product Variety Innovation

Our second approach assumes that the decision to become an exporter is more directly related to the actual innovation time at which plants have a new opportunity to become an exporter. In this case, although the estimation procedures are nearly identical, there are several differences from the first approach. First, when estimating equation (1) to obtain the propensity score, d_i is a dummy variable indicating product variety innovation (instead of export market participation). In addition, there is no lag structure in the explanatory variables when estimating equation (1), although we include the set of explanatory variables used before. Second, when we estimate the DID PSM in equation (2), t_0 is the year in which the actual product variety innovation is introduced. Thus, by estimating the DID PSM at $s = +1, +2$, and $+3$, we can

estimate the learning-to-export effect after product variety innovation for IN_DE type plants compared to that of NI_NE (non-innovated and non-exported) plants.

The result of the probit estimation to obtain a sample in NI_NE matched to the IN_DE sample is reported in Table 9. As in Table 6, more productive, larger, younger, more capital-intensive, and more R&D-engaged plants are more likely to become innovators.

With a matched sample, we estimated the DID PSM as before where the treatment unit is IN_DE type varieties and the control unit is NI_NE type varieties. As shown in Table 10, the DID PSM results show a statistically significant learning-to-export effect this time. After the first, second, and third year of product variety innovation, the TFP differences between IN_DE and NI_NE are 4.1%, 4.0%, and 3.9%, respectively.¹²

Note that when the learning-to-export effect is estimated at $s = +1$ (i.e., just after the innovation year), all IN_DE samples are used in the entire procedure. However, when we estimate this effect at $s = +2$, we exclude the product varieties with one year of the innovation-export lapse (the samples in the first line in Table 5). This is done because these product varieties are already exported at $s = +1$. By the same reasoning, when we estimate the learning-to-export effect at $s = +3$, the product

TABLE 9—PROBABILITY OF INNOVATION: PROBIT MODEL

Variables	IN_DE vs. NI_NE
TFP_t	0.039*** (0.006)
$Size_t$	0.123*** (0.003)
Age_t	-0.491*** (0.008)
K/L_t	0.060*** (0.005)
$R\&D_t$	0.144*** (0.016)
Year dummy	Yes
Industry dummy	Yes
Number of observations	279,775
Log likelihood	-29,348.6

Note: 1) TFP is measured by the method of Levinsohn and Petrin (2003), 2) Size is the natural logarithm of the number of employees, 3) Age is the log value of the plant's age, 4) K/L is the ratio of capital to the number of workers in the log, 5) R&D is a dummy variable that takes a value of 1 if the value of R&D is positive and a value of 0 otherwise, 6) Robust standard errors are in parentheses, 7) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

¹²As a robustness check, we conduct the same exercise as in Tables 9 and 10 with a new measure of TFP. Kasahara and Rodrigue (2008) and Ahn and Choi (2020) identified a significant economic role of foreign imported input as a necessary factor in measurement of total factor productivity. Thus, following Ahn and Choi (2020), we re-estimated TFP by taking into account the import share of input. These results are reported in Tables A1 and A2 in the appendix, which correspond to the results in Tables 9 and 10, respectively. Comparing Tables 9 and A1 and Tables 10 and A2, we do not find any qualitative changes, confirming the robustness of our results. Other results are also determined with new measure of TFP; while not reported here, they are available upon request. We would like to thank an anonymous referee for suggesting this robustness check.

TABLE 10—ESTIMATED EFFECT OF PRODUCT VARIETY EXPORT DECISION (IN_DE vs. NI_NE):
WHEN EXPORT DECISION IS MADE AT THE POINT OF PRODUCT VARIETY INNOVATION

	<i>s</i> = +1	<i>s</i> = +2	<i>s</i> = +3
Cross-sectional PSM	0.020 (0.015)	0.011 (0.021)	0.014 (0.029)
DID PSM	0.041*** (0.008)	0.040*** (0.011)	0.039*** (0.017)
Number of treated observations	6,893	3,241	1,623

Note: 1) Robust standard errors are in parentheses, 2) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

varieties with one and two years of an innovation-export lapse (the samples in the first and second lines in Table 5) are excluded as well.

IV. The Role of Industrial Protection

A. Parametric DID Estimation

The next question we would like to ask is whether these types of learning-to-export effects, if any, are dependent on the degree of import protection as set by tariff policies. As mentioned in section 1, amongst the three different hypotheses pertaining to the link between productivity and exports, learning to export is more closely related to the trade protection argument and can provide justification for such policies. For example, with the existence of a self-selection mechanism where intra-firm productivity is exogenously determined, trade protection cannot play any role in changing intra-firm productivity. At the same time, the learning-by-exporting effect implies that productivity increases only after international market participation, meaning that trade protection cannot be justified as well. As described in Slaughter (2004), dynamic arguments for infant industry protection tell us that trade protection can buy protected industries the time they require to learn before participating in the international market and to correct inefficiencies. In this section, we investigate this possibility.

However, because our DID PSM estimate in the previous section relies on a non-parametric methodology that gives a single estimated value, it would not be appropriate to use it to tackle this issue. To mitigate this issue, we return to the usual parametric DID estimation procedure combined with a matching technique. Having estimated the probit model in equation (1) and matched the sample between the treated (IN_DE type) and control units (NI_NE type), we run the following parametric DID model:

$$(3) \quad y_i = \alpha_0 + \alpha_1 IN_DE_i + \alpha_2 t_i + \gamma(IN_DE_i \times t_i) + \varepsilon_i$$

Here, y_i is the outcome variable (in our case TFP), IN_DE_i the treatment dummy variable (1 if innovated product variety with delayed export and 0 if non-

TABLE 11—PARAMETRIC DID ESTIMATION (IN_DE vs. NI_NE) FOR TFP

Variables	(1) $s = +1$	(2) $s = +2$	(3) $s = +3$
<i>IN_DE</i>	0.031*** (0.008)	0.033*** (0.011)	0.028* (0.016)
<i>Time</i>	-0.021** (0.010)	0.026* (0.015)	0.000 (0.032)
<i>IN_DE*Time</i>	0.052*** (0.012)	0.046** (0.018)	0.051* (0.026)
<i>Constant</i>	2.369*** (0.010)	2.345*** (0.012)	2.356*** (0.017)
Year dummy	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes
Number of observations.	25,256	12,280	6,256
Adjusted R ²	0.737	0.737	0.721

Note: 1) The dependent variable is the natural logarithm of TFP measured using the method devised by Levinsohn and Petrin (2003), 2) *IN_DE* is a dummy variable that takes a value of 1 if the product variety belongs to *IN_DE* and a value of 0 to the matched sample in *NI_NE*, 3) *Time* is a dummy variable that takes a value of 0 when innovation takes place and a value of 1 after s -year, where $s = 1, 2$, or 3 , 4) Industry dummies are constructed on the 3-digit Korean Standard Industrial Classification level, 5) Robust standard errors are in parentheses, 6) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

innovated variety without export), and t_i the time dummy (0 at the time when the innovation occurs and 1 after the innovation occurs). In this specification, the estimated γ represents the DID treatment effect.

The estimated results of equation (3) are shown in Table 11. The DID treatment effect is 5.2% of the TFP difference at $s = +1$, 4.6% at $s = +2$, and 5.1% at $s = +3$. These results are broadly consistent with the DID PSM result in Table 10.

B. Triple-differences Estimation to Accommodate Tariff

To determine whether there are any disproportionate learning-to-export effects according to protection policies, we extend equation (3) to the following triple DID estimation equation.

$$\begin{aligned}
 y_i = & \alpha_0 + \alpha_1 IN_DE_i + \alpha_2 t_i + \alpha_3 tariff_i \\
 (4) \quad & + \beta_1 (IN_DE_i \times t_i) + \beta_2 (IN_DE_i \times tariff_i) + \beta_3 (t_i \times tariff_i) \\
 & + \gamma (IN_DE_i \times t_i \times tariff_i) + \varepsilon_i
 \end{aligned}$$

In this specification, we focus on the triple interaction term γ , because it represents whether the DID estimate depends on the tariff rate. This can be easily found by taking the partial derivative of equation (4) with respect to tariffs:

$$(5) \quad \frac{\partial y_i}{\partial tariff_i} = \alpha_3 + \beta_2 IN_DE_i + \beta_3 t_i + \gamma (IN_DE_i \times t_i)$$

TABLE 12—TRIPLE-DIFFERENCES ESTIMATION (IN_DE vs. NI_NE) FOR TFP

Variables	(1) $s = +1$	(2) $s = +2$	(3) $s = +3$
<i>IN_DE</i>	0.072*** (0.015)	0.042* (0.022)	0.062** (0.031)
<i>Time</i>	-0.027 (0.018)	0.043* (0.023)	0.047 (0.042)
<i>Tariff</i>	0.306** (0.128)	-0.009 (0.147)	0.393* (0.226)
<i>IN_DE * Time</i>	0.088*** (0.023)	0.053* (0.031)	0.072 (0.046)
<i>IN_DE * Tariff</i>	-0.475*** (0.157)	-0.088 (0.222)	-0.369 (0.300)
<i>Time * tariff</i>	0.039 (0.182)	-0.206 (0.200)	-0.559* (0.313)
<i>IN_DE * time * tariff</i>	-0.480** (0.235)	-0.161 (0.292)	-0.303 (0.427)
Year dummy	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes
Number of observations	24,654	11,975	6,097
Adjusted R ²	0.742	0.740	0.731

Note: 1) *IN_DE* is a dummy variable that takes a value of 1 if the product variety belongs to *IN_DE* and a value of 0 to the matched sample in *NI_NE*, 2) *Time* is a dummy variable that takes a value of 0 when innovation takes place and a value of 1 after s -year where $s = 1, 2$, or 3 , 3) Industry dummies are constructed based on the three-digit Korean Standard Industrial Classification level, 4) Robust standard errors are in parentheses, 5) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

The right-hand side of equation (5) is identical to equation (3), meaning that γ captures the extent to which and the direction by which the effect of tariffs on the outcome depends on the DID term ($IN_DE_i \times t_i$).

Table 12 shows the triple-differences estimation results of equation (4) above. The triple-differences terms in Table 12 are all estimated to be negative and statistically significant only at $s = +1$. The negative sign implies that the learning-to-export effect is lower when the tariff rate is high, and this is particularly significant one year after the innovation year. This empirical result appears to argue against the infant industry argument: protection by the tariff rate may not justifiable to enhance the learning-to-export effect according to our data.

V. Further Discussion

The analyses in sections 3 and 4 imply that some evidence of the learning-to-export effect for the *IN_DE* type of product varieties exists in the sense that their productivity outcome is superior to the corresponding control group after the innovation and that tariff protection does not help to promote such a learning-to-export effect. This leads to the question of the origin of this superior productivity outcome. López (2004) emphasized that such a learning-to-export effect can be accomplished by firms that consciously invest more in physical or knowledge capital. Thus, we investigate this possibility in this section with our dataset.

Table 13 shows how three different outcome variables (the capital-labor ratio,

TABLE 13—PARAMETRIC DID ESTIMATION (IN_DE vs. NI_NE)
FOR OTHER VARIABLES RELATED TO CONSCIOUS EFFORTS

Dependent variable	K/L ratio			(2) R&D dummy			(3) Investment dummy		
	$s = +1$	$s = +2$	$s = +3$	$s = +1$	$s = +2$	$s = +3$	$s = +1$	$s = +2$	$s = +3$
IN_DE	0.072*** (0.020)	0.091*** (0.028)	0.101*** (0.038)	0.141*** (0.028)	0.167*** (0.039)	0.166*** (0.055)	0.131*** (0.023)	0.121*** (0.033)	0.156*** (0.046)
$Time$	-0.032 (0.021)	-0.062* (0.034)	-0.100 (0.066)	-0.186*** (0.032)	-0.158*** (0.051)	-0.297*** (0.101)	-0.063** (0.025)	-0.119*** (0.040)	0.016 (0.081)
IN_DE $* Time$	0.066** (0.028)	0.066* (0.039)	0.072 (0.055)	0.231*** (0.040)	0.211*** (0.056)	0.200** (0.080)	0.070** (0.032)	0.131*** (0.047)	0.011 (0.065)
Constant	2.713*** (0.023)	2.730*** (0.030)	2.705*** (0.040)	-1.394*** (0.075)	-1.444*** (0.101)	-1.615*** (0.149)	0.392*** (0.059)	0.482*** (0.081)	0.317*** (0.106)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	25,256	12,280	6,256	25,184	12,192	6,222	25,256	12,280	6,216
Adj.R ² / Pseudo-R ²	0.197	0.191	0.186	0.083	0.075	0.083	0.027	0.034	0.033

Note: 1) IN_DE is a dummy variable that takes a value of 1 if the product variety belongs to IN_DE and a value of 0 to the matched sample in NI_NE , 2) $Time$ is a dummy variable that takes a value of 0 when innovation takes place and a value of 1 after s -year where $s = 1, 2$, or 3 , 3) Industry dummies are constructed based on the three-digit Korean Standard Industrial Classification level, 4) Regressions of the R&D dummy and investment dummy are run by probit specification, 5) Robust standard errors are in parentheses, 6) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

R&D dummy, and investment dummy variable) behave under the DID specifications in equation (3). All procedures are identical to those used before, but the dependent variables are replaced with other outcome variables. The DID terms ($IN_DE * time$) in Table 13 are estimated to be positive, and most of them are statistically significant with two exceptions (the K/L ratio and investment dummy at $s = +3$). This means that physical capital and R&D activities are higher for IN_DE group varieties after innovation and before export participation compared to the corresponding control group. This in turn implies that the higher productivity performance of IN_DE varieties is closely related to their investment in physical capital and R&D activities.

The next natural question is therefore whether these conscious efforts of firms are related to the tariff protection. In Table 14, we run triple differences (equation (4)) for the three different outcome variables once again. As shown in the table, the estimated coefficients of the triple-difference term ($IN_DE * time * tariff$) are all insignificant, except for the K/L ratio at $s = +1$. As in the productivity outcome case, protection by import tariff cannot be justified to induce firms to invest more in physical capital and R&D activities.

TABLE 14—TRIPLE-DIFFERENCES ESTIMATION (IN_DE vs. NI_NE)
FOR OTHER VARIABLES RELATED TO CONSCIOUS EFFORTS

Dependent variable	K/L ratio			R&D dummy			Investment dummy		
	$s = +1$	$s = +2$	$s = +3$	$s = +1$	$s = +2$	$s = +3$	$s = +1$	$s = +2$	$s = +3$
<i>IN_DE</i>	-0.014 (0.041)	-0.006 (0.058)	0.091 (0.079)	0.045 (0.065)	0.007 (0.088)	-0.017 (0.120)	0.177*** (0.050)	0.065 (0.067)	0.195** (0.097)
<i>Time</i>	-0.060 (0.043)	-0.037 (0.056)	-0.089 (0.090)	-0.178** (0.077)	-0.188* (0.097)	-0.075 (0.171)	0.019 (0.052)	-0.156** (0.068)	0.150 (0.116)
<i>Tariff</i>	-0.767** (0.365)	-0.687* (0.412)	-0.172 (0.564)	-1.051 (0.694)	-1.077 (0.868)	-2.168** (1.073)	0.729 (0.454)	-0.378 (0.521)	0.626 (0.806)
<i>IN_DE</i> * <i>time</i>	0.175*** (0.057)	0.123 (0.078)	0.145 (0.106)	0.224** (0.092)	0.171 (0.118)	0.092 (0.188)	0.016 (0.069)	0.186** (0.092)	-0.001 (0.135)
<i>IN_DE</i> * <i>tariff</i>	1.034** (0.442)	1.072* (0.608)	0.083 (0.794)	1.357* (0.742)	1.983** (0.973)	2.300* (1.295)	-0.524 (0.537)	0.761 (0.686)	-0.360 (0.996)
<i>Time</i> * <i>tariff</i>	0.297 (0.479)	-0.451 (0.558)	-0.329 (0.733)	-0.152 (0.933)	0.275 (1.089)	-3.165* (1.868)	-1.039* (0.576)	0.662 (0.682)	-1.543 (1.010)
<i>IN_DE</i> * <i>time</i> * <i>tariff</i>	-1.309** (0.627)	-0.595 (0.840)	-0.901 (1.088)	0.282 (1.080)	0.631 (1.321)	1.624 (2.246)	0.634 (0.757)	-0.832 (0.976)	0.082 (1.430)
Constant	2.772*** (0.041)	2.791*** (0.049)	2.716*** (0.067)	-1.304*** (0.109)	-1.449*** (0.153)	-1.326*** (0.207)	0.316*** (0.087)	0.489*** (0.112)	0.302** (0.151)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	24,654	11,975	6,097	24,578	11,892	6,076	24,654	11,972	6,046
Adj.R ² / Pseudo-R ²	0.199	0.194	0.188	0.0871	0.0791	0.0855	0.0277	0.0350	0.0335

Note: 1) *IN_DE* is a dummy variable that takes a value of 1 if the product variety belongs to *IN_DE* and a value of 0 to the matched sample in *NI_NE*, 2) *Time* is a dummy variable that takes a value of 0 when innovation takes place and a value of 1 after s -year where $s = 1, 2$, and 3 , 3) Industry dummies are constructed based on the three-digit Korean Standard Industrial Classification level, 4) Robust standard errors are in parentheses, 5) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

VI. Concluding Remarks

Using Korean manufacturing data for 1990-1998, this paper aimed to investigate whether empirical evidence supports the learning-to-export hypothesis, which has received little attention in the literature thus far. By taking full advantage of our plant-product level data, we find some evidence of the learning-to-export effect, especially for innovated product varieties with delayed exports. Our DID estimation results combined with propensity score matching imply that between the time of innovation and export participation, innovating firms show superior productivity performance compared to matched control groups. Moreover, other performance outcome variables tested here, i.e., the K/L ratio, R&D dummy, and an investment dummy variable, also behave similarly. Thus, during the time lapse between innovation and export, productivity, K/L ratio, R&D, and investment move in the same direction; this is an indication of the learning-to-export effect. However, our triple-differences estimation results show that protecting industries by means of

higher import tariffs is not justifiable to enhance learning-to-export effects in all specifications with different outcome variables.

APPENDIX

In this appendix, we re-estimated our TFP outcomes following Ahn and Choi (2020) and then re-did the same exercise described in Tables 9 and 10. With a conventional method of estimating TFP following Levinsohn and Petrin (2003), we added the industry-level share of imported inputs. First, we used the input-output table for 1990-1995-2000 and calculated the imported input share by industry at the KSIC two-digit level. Given that the input-output table has information only for the three years above (1990, 1995, and 2000), we interpolate the imported input shares in other years. Subsequently, we used this imported input share to estimate the TFP, as in Ahn and Choi (2020). The following two tables correspond to Tables 9 and 10 in the main text. As indicated, there are no qualitative changes when conducting the same analyses with this new TFP measure.

TABLE A1—PROBABILITY OF INNOVATION: PROBIT MODEL WITH A NEW MEASURE OF THE TFP

Variables	IN_DE vs. NI_NE
TFP_t	0.047*** (0.015)
$Size_t$	0.119*** (0.006)
Age_t	-0.488*** (0.008)
K/L_t	0.060*** (0.005)
$R\&D_t$	0.143*** (0.016)
Year dummy	Yes
Industry dummy	Yes
Number of observations	285,443
Log likelihood	-29,690.0

Note: 1) TFP is measured using the method devised by Levinsohn and Petrin (2003), 2) Size is the natural logarithm of the number of employees, 3) Age is the log value of the plant's age, 4) K/L is the ratio of capital to the number of workers in the log, 5) R&D is a dummy variable that takes a value of 1 if the value of R&D is positive and a value of 0 otherwise, 6) Robust standard errors are in parentheses, 7) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

TABLE A2—ESTIMATED EFFECT OF PRODUCT VARIETY EXPORT DECISION (IN_DE vs. NI_NE): WHEN EXPORT DECISION IS MADE AT THE POINT OF PRODUCT VARIETY INNOVATION WITH A NEW MEASURE OF TFP

	$s = +1$	$s = +2$	$s = +3$
Cross-sectional PSM	0.100*** (0.008)	0.116*** (0.011)	0.142*** (0.015)
DID PSM	0.037*** (0.009)	0.040*** (0.015)	0.080*** (0.022)
Number of treated observations	6,893	3,241	1,623

Note: 1) Robust standard errors are in parentheses, 2) *, **, and *** indicate that the estimated coefficients are significant at the 10%, 5%, and 1% levels, respectively.

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Public Opinions on Inter-Korean Economic Cooperation: A Survey Analysis[†]

By SEUNG-HO JUNG AND YONG-SHIN CHO*

This research attempts to provide an in-depth analysis of the public perceptions of inter-Korean economic cooperation. KDI survey data with a sample size of 1,000 were subjected to empirical analyses. By means of ordered logit estimations, we derive the following results. First, there is a significant effect of age on economic cooperation perceptions, where younger generations tend to be more negative. Second, the group who has positive view on the economic cooperation tends to prefer large-scale, domestic-entity-funded cooperation projects, whereas the group who has negative view tends to prefer small-scale projects and projects funded by international organizations. According to these results, prioritizing trade with the involvement of international organizations is likely to be an effective measure to alleviate potential political constraints and to achieve sustainable long-run economic cooperation systems when pursuing the economic cooperation.

Key Word: Inter-Korean Economic Cooperation, Public Support,
Policy on North Korea, Financing

JEL Code: H77, F55

I. Introduction

This research aims to examine public opinions as they pertain to inter-Korean economic cooperation using novel data from surveys conducted by the Korea Development Institute (KDI) in 2019. The KDI survey intends to discover public opinion, which is critical when designing long-term policy directions of national agendas, such as policy measures on aging populations, jobs and education. The survey questionnaire also includes extensive questions about inter-Korean economic

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cooperation, which is the focus of our research.

Inter-Korean economic cooperation is among the most important policy instruments with regard to South Korea's policy on North Korea. It is in the interest of not only scholars and policymakers but also the general public. According to the '2020 Unification Perceptions Survey' conducted by the Institute for Peace and Unification Studies at Seoul National University, the respondents evaluated inter-Korean economic cooperation to be the most effective tool for both denuclearization and reforming and for the opening up of the North Korean economy among the policy measures of social and cultural interactions, economic aid, and economic sanctions (or military deterrence) (Kim *et al.*, 2021).

Despite the perceived effectiveness of the inter-Korean economic cooperation as a policy tool, public support for such cooperation is relatively low. The KDI survey suggests that negative opinions appear to be high. Only 33.2% of respondents approve of economic cooperation, whereas 41.2% disapprove and 25.6% have neutral opinions. When asked how urgent economic cooperation is, 46% of respondents evaluated it to be urgent, whereas 54% did not (Jung, 2021).

Similarly, the survey data compiled by the Korea Institute for National Unification (KINU) in 2020 also support this view. The survey polled the opinions of respondents in a scale of 0 (most strongly disagree) to 11 (most strongly agree) with regard to the argument "Economic interactions and cooperation with North Korea should continue even in the times of political and military confrontation." When converted to a Likert-type five-point scale for comparison with the KDI survey data, 34.8% of the respondents 'agree' with the argument, 18.1% 'disagree' and 47.2% are 'neutral'. Both the KDI and KINU survey data show that only around 30% of people have positive opinions about economic cooperation with North Korea, while the majority of people have negative or neutral sentiments.

Considering the importance of public support when initiating inter-Korean economic cooperation consistently, in-depth analyses to search for the reasons behind the negative sentiment over this cooperation are crucial. A number of studies address issues of inter-Korean economic cooperation from various perspectives.

In particular, several studies dealing with strategies for economic cooperation were conducted in the wake of a series of South-North and U.S.-North Korea summits in 2018 which, at the time, raised optimism about the revitalization of the South-North relationship. Lim (2018) reorganizes multi- and unilateral sanctions on North Korea and offers possible economic cooperation projects in accordance with possible steps toward the lifting of sanctions. Lim and Kim (2018) argue that in order to resume previous economic projects such as the Kaesong Industrial Complex project with sanctions remaining in effect, it is essential for the Korean government to cooperate and consult with the UN National Security Council and the U.S. so as to minimize conflicts associated with the sanctions by means of the cooperation projects being pursued.

There are also studies that criticize the framework of existing economic cooperation projects from perspectives of the initiating party (public or private sector), required resources, and project contents. First, Lee (2012) argues that the party initiating economic cooperation should be in the private sector rather than the government. According to the study, this change can alleviate political constraints by evading the criticism over using public funds to finance economic cooperation

with North Korea, which remains a controversial issue in society. Lee *et al.* (2019) proposes that inter-Korean economic cooperation should look beyond the previous form of South-North specific transactions and should be pursued under international cooperation that includes international financial organizations, which could eventually induce North Korea to participate in the global economy. Regarding the required resources for economic cooperation, Lee (2020) offers a few means of funding these, such as utilizing the South-North Cooperation Fund or by means of a package type of funding involving the right to develop mineral resources in North Korea. Jung (2021) reports that there exists significant public opposition to large-scale public financing for cooperation apart from the approval or disapproval of cooperation. Furthermore, he argues that human resource development types of cooperation are much more preferable than infrastructure development types.

In addition, a few studies evaluate the economic benefit of inter-Korean economic cooperation. According to this line of research, the economic benefits from cooperation do not stem significant from the substantial difference in the sizes of the economies between the two states. Kim (2015) estimates the benefit for South Korea from the economic cooperation to be between 0.012% and 0.043% of its GNI. He adds with regard to this estimated amount that even if more than ten KIC-sized economic special zones were to be created, it would only increase the South Korean GNI by 0.1% to 0.5%. Shin and Kim (2018) similarly estimate that economic cooperation would only increase the South Korean GDP by 0.02%. However, the benefit of South-North economic integration is expected to be substantial, especially for North Korea. Kim (2014) estimates that the North Korean economy is expected to grow by 13.2% on average per annum from 2014 to 2050 if the country decides to make an economic transition and to reform its institutions overall. Choi and Kim (2017) estimate that the value-added of seven economic cooperation projects would reach a total of 150 billion US dollars over the next 30 years. This result, however, includes the benefit of South-North economic integration rather than the exclusive benefit of economic cooperation.

As covered thus far, much of the recent literature focuses on strategies for and economic benefits of inter-Korean economic cooperation. However, to the best of our knowledge, this study is distinctive in that it is the first rigorous empirical analysis of public perceptions on economic cooperation between the two Koreas. The lack of attention toward public perceptions on this particular issue can be attributed to the fact that most studies conducted thus far in this area find constraints from external sources such as sanctions and the low institutionalization level of North Korea. However, if public support is not secured, such internal constraints can be as much of a stubborn obstacle to economic cooperation as external constraints are. The main contribution of this research lies in how it can provide an in-depth analysis of public perceptions, and by doing so, to provoke discussions on the issue.

This research employs the Inter-Korean Economic Cooperation section of the KDI survey data, conducted in 2019 and involving 1,000 South Koreans. We construct ordered logit estimation models setting a four-scale economic cooperation urgency variable and a five-scale approval variable of the survey data as the main dependent variables to investigate factors affecting public sentiment. As explanatory variables, we choose preferred type and preferred source for funding variables. In addition, we control for the respondents' opinions on labor market flexibility, easing corporate

regulations, government spending on national security, and government spending cuts. According to the analysis, we aim to identify the main concerns held by the public about economic cooperation and the preferences of the relatively negative sentiment group among the public. Through these characterizations of public perceptions, practical policy directions for the economic cooperation can be derived to secure general support.

The rest of the paper is organized as the following. Section 2 provides summary statistics of the key variables and outlines the correlations between the key variables. Section 3 covers the construction of the empirical models and reports the results. Section 4 concludes the paper and offers some policy implications.

II. Data and Statistics

A. Data

Thus far, there has been nearly no in-depth statistics suitable for an analysis on South Korean perceptions towards inter-Korean economic cooperation. In this research, we employ a dataset constructed by KDI based on a survey conducted at the end of 2019 (Dec. 13 to Dec. 15). The total number of the respondents is 1,000, 49.6% of which are males and 50.4% females. The regional, age, and level of education compositions of the respondents are similar to those in national statistics and thus suitably represent the overall population.

The survey questionnaire is consisted of ten sections, with each of which asking for respondents' opinions on various social and economic issues, namely, 'Measures on the Aging Population', 'Jobs', 'Education', 'Cultural Life', 'Public Expenditures', 'Government Regulations', 'Local Government Policies', 'Foreign Trade', 'Public Policy Directions and Evaluations', and most importantly 'Inter-Korean Economic Cooperation'. As the focus of this research is perceptions on economic cooperation, we mainly utilize the questions under the section 'Inter-Korean Economic Cooperation'. However, we also employ several questions from other sections as our control variables for the empirical analysis, which will be covered in detail in the next section. Although this survey includes comprehensive questions pertaining to inter-Korean cooperation, the dataset bears limitations similar to those in ordinary cross-section data in that it only reflects public opinions at the specific time of the survey. In particular, at the end of 2019 when the survey was conducted, one can argue that public sentiment with regard to this issue was likely to be more skeptical towards the economic cooperation due to the depressing result of the Hanoi summit of February of 2019 and that this time-specific factor may have resulted in some degree of negative-sentiment-leaning bias in the data. However, it is reasonable to believe that the overall positive sentiment on North Korea-related issues held by the public in 2018 was exceptional, as the number and the intensity of the interactions between the two Koreas and between the US and North Korea as observed by the public reached levels for which comparable precedents are difficult to find since the division of the peninsula. Given that the negative shift in public sentiment about economic cooperation in 2019 after the Hanoi summit arose during such exceptional times, we consider that the

TABLE 1—DATA COMPARISON

		KDI Survey Data		Official Statistics (2019)
		Frequency	Proportions (%)	Proportions (%)
Region	Seoul	193	19.3	18.8
	Busan	68	6.8	6.6
	Daegu	48	4.8	4.7
	Incheon	57	5.7	5.7
	Gwangju	28	2.8	2.8
	Daejeon	28	2.8	2.8
	Ulsan	22	2.2	2.2
	Gyeonggi	250	25.0	25.5
	Sejong	6	0.6	0.7
	Gangwon	31	3.1	3.0
	Chungbuk	30	3.0	3.1
	Chungnam	42	4.2	4.1
	Jeonbuk	34	3.4	3.5
	Jeonnam	36	3.6	3.6
	Gyungbuk	52	5.2	5.1
	Gyungnam	64	6.4	6.5
	Jeju	11	1.1	1.3
Gender	Male	496	49.6	49.9
	Female	504	50.4	50.1
Age	20s	161	16.1	15.9
	30s	164	16.4	16.6
	40s	197	19.7	19.6
	50s	202	20.2	20.3
	60+	276	27.6	27.6

Source: Statistics Korea (<http://kostat.go.kr/portal/eng/index.action>, Search Date: 2021. 7. 16).

aforementioned concerns over negative-sentiment-bias in the data are not overly severe and therefore reasonably appropriate for the empirical analysis here. A survey conducted in February of 2019 during the Hanoi Summit by *Realmeter*, a Korean public opinions research firm, shows that 68.9% of the respondents agreed that the Kaesong Industrial Complex (KIC) project or Mt. Kumgang tourism should resume; this outcome was 19.5% higher than the finding of an identical survey conducted in 2017 (49.4%). However, public opinion reverted to its ordinary level after the Hanoi summit in 2020, where 43.6% of the respondents signaled their support for the reimplementation of the previous cooperation projects, thus confirming our earlier conjecture.

B. Descriptive Statistics

In this subsection, we investigate overall perceptions held by South Koreans towards inter-Korean economic cooperation. We introduce the general statistics of the questions in the ‘Inter-Korean Economic Cooperation’ section of the KDI survey dataset. The main questions are, ‘Do you approve or disapprove of Inter-Korean Economic Cooperation?’, ‘How urgent do you feel about Inter-Korean Economic Cooperation?’, ‘Which of the following types of the economic cooperation do you

think should be prioritized?”, “Which of the following types of funding do you prefer for economic cooperation?”, “Which of the following states do you think the final goal of the economic cooperation should aspire to?” The questionnaire also includes subsample questions that ask about specific reasons for approval or disapproval and about the urgency of economic cooperation. Summary statistics for all of the questions in the section can be found in the Table 2.

The first factor to highlight would be the approval rating. The proportion of the respondents who selected ‘very much disapprove’ or ‘disapprove’ stands at 33.2%, while 41.2% selected ‘approve’ or ‘very much approve’, suitably representing the divided view. Approximately a quarter (25.6%) of the respondents reported that they are neutral. The ‘approve’ group appears to consider economic cooperation as an opportunity for the South Korean economy to thrive. It was also found that 67% of respondents selected either ‘it could be a breakthrough for the Korean economy’ or ‘to secure the growth of the Korean economy’ as their reason for approving of cooperation. These proportions initially may appear to be inconsistent with the opinions of experts who estimate the expected economic benefit of cooperation to be limited. However, it must be noted that the above question is only presented to the subsample of the group who approve of economic cooperation. Therefore, it does not represent the opinions of the general public. It is reasonable to believe that the approval group evaluates the economic benefit of the cooperation as substantial.

Several different characteristics related to gender are also evident in Table 2. First, the findings show that female respondents are more cautious in general. More female respondents expressed relatively moderate options, as exemplified by their choices of ‘disapprove’, ‘neutral’, and ‘approve’ for the approval question (20.6%, 26.2% and 28.0%, respectively) compared to the selections by the male respondents. Moreover, male respondents displayed stronger hostility towards the North. The proportion of male respondents who reported ‘North Korea is an enemy state to the South’ (21.7%) in response to the question asking about their disapproval of economic cooperation is significantly higher than that of the female respondents (6.9%).

The main concerns held by the ‘disapprove’ group toward pursuing economic cooperation are either political or economic. Nearly half of the ‘disapprove’ group (45.8%) expressed concerns about the profits from the economic cooperation leaking into North Korea’s nuclear and missile development programs, while 36.4% of the group doubted the benefit of economic cooperation relative to its cost. Meanwhile, a significant proportion of the ‘disapprove’ group (13.9%) shares negative sentiment towards the North, choosing ‘North Korea is an enemy state of the South’. With regard to the urgency of economic cooperation, 46% of the respondents in total consider it to be urgent, whereas 54% selected either ‘not at all urgent’ or ‘not urgent’.

The results of the survey incorporate some important facts about the overall sentiment of South Koreans towards inter-Korean economic cooperation. As shown in Table 3, respondents who approve of economic cooperation tend to think that it is urgent while respondents who disapprove of economic cooperation tend to think that it is not urgent. This pattern is also statistically verified in that the correlation

TABLE 2—SUMMARY STATISTICS

Questions	Obs.	Options	Proportion (%)	Gender (%)	Mean	SD
How much do you approve or disapprove of inter-Korean economic cooperation?	1,000	1) Very much disapprove	15.7	17.3	14.1	
		2) Disapprove	17.5	14.3	20.6	
		3) Neutral	25.6	25.0	26.2	3.068
		4) Approve	26.7	25.4	28.0	1.283
		5) Very much approve	14.5	17.9	11.1	
If you approve, what is the reason? (This question is only presented to the respondents who selected either 'very much approve' or 'approve' for the approval question above.)	412	1) It could be a breakthrough for the Korean economy	13.8	15.8	11.7	
		2) To secure the growth of the Korean economy	53.2	49.8	56.9	
		3) To induce the denuclearization of the North	7.0	7.0	7.1	2.475
		4) To incentivize the North to open and reform their economy	24.0	26.5	21.3	1.074
		5) To improve the quality of living of the North Korean people	1.5	0.9	2.0	
		6) Others	0.5	0.0	1.0	
If you disapprove, what is the reason? (This question is only presented to the respondents who selected either 'very much disapprove' or 'disapprove' for the approval question above.)	332	1) The cost of the cooperation is too high compared to the economic benefit	36.4	23.6	48.0	
		2) There are concerns over nuclear and missile program development using the economic benefit of the cooperation	45.8	50.3	41.7	
		3) Poor business environment	1.5	3.2	0.0	2.000
		4) North Korea is an enemy state of the South	13.9	21.7	6.9	1.074
		5) Others	2.4	1.3	3.4	
How urgent do you feel about inter-Korean economic cooperation?	1,000	1) Not at all urgent	16.8	21.0	12.7	
		2) Not urgent	37.2	32.3	42.1	
		3) Slightly urgent	30.5	28.2	32.7	2.447
		4) Very urgent	15.5	18.6	12.5	0.945
Which of the following types of economic cooperation do you think should be prioritized?	1,000	1) Expand trade	23.8	22.8	24.8	
		2) Tourism sector cooperation (i.e., Mt. Kumgang)	10.8	10.5	11.1	
		3) Firm sector cooperation (i.e., KIC)	17.3	18.8	15.9	2.935
		4) Large-scale infrastructure development (i.e., roads, rails, power grid)	44.3	43.2	45.4	1.285
		5) Others	3.8	4.8	2.8	
Which of the following types of funding do you prefer for economic cooperation?	1,000	1) Public funding (i.e., government finance)	23.2	23.6	22.8	
		2) Private funding (i.e., firms, banks)	25.7	28.4	23.0	
		3) Foreign private funding (i.e., foreign firms and banks)	26.0	25.0	27.0	2.557
		4) Funding from international organizations (i.e., the UN)	22.4	20.6	24.2	1.149
		5) Others	2.7	2.42	3.0	
Which of the following states do you think the final goal of the economic cooperation should aspire to?	1,000	1) Political and economic complete unification	29.8	30.7	29.0	
		2) Economic integration each state maintaining respective political systems	33.7	32.5	34.9	
		3) High level of economic interaction	22.0	23.8	20.2	2.154
		4) Re-implementing previous economic cooperation projects (i.e., Mt. Kumgang tourism and KIC) under the current situation	11.4	9.1	13.7	0.991
		5) Others	3.1	4.0	2.2	

TABLE 3—CROSS TABLE OF THE APPROVAL AND URGENCY VARIABLES

(Unit: %)

		Urgency				
		Not Urgent at All	Not Urgent	Urgent	Very Urgent	Total
Approval	Strongly Disapprove	75	7.26	0.98	0.65	15.7
	Disapprove	17.86	34.41	4.92	1.29	17.5
	Neutral	6.55	45.97	23.61	1.29	25.6
	Approve	0.6	12.37	60	23.87	26.7
	Strongly Approve	0	0	10.49	72.9	14.5
Total		100	100	100	100	100

Note: The correlation coefficient of the two variables is 0.8204 and statistically significant at the 1% level.

coefficient of the two variables is 0.82 and is statistically significant at the 1% level. The close tie between the two variables implies that public opinion about economic cooperation is strongly polarized, motivating further analysis.

The polarizing view of inter-Korean economic cooperation is also evident in the questions that follow. First, more than 40% of the respondents (44.3%) support a high cost of economic cooperation, as represented by ‘large-scale infrastructure development’, whereas nearly half (51.9%) of the respondents prefer forms of economic cooperation that can be had a lower cost, such as trade (23.8%), tourism (10.8%) and firm-sector cooperation (17.3%).

Similarly, nearly half of the respondents prefer domestic sources of funding, such as government spending (23.2%) and investments by domestic private firms (25.7%). The other half prefers foreign source funding such as foreign private investments (26.0%) and hosting funding from international organizations (22.4%) such as the U.N.

The distribution of the respondents with regard to the answers regarding their preferred ultimate goal of economic cooperation is relatively even. The highest degree of integration represented by the option ‘political and economic complete unification’ was indicated by 23.2% of the respondents, whereas the second highest degree of integration, represented by the option ‘economic integration maintaining respective political systems’ earned the most votes by the respondents (33.7%). The two lower degrees of integration, represented by the option ‘high degree of economic interactions’ and ‘re-implementing previous economic cooperation projects under the current condition’ were selected by 22.0% and 11.4% of the respondents, respectively.

C. Inter-Variable Correlations

There could be multiple dimensions by which these perceptions on inter-Korean economic cooperation can be interpreted. In order to investigate the characteristics of the positive and negative perception groups further, we attempt to explain the approval variable and the urgency variable by age groups, along with variables which incorporate details about the economic cooperation, such as the preferred types and preferred sources of funding.

First, due to the rapid economic growth and social changes that the Korean society

has experienced since the Korean War, there exists noticeable generational segregation in overall values and perceptions on many social, political and economic issues in South Korea. These divisions are also observed in the perception toward economic cooperation with North Korea. Figure 1 presents the relationship between the age groups and the approval variable. Respondents who approve of economic cooperation are least frequent in the group in their 20s, and from then on, the ‘approve’ group increases with age, reaching a peak at around 50s, after which it declines for those who are 60+. Conversely, the proportion of the ‘disapprove’ group decreases up to those in their 40s and then climbs back up until the oldest group. The proportion of the ‘neutral’ group continuously decreases until the oldest group. These patterns suggest that the youngest and the oldest age groups share similar negative perceptions toward economic cooperation, whereas those in their 40s and 50s have relatively positive perceptions.

In terms of preferred cooperation projects, large-scale projects of ‘infrastructure development’ are most preferred by those in their 40s, in line with the observed positive perception tendencies expressed by those in their 40s and 50s. In contrast, relatively small-scale projects such as ‘trade’ and ‘tourism’ are most preferred by those in their 60s and in their 20s, respectively; recall that these are the groups



FIGURE 1. APPROVAL/DISAPPROVAL PROPORTIONS AND PREFERRED TYPE BY AGE GROUP

expressing negative sentiment towards economic cooperation. This pattern of preferred type by age alludes to the fact that groups with positive perceptions are more likely to support large-scale projects, whereas those with negative perceptions are more likely to support small-scale projects.

Nonetheless, older and younger generations do have similar concerns when it comes to the reasons for approving or disapproving of economic cooperation. As the Figure 2 shows, all age groups selected ‘to secure the future growth of the South Korean economy’ most frequently as the reason for approving of economic cooperation. However, the proportion of respondents who selected such options decreases with age, whereas the proportion of the respondents who are mainly concerned about the North (option ‘to incentivize the North to open and reform’) increases with age. As a result, the proportional gap between the two groups narrows significantly for those who are 60+ relative to those in their 20s.

The ‘reason for disapproval’ pattern also shows age dependency, although it is weaker than in the ‘reason for approval’ case. The proportion of the respondents who selected ‘high cost of the economic cooperation’ as the main reason for their

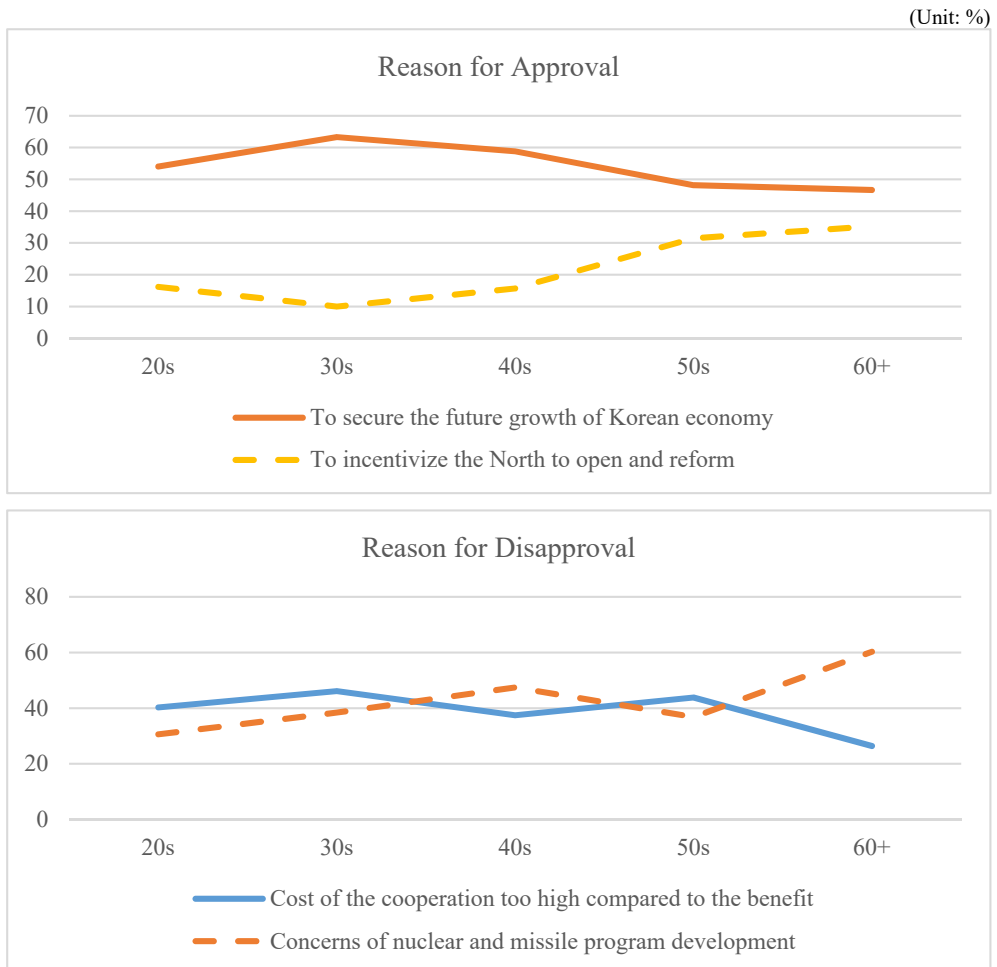


FIGURE 2. REASONS FOR APPROVAL/DISAPPROVAL BY AGE GROUP

disapproval is higher than the proportion of the respondents who are concerned with the nuclear and missile development programs of the North for those in their 20s as opposed to those who are 60+. The 60+ age group is mostly concerned about the nuclear and missile development programs much more than the cost of economic cooperation. Both patterns of reasons for approving and disapproving of economic cooperation imply that there are growing trends of economic concerns regarding this type of cooperation, more so among the younger generations.

Secondly, we analyze the tendencies of the positive and negative groups according to their preferred types and sources of funding. The options that these survey questions offer can largely be divided into three types in terms of the scale of investment required. More specifically, they can be divided into large-scale investments represented by the option 'infrastructure development', mid-scale investments represented by the two options that offer the reimplementation of tourism and firm-sector cooperation, and lastly relatively small-scale investments as represented by 'promoting trade'.

As shown in the Figure 3, the respondents who prefer relatively large-scale investments for cooperation tend to reveal positive perceptions about economic cooperation, while the respondents who prefer relatively small-scale investments for cooperation tend to have negative perceptions. The statistics indicated that 40.3% of the respondents who prefer trade are most likely to choose 'Very much disapprove' or 'Disapprove', while over half of the respondents (51.5%) who prefer infrastructure development are most likely to choose 'Very much approve' or 'Approve'. Neutral respondents appear to prefer reimplementation of previous economic cooperation projects, such as tourism and firm-sector projects (i.e., Mt. Kumgang tourism and the Kaesong Industrial Complex). One pattern in Figure 3 that stands out is that tourism is the most favored type of economic cooperation among the neutral group, as economic cooperation is likely to involve large-scale projects which affect not only the prospects of the South-North relationship in the future but also the prospects of the national economy in the long run. From this perspective, the approval and disapproval groups are likely to evaluate economic cooperation based on future political and economic benefits. The neutral group however, is presumably evaluating economic cooperation based on individual

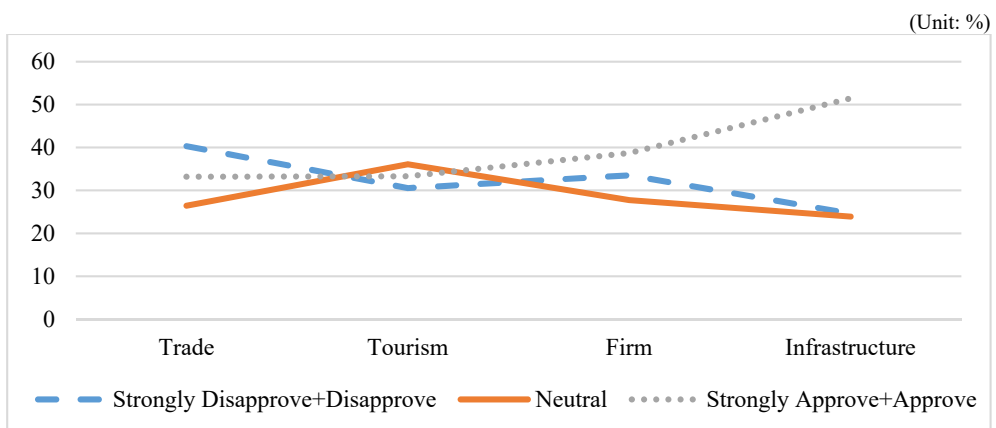


FIGURE 3. APPROVAL/DISAPPROVAL VS. PREFERRED TYPE OF ECONOMIC COOPERATION

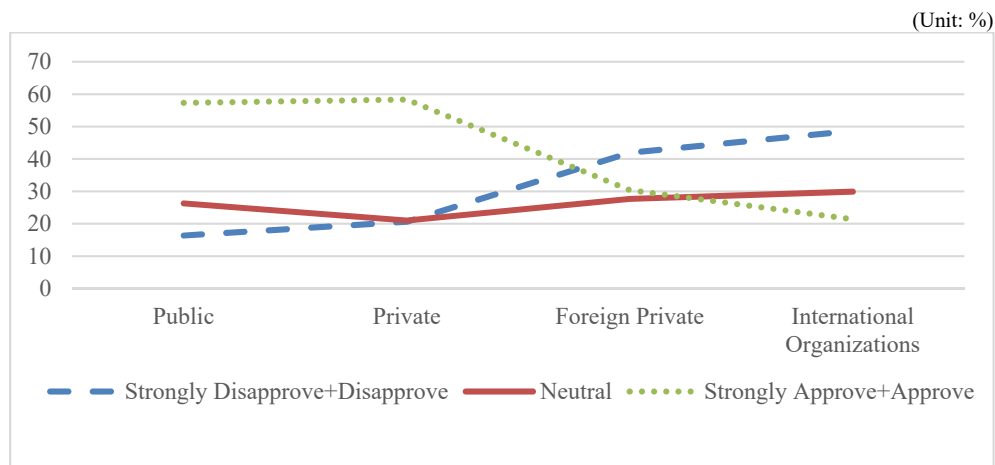


FIGURE 4. APPROVAL/DISAPPROVAL VS. PREFERRED SOURCE OF FUNDING

preferences, as they are likely to have either no interest or have not given serious thought to the consequences of economic cooperation on a national level. As a result, we suspect that there are two possible reasons for the neutral group's choice of tourism as their preferred type. First, it may provide them with a chance to visit North Korea, which is directly related to a possible consumption opportunity for this group. A second possible reason is because tourism is simply the most probable and easily implementable type of economic cooperation. Because the options offered for the question, which asks about their preferred type, do not include 'none of the above', it is likely that the neutral group selected the most probable and most easily implementable previously implemented project, i.e., tourism.

The approval variable can also be explained with the preferred source of funding variable. As the Figure 4 displays, the respondents who prefer domestic sources of funding (i.e., government finance or private-sector investment) tend to approve of economic cooperation ('Very much approve' or 'Approve'). Specifically, 57.3% and 58.4% of the respondents who selected public (government) investment and private-sector investment, respectively, signaled their approval of economic cooperation. On the other hand, the respondents who prefer foreign sources of funding tended to disapprove of economic cooperation ('Very much disapprove' or 'Disapprove').

The observed differences in perceptions of inter-Korean economic cooperation depending on age, preferred types and preferred sources of funding offer policy implications for pursuing economic cooperation, although a more rigorous analysis is required. This is covered in the next section.

III. Empirical Analysis

A. Model Construction

In this section, we construct an empirical model for a more in-depth investigation of the characteristics of the groups expressing positive and negative perceptions of

inter-Korean economic cooperation. Through the empirical model, we aim to discover which variables affect the positive and negative perceptions under a controlled statistical environment. The specifications of the models are expressed as shown below.

$$y_i = \alpha + \beta_1 type_i + \beta_2 funding_i + \gamma pol_i + \theta X_i + \mu_i + \varepsilon_i$$

In this equation, y_i represents the two dependent variables of approval and urgency with regard to economic cooperation. The approval variable scales from 1) Strongly Disapprove to 5) Strong approve, and the urgency variable scales from 1) Not at all urgent to 4) Very urgent. In addition, $type_i$ represents the preferred type of economic cooperation, which is composed of the three binary variables of ‘infrastructure development’ and ‘trade’, each taking a value of 1 if the respective type of cooperation project is preferred by the respondents and 0 otherwise, along with ‘reimplementation of existing cooperation projects’ as the reference group. $funding_i$ involves four binary variables, each representing the options offered in the corresponding survey question. The options are ‘domestic public funding’, ‘domestic private funding’, ‘investments by foreign private firms’, and ‘funding from an international organization’. Each of the four binary variables takes a value of 1 if the respondent has chosen a particular option, and 0 otherwise. pol_i represents a set of control variables reflecting the underlying political view of the respondent. X_i represents a set of demographic characteristic variables, in this case age, level of education, level of income, and marital status. μ_i represents a region fixed effect (see Table A1 for details).

Although the approval variable and the urgency variable both attempt to distinguish between positive and negative perceptions in general, the resulting compositions of the distinguished groups show different characteristics. The approval variable captures relatively radical respondents within the resulting positive or negative perception group who have stronger positive or negative opinions compared to those from the urgency variable. There are two main reasons behind this measurement difference. The first is ascribed to the fact that there exists the option ‘neutral’ for the approval question, which those holding mild opinions can choose, leaving only the polarized proportion of the respondents for both the positive and negative perception groups. Secondly, the approval question requires the respondents to make a categorical decision. Evidently, the majority (59.7%) of the disapproval group selected the options ‘nuclear and missile development program concerns’ or ‘North Korea is an enemy state’ to explain their disapproval; these issues are difficult to resolve given that they involve the need to build up trust between the two states. Consequentially, the characteristics of the respondents expressing disapproval to the approval question would differ from those of the ‘not urgent’ respondents when they replied to the urgency question.

We do not utilize the survey questions that ask the respondents to explain their approval and urgency selections for the following two reasons. First, the design of the survey is such that each question requiring such a reason is only applicable to a subsample of respondents. For example, the questions that require a reason for approval are only applicable to respondents who approve of the cooperation, for

instance. This substantially reduces the number of samples for the empirical analysis, which in turn undermines the accuracy of the results. Secondly, as mentioned previously, the aim of this research is to explore the characteristics of those who belong to positive and negative perception groups to derive policy implications for future directions regarding economic cooperation, which is difficult to achieve by analyzing the reasons for their respective perceptions.

B. Results

In this subsection, we report the empirical results. For each of the dependent variables, we estimate three specifications (Columns 1 through 6 in Tables 4 and 5) with an identical set of control variables. The first specifications for each dependent variable regress the three cooperation types of variables, the second set applies to the four funding source variables, and third is for all types and sources of funding variables inclusively. As presented in Tables 4 and 5, the results for the two dependent variables are nearly analogous, except for the differences in the significance levels and sizes of a few of the coefficients. Therefore, we explain the results of the regressions of the two dependent variables simultaneously.

First, there are two demographic variables that are statistically significant. For both of these, the coefficients of the age variable are positive and statistically significant, with the coefficient of the age-squared variable being negative and statistically significant. This implies that the age effect on the perception of inter-Korean economic cooperation forms an inversed U-shape, where the positive perception increases with age but at a decreasing rate (its peak is found to arrive at age 50.9 on average for the urgency variable and at age 50.6 on average for the approval variable). This pattern is consistent with the age effect on the perception of unification addressed in the previous literature, in which younger age groups have more negative perceptions compared to the older age groups (Kim, 2019). According to the ‘Unification Perception Survey’ conducted by the Institute for Peace and Unification Studies (IPUS) at Seoul National University, the average proportions of the respondents who think that unification is necessary by age group for those in their 20s, 30s, 40s, 50s, and 60s are 43.5%, 44.7%, 57.2%, 64.8% and 63.1%, respectively, from 2018 to 2020, with the most positive group found to be those in their 50s. This discrepancy in unification perception among the age groups certainly requires further research. Here, we offer some possible reasons for this. First, those currently in their 50s were the main forces behind the democratization movement of the 1980s; this group is also politically known to be pro-unification. Secondly, the group has the most positive experiences and memories of flourishing inter-Korean interactions after the ‘6.15 Communal Declaration’ of 2000, which may have induced the positive unification and economic cooperation perceptions in this group. The younger generations on the other hand do not share the same experiences compared to those in their 50s. In contrast, they have ample memories of political and military friction between the two states likely to have caused relatively negative perceptions about unification and economic cooperation. Moreover, the result of the Column (1) specification showing the approval variable regression (Table 4) suggests that male respondents have more positive perceptions of economic cooperation than female respondents.

TABLE 4—COOPERATION APPROVAL ORDERED LOGIT ESTIMATION RESULTS

Dependent Variable: Inter-Korean Economic Cooperation Approval			
	(1)	(2)	(3)
Demographic Variables			
Age	0.152*** (0.0330)	0.146*** (0.0320)	0.141*** (0.0331)
Age Squared	-0.00151*** (0.0003)	-0.00145*** (0.0003)	-0.00138*** (0.0003)
Gender	-0.262** (0.1210)	-0.146 (0.1210)	-0.175 (0.1230)
Marital Status	-0.0648 (0.1640)	-0.0168 (0.1580)	-0.0091 (0.1600)
Level of Income	0.0666** (0.0337)	0.0422 (0.0330)	0.0488 (0.0334)
Level of Education	-0.0465 (0.0642)	-0.0629 (0.0638)	-0.0438 (0.0645)
Variables of Interest (Preferred Cooperation Type)			
Infrastructure Development	0.334** (0.1440)		0.378** (0.1470)
Expanding Trade	-0.262 (0.1640)		-0.279* (0.1670)
Re-implementing Existing Cooperation Projects		(Reference Group)	
Variables of Interest (Preferred Source of Funding)			
Domestic Public Funding		1.012*** (0.1840)	0.976*** (0.1880)
Domestic Private Funding		0.937*** (0.1740)	0.944*** (0.1770)
International Organization Funding		-0.315* (0.1700)	-0.296* (0.1740)
Foreign Corporate Funding		(Reference Group)	
Control Variables			
Ultimate Goal of Economic Cooperation	0.246*** (0.0614)	0.161** (0.0638)	0.169*** (0.0637)
Labor Market Flexibility	-0.154** (0.0683)	-0.134** (0.0666)	-0.127* (0.0678)
National Security	0.0914 (0.0734)	0.0682 (0.0706)	0.107 (0.0726)
Government Spending	-0.476*** (0.0754)	-0.457*** (0.0754)	-0.433*** (0.0756)
Easing Corporate Regulations	-0.183** (0.0841)	-0.159* (0.0824)	-0.166** (0.0839)
Observations	949	957	941
Pseudo R ²	0.0660	0.0861	0.0933
Region FE	YES	YES	YES

Note: Robust standard errors are in parentheses (***) $p < 0.01$, (**) $p < 0.05$, (*) $p < 0.1$.

TABLE 5—COOPERATION URGENCY ORDERED LOGIT ESTIMATION RESULTS

Dependent Variable: Inter-Korean Economic Cooperation Urgency			
	(4)	(5)	(6)
Demographic Variables			
Age	0.181*** (0.0334)	0.176*** (0.0336)	0.171*** (0.0348)
Age Squared	-0.00178*** (0.0004)	-0.00174*** (0.0004)	-0.00167*** (0.0004)
Gender	-0.037 (0.1270)	0.0515 (0.1260)	0.0464 (0.1280)
Marital Status	0.000879 (0.1730)	0.0741 (0.1720)	0.0744 (0.1760)
Level of Income	0.0464 (0.0343)	0.0235 (0.0337)	0.0274 (0.0348)
Level of Education	-0.0454 (0.0659)	-0.0675 (0.0645)	-0.0457 (0.0652)
Variables of Interest (Preferred Cooperation Type)			
Infrastructure Development	0.280* (0.1470)		0.319** (0.1500)
Expanding Trade	-0.490*** (0.1710)		-0.527*** (0.1750)
Re-implementing Existing Cooperation Projects		(Reference Group)	
Variables of Interest (Preferred Source of Funding)			
Domestic Public Funding		1.013*** (0.1810)	0.995*** (0.1850)
Domestic Private Funding		0.941*** (0.1810)	0.959*** (0.1840)
International Organization Funding		-0.586*** (0.1810)	-0.561*** (0.1830)
Foreign Corporate Funding		(Reference Group)	
Control Variables			
Ultimate Goal of Economic Cooperation	0.200*** (0.0640)	0.108* (0.0658)	0.117* (0.0665)
Labor Market Flexibility	-0.157** (0.0712)	-0.125* (0.0699)	-0.128* (0.0717)
National Security	0.0693 (0.0701)	0.048 (0.0675)	0.0802 (0.0702)
Government Spending	-0.446*** (0.0775)	-0.423*** (0.0777)	-0.391*** (0.0784)
Easing Corporate Regulations	-0.245*** (0.0827)	-0.221*** (0.0854)	-0.230*** (0.0860)
Observations	949	957	941
Pseudo R ²	0.0773	0.107	0.118
Region FE	YES	YES	YES

Note: Robust standard errors are in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Secondly, the preferred type of economic cooperation also has an effect on perceptions. The coefficient of the 'infrastructure development' variable is positive and statistically significant on both of the dependent variables, implying that the respondents who prefer infrastructure development over the reference reply 're-implementing existing cooperation projects' are more likely to approve of economic cooperation and consider it to be highly urgent. In contrast, the respondents who selected 'promoting trade' as their preferred type of economic cooperation tend to disapprove and feel that economic cooperation is not an urgent issue. The empirical results thus far suggest that the South Korean public tends to perceive infrastructure development projects as a type of economic assistance (or long-term investments) which incurs a short-term financial burden but with the possibility of long-term economic benefits. On the other hand, the public seems to consider trade with the North as a project that involves commercial transactions which may be mutually beneficial. In sum, willingness to tolerate a short-term burden appears to be the decisive factor in forming these perceptions.

With regard to the preferred source funding for economic cooperation, there exist two main narratives according to the results. First, the preference for domestic sources of funding, such as domestic government spending and domestic firm investments, over the foreign private firm investments (the reference group) is likely to result in positive perceptions toward economic cooperation. Moreover, the preference for domestic public funding induces a stronger positive perception than the preference for domestic private funding, as suggested by the coefficients of each explanatory variable. On the other hand, the preference for funding from international organizations such as the UN over foreign private firm investments is likely to result in negative perceptions with regard to economic cooperation. This result is in line with the previous results pertaining to the preferred type variables, as types of economic cooperation that incur high short-term costs are most likely to require domestic and public financing. Those in the negative perception group, on the other hand, are intolerant towards large-scale economic cooperation projects which are, in their opinion, not very beneficial. They therefore oppose the use of domestic sources of funding, especially the government financing or, in other words, the taxpayers' money. These results provoke discussions about preferred initiating entities of economic cooperation. Those who actively support cooperation are likely to prefer cooperation mainly led by the government or domestic entities, which historically have been conventional types of entities. However, the group of people expressing skepticism prefers cooperation models that instead involve international entities.

In addition, the respondents who consider complete unification as the ultimate goal of economic cooperation tend to be those expressing positive perceptions. This result is intuitive, as economic cooperation is widely conceived as a necessary process for unification.

There are several interesting findings that incorporate the effects of political views on economic cooperation perception. Most of the control variables which reflect the political views of the respondent, such as 'lay-off of low-performing employee', 'government spending cuts' and 'easing corporate regulations', are statistically significant with regard to both dependent variables. The negative signs of the coefficients of these variables suggest that the more progressive the respondent is,

the more likely they will express positive perceptions toward economic cooperation. More specifically, the respondents who oppose the ideas that firms should be able to lay-off low-performing employees easily, who oppose small government measures (as opposed to government spending cuts), and who oppose the overall easing of corporate regulations are likely to have positive perceptions toward economic cooperation, while the respondents who agree with the above arguments are likely to have negative perceptions. This result provides evidence of the fact that the inter-Korean economic cooperation perceptions are sensitive to the political views of people despite the fact that economic cooperation, in essence, is an economic issue. It also suggests that building up positive perceptions about this issue will not be easy, as one's political views are often difficult to change.

Overall, the following characteristics of South Korean public opinions about inter-Korean economic cooperation could be inferred. On average, the group of people who are younger, who prefer lower short-term cost cooperative projects, who prefer foreign sources of funding, and who hold relatively conservative political views tend to have negative perceptions toward economic cooperation, while the group of people who are older, prefer higher short-term cost cooperative projects, prefer domestic sources of funding, and who have relatively progressive political views tend to have positive perceptions toward economic cooperation. As the statistical results and the underlying implications reveal, pursuing economic cooperation with the North is a polarizing issue in South Korea.

Considering the facts that public perceptions toward economic cooperation are inevitably tied to unification perceptions and that the political views of people affect their perceptions on economic cooperation, it is reasonable to conclude that the polarizing perceptions toward this issue are rigid in its nature. Consequentially, some degree of controversy in policy discussions as to which cooperation project and which source of funding should be prioritized could arise, meaning that the issue has to be approached delicately so that cooperation can be ensured without much social friction. According to the results of our analysis, cooperative projects should be pursued on a lower scale (or cost) and under international norms for the facilitation of foreign investments to persuade those with negative perceptions, which in turn will broaden the base of support for this type of cooperation.

IV. Conclusion

Inter-Korean economic cooperation is acknowledged to be an important tool when dealing with political and national security contentions as they pertain to North Korea. However, both external and internal constraints exist, such as public support. Despite the importance of this issue, studies of public perceptions toward cooperation remain scant. Hence, this research attempts to characterize positive and negative perception groups with regard to inter-Korean economic cooperation. KDI survey data were utilized as the main source to construct ordered logit estimation models.

First, age is an important factor that affects both the sense of urgency and the approval of economic cooperation. The age effect on cooperation sentiments forms

an inversed U-shape with a peak around the early 50s. The negative perception tendencies of the younger generations are suspected to stem from the growing economic concerns that they have regarding economic cooperation with the North.

Secondly, respondents who prefer domestic sources of funding (public or private) over foreign private firm investments tend to be part of the positive perception group; this group approves of this cooperation and considers it to be urgent. In contrast, respondents who prefer funding by the international organizations over investments by foreign private firms tend to be in the negative perception group, who disapproves of cooperation, not considering it to be urgent.

Thirdly, the respondents who prefer infrastructure development as their preferred type of cooperation are more likely to be among the positive perception group compared to the respondents who prefer the reimplementation of existing cooperation projects, whereas the respondents who prefer to promote trade tend to be members of the negative perception group.

Lastly, the respondents who have more progressive political views, such as disagreeing with labor market flexibility, opposing the easing of corporate regulations, and opposing government spending cuts, are more likely to be part of the positive perception group, whereas the respondents who hold positive views with regard to these positions are more likely to be in the negative perception group.

These results however, should be interpreted with caution because the possibility of reverse causality cannot be ruled out. It is difficult to find a way to control for possible endogeneity because the variables we employed are limited to the survey questionnaire. Therefore, the relationship between public opinion with regard to cooperation and the independent variables should be interpreted in terms of a correlation rather than causality.

Our findings suggest the need to change the inter-Korean economic cooperation strategy in order to widen the base of public support in order to alleviate the political constraints on economic cooperation. The primary concern held by those in the negative perception group about this type of cooperation seems to be the economic cost stemming from large-scale cooperative projects. Consequently, the negative group prefers small-scale projects such as trade and projects led by international organizations. Therefore, in order to restore public support, the South Korean government perhaps should employ a step-by-step approach to invigorate trade with the North prior to initiating large-scale projects such as infrastructure development. Such prioritization would lower the concerns over the exploitation of taxpayer funds and induce stronger expectations about mutual economic benefits. In addition, the involvement of international organizations can be not only instrumental with regard to diversifying the financing resources required for cooperation projects, but can also mitigate public concerns about costs. Improvements in the institutionalization levels of the North Korean economy can also be expected.

APPENDIX

TABLE A1—SUMMARY STATISTICS FOR THE CONTROL VARIABLES

Questions	Obs.	Options	Proportions (%)	Mean	SD
How old are you?	1,000	-	-	46.98	14.00
Which of the following is your highest level of education completed?	1,000	1) Below Middle School	1.5	3.512	0.9741
		2) High School	19.9		
		3) College	15		
		4) University	53.1		
		5) Beyond Graduate School	10.5		
What is your marital status?	1,000	1) Not married	31.0	4.268	1.430
		2) Married	66.2		
		3) Others	2.8		
What is your household income? (Korean Won)	1,000	1) Below 1 M	2.8	4.889	1.992
		2) 1 M ~ 1.99 M	8.3		
		3) 2 M ~ 2.99 M	18.0		
		4) 3 M ~ 3.99 M	17.1		
		5) 4 M ~ 4.99 M	15.0		
		6) 5 M ~ 5.99 M	15.6		
		7) 6 M ~ 6.99 M	7.1		
		8) 7 M +	16.1		
How much do you agree with the argument 'creating an environment that could allow firms easily to lay off low-performing employees should lower the burden for the firms to hire new employees?'	1,000	1) Strongly Disagree	7.0	3.098	1.058
		2) Somewhat Disagree	22.7		
		3) Neutral	31.6		
		4) Somewhat Agree	30.9		
		5) Strongly Agree	7.8		
How much do you agree or disagree with regard to the economic policy of easing corporate regulations?	1,000	1) Strongly Disagree	2.8	3.483	0.9458
		2) Somewhat Disagree	10.5		
		3) Neutral	35.6		
		4) Somewhat Agree	37.8		
		5) Strongly Agree	13.3		
How much do you agree or disagree with regard to cutting government spending?	1,000	1) Strongly Disagree	2.3	3.404	0.9657
		2) Somewhat Disagree	13.3		
		3) Neutral	39.9		
		4) Somewhat Agree	30.2		
		5) Strongly Agree	14.3		
How much do you agree or disagree on government financing for national security?	1,000	1) Strongly Disagree	2.1	3.991	0.9827
		2) Somewhat Disagree	5.1		
		3) Neutral	20.8		
		4) Somewhat Agree	35.6		
		5) Strongly Agree	36.4		

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Social Welfare Analysis of Policy-based Finance with Support for Corporate Loan Interest[†]

By CHANGWOO NAM*

We analyze the social welfare effect when a policy-based financial system (PFS) enters a decentralized financial market. Particularly, the PFS in this case supports the interest spread for corporate loans held by firms with heterogeneous bankruptcy decisions under an imperfect information structure. Although support for capital costs through the PFS expands the economy consistently, the optimal level of PFS out of the corporate loan market is estimated to be 8.6% by a simulation model considering social welfare adjusted by the disutility of labor. This result is much lower than the recent level of PFS in the Korean financial sector.

Key Word: Social Welfare, Policy-based Finance, Default Decision, Firm Dynamics
JEL Code: E22, G32, G33

I. Introduction

Why does the Korean government want to maintain a very large policy-based finance sector? In the 1960s and 70s, when the market was not well formed, the efficient allocation of limited resources was very important. Accordingly, the government would have a role in directly intervening in the market. The Korean financial industry underwent a major restructuring after the 1997 financial crisis and thus inefficient financial companies had been winnowed out and ousted such that the financial market, mainly composed of large banks, developed more readily, especially under the control of financial holding companies. However, large-scale policy-based institutions such as the Korea Development Bank, the Export-Import Bank of Korea and the Industrial Bank of Korea (hereafter KDB, KEXIM, and IBK) still play a large role in the Korean financial market. In particular, the guarantee insurance market, including the market for credit guarantees, has not yet been opened to third parties. In this situation, KDB and KEXIM have failed to promote the restructuring of insolvent companies properly. Recently, public opinion holds that the policy-based financial system should be greatly improved to achieve financial

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efficiency and for better financial market development.

However, in order for public opinion to be reflected in the financial policy, it should be verified that the current size of policy-based finance in the Korean financial sector is excessive via rigorous economic logic. From this point of view, the subject of this paper is clear. In other words, this paper analyzes how social welfare arises and what the optimal size of policy-based finance should be in the financial sector when policy-based financial institutions that support firms by supporting loan interest enter the financial sector. In particular, this paper develops a general equilibrium model. First, firms are heterogeneous because they undergo idiosyncratic shocks individually. Second, commercial banks and policy-based banks (government-owned banks) do not fully observe these heterogeneous characteristics of firms. In other words, this paper basically assumes that the financial market operates as an imperfect information system when lending to firms. In this model, firms also decide whether or not to continue operating, that is, whether or not to default, depending on their heterogeneity.¹ Finally, the analysis of social welfare does not aim to expand unconditionally the economy because the increase in the labor demand of firms by financial support is reflected in social welfare.

To summarize the results of the analysis, the level of policy-based finance that optimizes social welfare through a simulation is found to be 8.6 percent of the financial sector. This figure is much lower than the 34.4 percent average in the Korean financial market over the past three years. Furthermore, noting not only that policy-based finance is more likely to encounter moral hazard than private finance but also that policy-based finance is less efficient, it can be seen that the policy-based finance scheme implemented by the government in the Korean financial market is overabundant.

This paper is organized as follows. Section 2 explains the current state of policy-based finance in Korea, and Section 3 explains the theoretical background and how we designed the model in this paper. Section 4 explains the methodology and parameters needed for the simulation based on the theoretical model, and Section 5 explores the results of the social welfare analysis. Finally, Section 6 concludes the paper.

II. Policy-based Finance in the Korean Financial Market

In Korean policy-based finance, KDB, KEXIM, and IBK are the major financial institutions that provide financial support to firms, such as corporate loans and export credits, among other types, apart from public credit guarantee funds. These organizations were established under the “Korea Development Bank Act” of 1954, the “Export-Import Bank of Korea Act” of 1976, and the “Industrial Bank of Korea Act” of 1961, respectively. KDB and KEXIM are 100% owned by the Korean government and IBK is a listed company, but more than half of its shares are owned by the government. Accordingly, the Korean government always implements financial support for corporations through these institutions.

¹In general, ‘default’ is a specific event in which a debtor refuses to make a payment, and ‘bankruptcy’ is a legal process by which a debtor cleans up his debts. However, this paper uses both default and bankruptcy in the same sense as an event and process.

TABLE 1—LIABILITIES AND CORPORATE LOANS OF POLICY-BASED FINANCIAL INSTITUTIONS
AND THE COMMERCIAL BANKING SECTOR IN 2020

(Unit: KRW Trill.)

	KDB	KEXIM	IBK	Commercial Banks
Total Liabilities	221.4	83.1	311.3	1,779.1
Deposits	46.0	0	136.7	1,434.9
Borrowings	158.7	78.7	159.5	209.3
Debentures	139.8	72.6	90.1	118.7
Others	16.6	4.4	15.0	134.7
Corporate loans (for all currencies)	151.5	71.9	195.6	624.9
LEs (except foreign currency)	71.7	17.3	6.4	75.6
SMEs (except foreign currency)	25.8	6.3	186.0	507.7

Note: This table lists the liabilities accounts and corporate loans of KDB, KEXIM, IBK and the commercial banking sector in 2020.

Source: Financial Statistics Information System (<http://fisis.fss.or.kr>).

Unlike commercial banks, these institutions raise funds mainly through borrowing, such as issuing bonds, rather than through deposits. For example, Table 1 shows the liabilities and corporate loans of policy-based financial institutions (hereafter PFIs) and commercial banks. Financing through borrowing for commercial banks accounts for only 11.9 percent of their total liabilities but is 64.5 percent for PFIs. In particular, PFIs issued 2.5 times the bank debentures issued by commercial banks on balance, which is possible because PFIs are guaranteed by the Korean government. Finally, most of the funds of PFIs through borrowing other than deposits are provided for corporate loans. In the table, the total corporate loans of commercial banks, including those denominated in a foreign currency, amount to 625 trillion won, while the total corporate loans of PFIs amount to 419 trillion won, which corresponds to 67.5 percent of the corporate loans of commercial banks. In fact, corporate loans from PFIs include loans to support export credit. Even when considering won-denominated loans, corporate loans for large enterprises (LEs) of PFIs are considerable, accounting for 126.2 percent of commercial banks' lending to LEs. However, the loans provided by PFIs to small and medium-sized enterprises (SMEs) amount to 42.4 percent of commercial banks' SME loans, which is relatively low compared to the level of corporate loans to LEs. As a result, it is suggested that PFIs must focus more on supporting SMEs rather than LEs. In addition, as corporate loans of PFIs account for 40.1 percent of all corporate loans, the role of PFIs is critical in the Korean financial market.²

III. Theoretical Model

Most macroeconomic models in which there is financial friction are divided into two categories. First, there are macroeconomic models that mainly examine

²We only could confirm that the French PFI, Bpifrance's corporate loans, accounted for an average of 9.8% of total corporate loans for two years (2018, 2019) (Source: Bloomberg, BankFocus). Although it is difficult to generalize from only French data, it shows that at least the share of PFS in Korea is considerably higher than that in France.

problems associated with consumer financial instruments, such as mortgage loans. On the other side, there are macroeconomic models based on dynamic decision-making models of firm dealing with corporate investments, dividends, and financing. In addition, these corporate financing models are divided into models dealing with equity financing and models dealing with debt financing.

The model in this paper not only focuses on debt financing during dynamic decision making by firms but also assumes that the financial industry in the model has an incomplete information system, i.e., information asymmetry. This means that individual firms should have heterogeneous characteristics, not homogeneous. Inefficiency due to information asymmetry in corporate loan markets has long been discussed. As an example, Stiglitz and Weiss (1981) explain that credit rationing may exist due to information asymmetry in corporate lending. In particular, they show that in a lending market where there is only a single collateral ratio, adverse selection occurs because the lender does not properly observe the risks of the projects, meaning that only risky projects remain in the market as loan interest rates increase. However, the model they develop is a partial equilibrium model, and they do not explain how consumers and governments move in their model. In addition, the loan contract in Stiglitz and Weiss (1981) is a one-shot game and not a repeat game.

In contrast, the firms in our model have repeatedly made corporate decisions under information asymmetry. In fact, since Stiglitz and Weiss (1981), there has been much debate as to whether credit rationing exists in the corporate lending and loan market, but model development based on their information asymmetry has been rare as a general equilibrium model in which consumers, banks and government exist at the same time. Corbae and D'Erasmus (2017) started to analyze social welfare in relation to corporate bankruptcy and restructuring in the general equilibrium model. However, their financial market does not contain asymmetric information because their banks fully observe the firm heterogeneity and offer individual interest rates on loans. Also, they do not consider the disutility of labor in the household problem. On the other hand, there are other general equilibrium models that analyze the relationship between consumers and banks due to information asymmetry in the consumer finance market. In particular, this paper refers to work by Chatterjee, Corbae, Nakajima, and Rios-Rull (2007) as well as Athreya, Tam, and Young (2012) to analyze information asymmetry in the corporate lending and loan market methodologically.

In the economy, corporate decision making is much more complex than consumer decision making. First, firms should optimize certain factors of production, such as capital and labor, considering the investment opportunity cost. Then, the output is determined by the equilibrium price in the market, and the wage for labor is also determined. From a financial point of view, a firm should choose the optimal allocation according to the operating situation when investing and allocating net profits and should choose to procure scarce capital using direct financing or indirect financing. Because firms' decisions about investments, dividends and corporate financing are related to future investment opportunities and cash flows, they are mainly based on a dynamic decision model using the Bellman equation. In general, the literature on dynamic decision making by firms is diverse, but this study is based on work by Zhang (2005); Clementi and Hopenhayn (2006); Cooper (2006); Li, Livdan, and Zhang (2009); Livdan, Saprizza, and Zhang (2009); and Nikolov and

Whited (2014). These studies basically design the firm's decision making as a dynamic model and analyze how this model is influenced by the uncertainty of each firm. They also analyze the impact of these corporate decisions on dividends, investments and stock prices. In particular, Clementi and Hopenhayn (2006) explain firm dynamics using dynamic contract theory under information asymmetry. However, they do not consider invariant firm distributions in the equilibrium model, although firms seek optimal contract terms that entice them into long-term lending contracts.

Our paper makes the following academic contributions. First, by explicitly applying information asymmetry in the dynamic corporate loan market, it creates an economy in which credit rationing is likely to exist. Second, as there is a possibility that a firm may default on a loan, the default value of a firm is determined endogenously in our paper. Third, as a key contribution of our paper, the government's tax policy induces PFS into the economy to provide low-interest financing to firms. Finally, the social welfare effect of PFS is ultimately analyzed by applying labor disutility to the model so that an excessive labor supply due to corporate support can have a negative effect on social welfare. In particular, our study essentially utilizes the economic structure of Hopenhayn (1992). In addition, as in Arellano, Bai, and Zhang (2012), firms fund their capital through bank loans and make decisions about defaults that determine their entry or exit in the market. Although they calculate exogenously the insolvent value of a firm when calculating the invariant firm distribution, in our model, the entry rate is internalized according to the corporate default and liquidation rate. In particular, one of the main features of our model is that the insolvent value of a firm is determined endogenously.

A. Operating Firms and Technology

We assume a perfectly competitive market for one homogeneous good that can be used by a representative household or used as capital by all firms that produce only this good. The production function of all firms has a decreasing return to scale, as follows:

$$y = e^x k^\alpha n^\gamma, \quad \alpha + \gamma < 1,$$

in which x is an idiosyncratic productivity shock, i.i.d. across firms, that follows a first-order Markov process with transition matrix $p(x'|x)$ that is common knowledge in this economy; $k \in \mathbb{R}^+$ is the capital input, and $n \in (0,1)$ is the labor input. In particular,

$$k \equiv 1 + b,$$

in which 1 represents normalized equity because in our model, there is no stock market, and all firms are assumed to be owned by one household with equity of 1. $b \in \mathcal{B} \equiv [0, \bar{b}]$, where \bar{b} is the capital borrowed from a bank.

The operating profit is defined as

$$\pi(b, x) = e^x k^\alpha n^\gamma - wn,$$

in which $w \in \mathbb{R}^+$ denotes the real wage, which is determined competitively. The operating profit by finding the optimal labor input is derived as

$$\pi^*(b, x) = a^* e^x k^\theta,$$

in which $\theta = \alpha / (1 - \gamma) < 1$ and $a^* = \left(\gamma^{\frac{\gamma}{1-\gamma}} - \gamma^{\frac{1}{1-\gamma}} \right) w^{\frac{\gamma}{\gamma-1}}$.³

B. Firm's Recursive Problem

The current value of a firm that was operating normally in the past is as follows:

$$(1) \quad \begin{aligned} V(b, x, 0) &= \max_{f \in \{0,1\}} V_f(b, x, 0) \\ &= \max \left\{ \begin{aligned} &V_0(b, x, 0) \equiv \max_{b' \in \mathcal{B}} d + \mathcal{M} \mathbb{E}[V(b', x', 0) | x] \\ &V_1(b, x, 0) \equiv vb + \mathcal{M} \mathbb{E}[V(0, x', 1)] \end{aligned} \right\} \end{aligned}$$

in which $V_0(b, x, 0)$ denotes the value by which the firm decides to operate normally as of the present, and d is the dividend to the owner. \mathcal{M} is the stochastic discount rate indicating the owner's intertemporal preference. b' is the amount of the new loan contract with a bank, and x' is the idiosyncratic shock in the next period. In the last column, 0 means that there is no history of default.

The dividend is structured as follows:

$$\begin{aligned} d &= \pi^* - i - q_b b + (b' - b) - \Phi(i, k) \\ &= \pi^* - \Phi(i, k) - q_b b - \delta k, \end{aligned}$$

in which i denotes an investment for which the corresponding law of motion is expressed as $i = k' - (1 - \delta)k$; k' is the capital installed in the next period, and δ is depreciation rate for the installed capital. q_b is the loan interest rate for b contracted in the last period. $\Phi(i, k)$ is a function of the capital adjustment cost:

$$\Phi(i, k) = \frac{(\phi^+ 1_{\{i \geq 0\}} + \phi^- \phi^+ 1_{\{i < 0\}})}{2} \left(\frac{i}{k} - \delta \right)^2 k,$$

³See the appendix.

in which ϕ^+ is the adjustment parameter for a positive investment and ϕ^- is the scale parameter for a negative investment, referring to a case in which the firm sells capital. It is assumed that $\phi^- > 1$ because in general, an investment in capital is irreversible, implying that firms should pay more when they sell capital compared to when they buy capital (Zhang, 2005). This investment irreversibility increases the likelihood of a firm's default when a firm experiences a very negative shock to production or management.

$V_1(b, x, 0)$ is the value when a firm decides to default on the payment of principal and interest to a lender. In particular, if the firm decides to default, the operating profit of the relevant period π^* is paid to the bank (whereas the wages for labor are paid previously), with the bankrupt firm's installed capital bought by the bank at the price of νb . In this case, νb can be interpreted as the liquidation value of the debt, and ν is the liquidation rate for the debt. This process of default and liquidation takes place at the end of the period. In addition, the bank disposes of the installed capital purchased from the bankrupt debtor.

Meanwhile, this capital structure is basically composed such that the size of the loan affects the corporate default and productivity. This is a system for determining the scale of production and the labor supply of the entire economy. In other words, in the capital structure of existing firm decision models, profit induces investments and loans are used as working capital. However, in our model, in the absence of an equity market, loans are used as facility investment funds rather than as working capital. Instead, the profit increases the incentive to be distributed to households as a dividend. This only changes the order in which profit and external funds are distributed to investments and dividends and does not lower the firm value, as the firm value is the present value of the dividends that will be received in the future. In addition, there is no possibility of excessive leverage because the mean and dispersion of investments and the debt ratio are fitted through a simulation.

The value of a firm that liquidates its debt in the last period but has a history of default is as follows:

$$(2) \quad V(0, x, 1) = 0 + \mathcal{M}(\xi \mathbb{E}[V(0, x, 0)] + (1 - \xi) \mathbb{E}[V(0, x', 1) | x]),$$

in which the bankrupt firm's cash flow is naturally zero, and $\mathbb{E}[V(0, x, 0)]$ is the entry value of a firm that finally closes down an old project, clearing the history of default and starting a new project. ξ is the closure rate of bankrupt businesses. Finally, the liquidation value for exiting the market is determined endogenously by the entry value into the market again. In addition, firms with new businesses start with zero debt.

C. Commercial Banking System

The commercial banking sector is assumed to be a perfectly competitive market with no entry costs. However, taking into account the difference between risk levels in the deposit market and the loan market, the lower limit of the return on the loan market is set as follows:

$$\int_b r_b b \mu(db) - q \int_b b \mu(db) \geq S = \sigma q \int_b b \mu(db),$$

in which r_b is the expected return on b ; q is the deposit interest rate and μ is the firm distribution based on beliefs pertaining to the loan market formed by banks through repeated loan contracts with firms. S is the minimum cash flow buffer that the bank must hold, and σ is the minimum buffer ratio. Strictly speaking, this ratio should be applied to risk-weighted assets in terms of the capital ratio, but it is assumed to be a ratio relative to the deposit income for convenience of the calculation.

Given the belief distribution and σ , the return condition for loan products in a perfectly competitive market is as follows:

$$r_b = M^{-1}(q_b) \mu(f=0|b) + \int_x \left[\frac{\pi}{b} - v \right] \mu(f=1, dx|b) = (1+\sigma)q,$$

and we derive the equation for the loan interest rate of b via

$$(3) \quad q_b = M \left[\frac{(1+\sigma)q - \int_x \left[\frac{\pi}{b} - v \right] \mu(f=1, dx|b)}{\mu(f=0|b)} \right] \geq (1+\sigma)q,$$

in which $M[\cdot]$ is a technical function smoothing loan interest rates within similar loan sizes, bs .

The last important assumption in the financial sector is that banks fail to observe firms' idiosyncratic shocks at every time, but when the loan is renewed, only the size of the loan creates a belief about the default probability. Therefore, even if the loan contract is renewed repeatedly, information about defaults held by banks is not updated. In addition, this belief is common knowledge in this economy.

D. Household Problem without Policy-based Finance

There is one representative household with a utility function with the unitary Frisch elasticity of labor supply such that

$$U(C, N) = \ln(C) - \frac{\lambda N^2}{2}$$

in which N denotes the aggregate labor such that the labor of a household is perfectly divisible and the household has the following budget constraint,

$$(4) \quad C + B' = D + wN + (1 + q)B,$$

in which D , B , and B' are the aggregate dividends and aggregate deposits in the current and subsequent period, respectively.

Therefore, the household problem is as follows:

$$(5) \quad W(C, N) = \max_{B', N} U(C, N) + \beta W(C', N').$$

From the above equation, we simply derive the first-order conditions as

$$(6) \quad \frac{U_1(C, N)}{U_1(C', N')} = \frac{C'}{C} = \beta(1 + q) \text{ and } \frac{U_2(C, N)}{U_1(C, N)} = \lambda CN = w,$$

and $\mathcal{M} \frac{\beta C}{C'}$ and $\beta = 1 / (1 + q)$ under steady-state equilibrium.

E. Policy-based Financial System

Thus far, we have explained the banking industry, which has no government intervention. However, we assume that PFIs enter into the banking industry as facilitated by the government because the government has an incentive to boost the economy through financial support. In particular, in this study, PFIs provide firms with loans with lower interest rates than those in the decentralized market, and commercial banks also offer loans with low interest rates according to the principle of a perfectly competitive market. Commercial banks and PFIs are then supported by the government and are subject to the following budget formula:

$$\int_b r_b b \mu(db) + T - q \int_b b \mu(db) = S \geq \sigma q \int_b b \mu(db),$$

in which T is the tax collected from the household.

There are two ways to support loan interest for corporate loans. Lenders support the loan interest rate in a proportional manner with an identical interest spread for all loans. The method of determining the interest rate is as follows: if $\mu(f = 1 | b) > 0$,

$$(7) \quad q_b^r = \left\{ M \left[\frac{(1 + \sigma)q - \int_x \left[\frac{\pi}{b} - v \right] \mu(f = 1, dx | b)}{\mu(f = 0 | b)} \right] - \tau_2 \right\} (1 - \tau_1) \\ = (q_b - \tau_2)(1 - \tau_1),$$

and if $\mu(f=1|b)=0$, then

$$q_b^\tau = q_b - \tau_2,$$

in which τ_1 is the ratio of proportional interest support and τ_2 is the interest spread. Why do we consider this PFS in the model? Usually, banks determine the interest rates for loans to firms in consideration of the buffer for financial stability and profitability. In the end, the capital productivity of a firm determines the profitability of the loan, which determines the loan interest rate. If it is possible for banks to raise funds at a low interest rate while maintaining financial stability (loan profit > deposit interest) through PFS, even relatively low-productivity firms will survive and participate in production without announcing a default. However, if a firm with overly low productivity survives and causes an excessive labor supply, the disutility of labor increases and social welfare decreases even as production expands. Therefore, the steady-state condition with PFS may have higher social welfare than the steady-state condition without PFS.

F. Government Budget

The tax system is based on lump sums such that households do not know how much the tax will be until the end of a period. The tax is determined as follows:

$$(8) \quad T = \int_b (q_b - q_b^\tau) b \mu(db).$$

G. Household Problem with Policy-based Finance

In an economy where the government actively intervenes in the banking industry, the household budget constraint is similar to equation (4):

$$C + B' + T = D + wN + (1+q)B.$$

The household problem is identical to (5), and the household has first-order conditions identical to those in (6). In fact, the assumption of Frisch elasticity of 1 is conservative because the elasticity estimated through microdata is usually lower than 1. If the model assumes that the elasticity is lower than 1, the incentive to expand social welfare through PFS is expected to be lower because the change in the labor supply is relatively small with respect to the change in wages. This means that the optimal level of PFS may be lower than that in the current model.

H. Invariant Firm Distribution

We explain how to compute banks' invariant belief system in the firm distribution.

First, the state-mapping function of state variable vector, (b, x, h) , is as follows:

$$F(b, x, h' = 0) = \begin{cases} 1 & \text{if } f = 0 \text{ and } h = 0 \\ \xi & \text{if } h = 1 \\ 0 & \text{if } f = 1 \end{cases}$$

$$F(b, x, h' = 1) = \begin{cases} 0 & \text{if } f = 0 \text{ and } h = 0 \\ 1 - \xi & \text{if } h = 1 \\ 1 & \text{if } f = 1, \end{cases}$$

in which h is the history of default that has a value of 1 if the firm decided to default in the past. The transition function of corporate policy is as follows:

$$P(b, x, h' = 0, S) = \int \left[1_{\{b' \in B \setminus \{0\}\}} F(b, x, h = 0, h' = 0) + 1_{\{b' = 0\}} F(b, x, h = 1, h' = 0) \right] p(dx' | x),$$

$$P(b, x, h' = 1, S) = \int \left[1_{\{b' \in B \setminus \{0\}\}} F(b, x, h = 0, h' = 1) + 1_{\{b' = 0\}} F(0, x, h = 1, h' = 1) \right] p(dx' | x),$$

in which S is defined as the compact space of state variables. Then, we define the transition function of firm via

$$P^*(b, x, S) = P(b, x, 0, S) + P(b, x, 1, S).$$

Finally, given (w, Q_b) , the distribution of the state vector, (b, x, h) , μ is defined as

$$(9) \quad \Upsilon_{(w, Q_b)\mu}(B \times X) = \int P^*(b, x, S) d\mu,$$

in which Q_b is the vector of q_b for all loan products, and Υ is the matrix operator. Therefore, μ is defined as the bank's belief function with respect to b and f . It then becomes possible to compute the default probability and the conditional default probability $\mu(f = 1)$ and $\mu(f = 1 | b)$ (Athreya, Tam, and Young, 2012). In addition, the unique existence of an invariant distribution refers to Theorem 2 in Chatterjee, Corbae, Nakajima, and Rios-Rull (2007).

I. Bayesian General Equilibrium

Definition. The Bayesian general equilibrium lists (a) the real wage w^* , (b) the vector of loan interest rates $Q_b^* \in (\mathbb{R}^+)^l$ and the deposit interest rate $q^* \in \mathbb{R}^+$, (c) if PFIs offer

corporate loans, the support system $\tau^* = (\tau_1^*, \tau_2^*) \in (0,1)^2$, and (d) lenders' belief about the firm distribution μ^* satisfying the following:

1. Firms solve the optimization problems of n^* , b^* and f^* given w^* and Q_b^{r*} in (1).
2. Lenders offer Q_b^{r*} as a Bayesian Nash equilibrium under perfect price competition given τ^* , b^* , f^* , μ^* and q^* in (7).
3. The government balances the tax T^* given τ^* , b^* , Q_b^{r*} and μ^* in (8).
4. The household solves the optimization problem of B^* and N^* given w^* , q^* , μ^* and T^* in (5).
5. Labor, loan and Deposit markets clear at w^* , q^* and Q_b^{r*} :

$$N^* = \int_{b,x} n^* \left(1 - 1_{\{(f^*, b^*) = (1,0)\}}\right) \mu^*(db, dx) \text{ and } B^* = \int_{b,x} b^* \mu^*(db, dx).$$

6. According to Walras's law, the household budget constraint according to the goods market clearing condition is as follows:

$$C^* = Y^* + q^* B^* - \Psi^* - \int_b q_b^* b^* \mu^*(db) - \delta K^*.$$

in which

$$Y^* = \int_{b,x} y^* \left(1 - 1_{\{(f^*, b^*) = (1,0)\}}\right) \mu^*(db, dx),$$

$$\Psi^* = \int_{b,x} \Phi(i^*, k^*) 1_{\{f^* = 0\}} \mu^*(db, dx),$$

$$K^* = \int_{b,x} (1 + b^*) 1_{\{f^* = 0\}} \mu^*(db, dx),$$

and i^* and k^* are solved based on the firm's problem (1).

IV. Policy Simulation Methodology

A. Computational Methodology

This study computes the equilibrium interest rates of the loan market and the equilibrium real wage of the labor market considering the heterogeneity of firms. In particular, for a social welfare analysis, λ , which determines the marginal utility of labor, is estimated while assuming that there is no policy-based finance and that the real wage is fixed at 1. It is also important to calculate the upper limit of b , \bar{b} . In this study, firms need a reasonable ceiling to grow their businesses through the loan market, not the stock market. Thus, we define \bar{b} , which is interpreted as the maximum leverage, as 11

and calculate the base model.⁴

We define firms' idiosyncratic shocks as AR(1):

$$x' = \eta(1 - \rho) + \rho x + \varepsilon',$$

with $|\rho| < 1$ and $\varepsilon \sim N(0, \omega)$. We discretize this process into a 20-state Markov process $\{x_1, \dots, x_{20}\}$ using the method of Adda and Cooper (2003). In particular, we do not estimate the parameters of idiosyncratic shocks using exogenously reduced forms with firm data, as in other studies such as Corbae and D'Erasmus (2017), but rather estimate the parameters in a way that minimizes the distance between moments from the simulated model and the moment of the financial data. Specific techniques for these computations are described in the appendix.

B. Parameters

This study requires 15 parameters for the model simulation. The parameters are divided into two groups. The first group is calculated independently of the model using corporate and financial data. Table 2 shows their values, α as the capital income share is 0.33, which is commonly used in the macroeconomic literature. In addition, γ uses a rate of 51.6%, the average of the labor income share obtained from the Bank of Korea (BOK: <https://ecos.bok.or.kr/>) from 1961 to 2020. θ is 0.682 from $\alpha / (1 - \gamma)$ in the firm's problem. q is 1.79%, the average yield of the ten-year treasury bonds adjusted by consumer price index (CPI) from 2001 to 2020. σ is 0.09,

TABLE 2—PARAMETER VALUES

Parameter	Value	Targets
α	0.330	Capital income share: standard parameter
γ	0.516	Labor income share
θ	0.682	$\alpha / (1 - \gamma)$
q	0.018	Ten-year treasury bonds yields
σ	0.090	(three-year corporate bonds (AA-) yields minus q) / q
β	0.982	$1 / (1 + q)$ from (6)
δ	0.051	Accumulated depreciation of property, plants and equipment
ξ	0.380	Closure rate of firms under court receivership
ϕ^+	4.381	Adjustment cost of positive net investment
ϕ^-	1.366e + 3	Adjustment cost of negative net investment
ν	0.270	Liquidation rate for debt
η	-1.262	Mean of the AR(1) process
ρ	0.911	Auto-correlated parameter of the AR(1) process
ω	0.417	Standard deviation of the AR(1) process
λ	4.960	Parameter for the disutility of labor: weight on leisure

Note: 1) The first group shows base parameters calculated using independent corporate and financial data, 2) The second group shows parameters estimated from the minimization of the simulation moments and the target moments.

⁴In order to check the robustness, we conducted a social welfare analysis using different values of \bar{b} , finding, however, no qualitative difference in the results.

which is the average yield of the three-year corporate bond (AA-) adjusted by CPI from 2001 to 2020 minus q and then divided by q . β is 0.982 from $1/(1+q)$ from (6). To use δ , first we calculate the annual sum of the decrements of tangible asset depreciation for unlisted non-financial firms audited externally from 2001 to 2020, taking the average after dividing the value by tangible assets.⁵ With this process, δ is 5.1%. The liquidation rate of bankrupt firms is calculated as 38.0%, as 388 out of the 1021 enterprises that filed for court receivership from 2008 to 2015 were closed.⁶

The second group of parameters is estimated from the simulated model. In particular, we estimate the parameters using a method that minimizes the distance between simulated moments and data moments weighted by a selected weighting matrix, as follows:

$$\Theta = \arg \min [m^d - m^s(\Theta)]' \mathcal{W} [m^d - m^s(\Theta)],$$

in which θ is a set of parameters; m^d are data moments; m^s are the simulated moments at parameters θ , here as $\int_{b,x} z^s(\Theta) d\mu^*$, where z^s is a value for an individual state vector, which means that our moments computed from the simulated firm distribution differ from those generated by the simulated method of moments (SMM) with random numbers, and \mathcal{W} is a positive definite weighting matrix selected to equalize the positions of the first decimal digit in all moments.

Table 3 shows the data moments selected to provide the identification of the parameters, also showing benchmark moments under the economy without a policy-based financial system.⁷ In fact, the selected data moments do not have an exact one-to-one relationship with the parameters. However, we can only explain that the selected moment has more information about the parameters we want to estimate than the other moments. In the table, the defaulted debt/total corporate debt levels and real interest rates must be related to ϕ^+ , ϕ^- and ν directly, and the net investment must influence the parameters η , ρ and ω of the idiosyncratic shock. The debt/equity ratio and corresponding standard deviation are related to all parameters.

TABLE 3—COMPARISON OF DATA AND MODEL MOMENTS

Moments	Target	Benchmark Model
Defaulted Debts / Corporate Debt on Credit (%)	6.32	6.15
Net Investment Ratio (%)	18.82	12.56
Debt/Equity (%)	201.5	224.6
Standard Deviation of Debt/Equity (%)	233.8	238.4
Real Interest Rate on Corporate Loans (%)	3.33	3.33
Labor	0.3	0.34

Note: This table lists the moments of the data and the simulated model (benchmark model) under an economy without policy-based finance.

⁵Accounting data for firms audited externally are obtained from KISVALUE.

⁶Data related to court receivership and the liquidation of businesses are obtained from KISLINE and the National Tax Service, respectively.

⁷See the appendix for the generation of data moments.

In addition, according to studies such as that by Gourio and Miao (2011), the benchmark labor at equilibrium is set to 0.3 in order to estimate λ . Finally, returning to the table, it can be seen that the moments simulated by our model approximate the target moments well.

ϕ^+ and ϕ^- in Table 2 are estimated as 4.381 and $1.366e+3$, which are relatively large compared to those in Zhang (2005) but at the reasonable level where firms decide to default. In addition, ν is estimated to be 0.270, which means that the lender buys the installed capital of a bankrupt firm for 27% of the debt minus its cash holdings. η , ρ and ω , defining the movement of idiosyncratic shocks, are estimated to be -1.262 , 0.911 and 0.417 , respectively. These values appear to be desirable enough compared to those in Zhang (2005); Li, Livdan, and Zhang (2009); Livdan, Saprizza, and Zhang (2009); and Nikolov and Whited (2014). Finally, λ is estimated to be 4.960 by applying C^* and N^* from the simulated model to (6).

V. Social Welfare Analysis

A. Benchmark Model Properties

As described above, the benchmark model assumes an economy in which there is no policy-based finance in order to estimate basic parameters such as λ or analyzing the social welfare of policy-based finance. First, we explain how firms' decision rules on bankruptcy are made in the benchmark model. Panel (A) in Figure 1 shows the bankruptcy decision rule with respect to the state variables (k, x) . As expected, firms with high capital levels and negative production shocks are likely to go bankrupt. In particular, a large amount of installed capital means not only that there is a considerable amount of debt but also that the firm is more vulnerable to production shocks due to the irreversibility of the investments. As a result, it can be seen that according to this decision rule, firms are concentrated in the category with relatively high productivity and a low debt structure in the invariant firm distribution $\mu(k, x)$ (Panel (B) in Figure 1).

Panels (C) and (D) in Figure 1 show the relationship between the loan interest rate Q_b , debt distribution $\mu(b)$ and default probability for each loan size $\mu(f=1|b)$. It can be seen that the higher the debt, the higher the default probability, with the loan interest rate increasing accordingly. Also, in Panel (D), the default probability is rather high for firms with very small loans. This occurs because if a firm starts a new business, the initial productivity shock is given equally, after which the start-up's default probability is higher than those of surviving firms due to the persistence of the shock. Although this appears to be in conflict with Panel (A), it only shows the bankruptcy decision rule and does not take into account the firm distribution. Nevertheless, in Panel (D), the loan interest rate is relatively low for startups because their cash level, that is, operating profit paid by bankrupt start-ups to the bank, is relatively high when the debt is liquidated, which ensures the bank's profitability even with a high default probability.

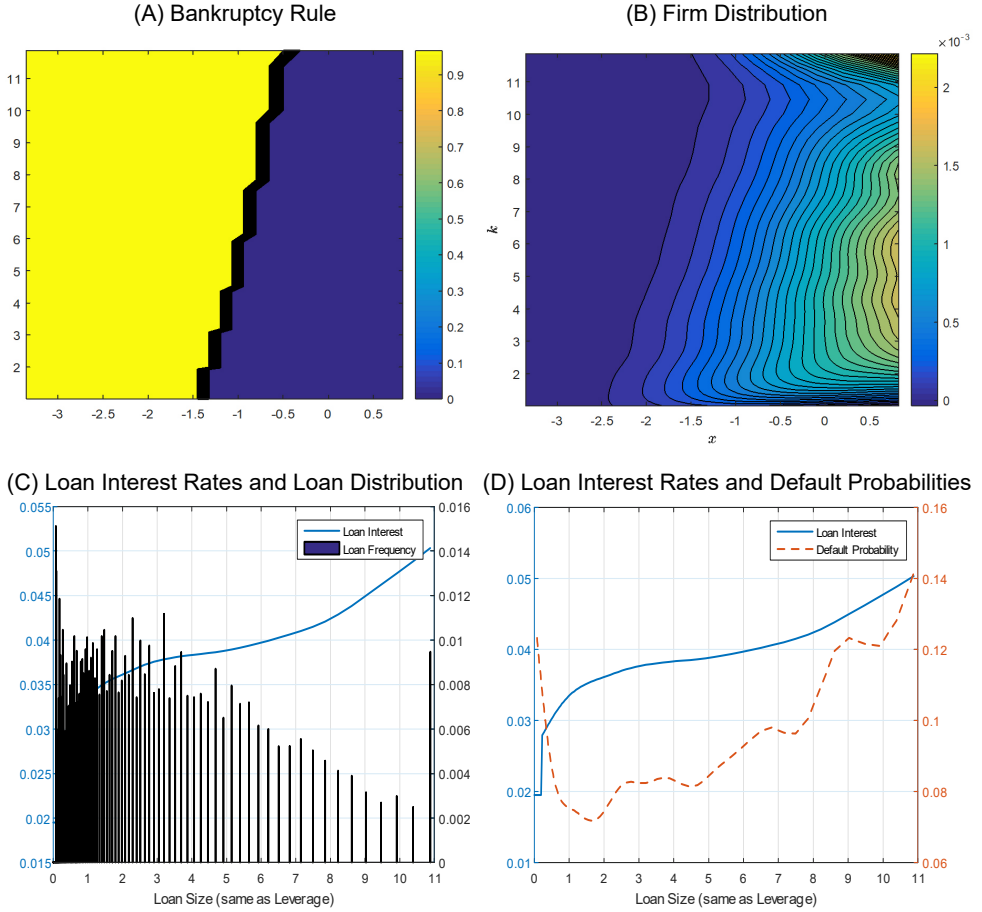


FIGURE 1. PROPERTIES OF BENCHMARK MODEL

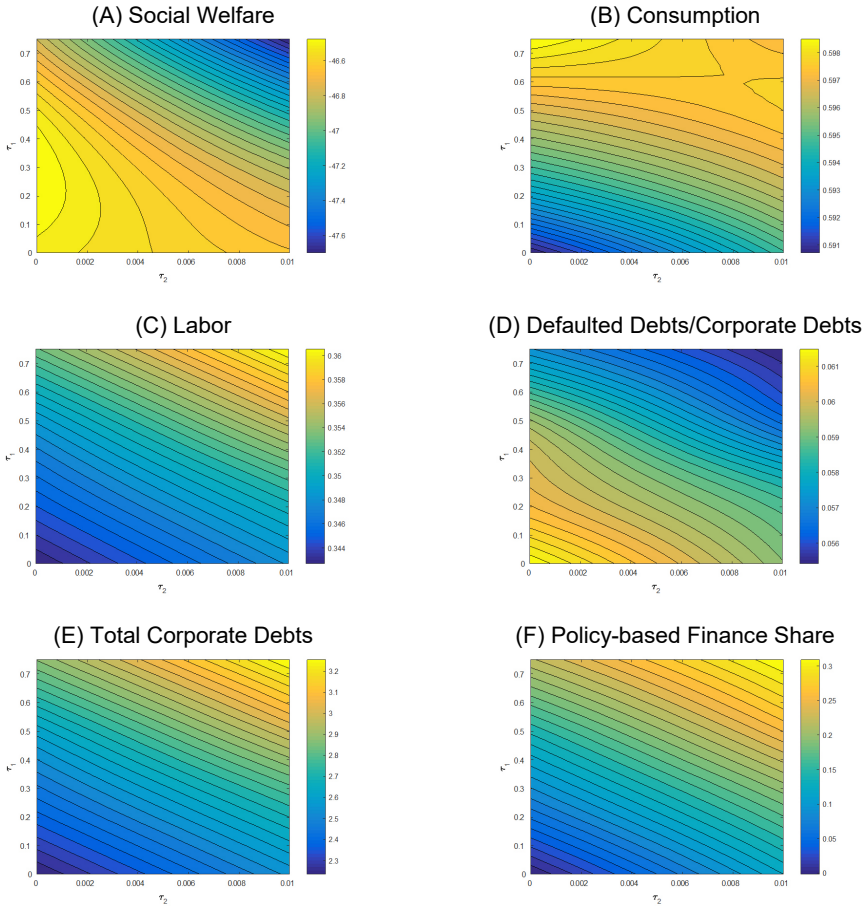
Note: 1) This figure displays the properties of the benchmark model: the economy does not have policy-based finance, 2) Panel (A) shows bankruptcy decision rule γ w. r. t. capital k and idiosyncratic shock x , 3) Panel (B) shows invariant firm distribution $\mu(k, x)$, 4) Panel (C) shows loan interest rates Q_b and invariant loan distribution $\mu(b)$: left axis is Q_b and the right axis is $\mu(b)$, 5) Panel (D) shows loan interest rates Q_b and conditional default probabilities $\mu(f = 1 | b)$: the left axis is Q_b and the right axis is $\mu(f = 1 | b)$.

B. Results of the Social Welfare Analysis

The range of τ for the social welfare analysis is set as follows:

$$\tau_1 \in [0, 0.75] \text{ and } \tau_2 \in [0, 0.01],$$

that is, we compute the social welfare when all interest rates are lowered by the same rate of up to 100bp for the market prices in the benchmark model or by up to 75% in proportion. Figure 2 shows the values of social welfare and other macro-variables with respect to τ_1 and τ_2 using contour plots. The contours of Panel (A) show that social welfare $W^*(\tau)$ is high when τ_1 is in the range of 0.05 to 0.45 and when τ_2 is less than 0.001, which means that it is more effective to adjust loan interest rates

FIGURE 2. COMPARISON OF SOCIAL WELFARE ACCORDING TO τ

Note: 1) This figure displays social welfare and macro variables w. r. t. (τ_1, τ_2) , 2) Each panel shows social welfare (W^*), consumption (C^*), labor (N^*), defaulted debt/corporate debt, total corporate debt, and shares of policy-based finance in the financial market using contour plots.

with τ_1 than with τ_2 . As explained above, given that social welfare in our model takes into account the disutility of labor, the optimal τ would be lower if we assume that labor elasticity is not one but that it low as labor demand increases.

Panel (B) shows us the important characteristic of this policy, specifically that interest policies pertaining to corporate loans are consistently effective in reviving the economy. More specifically, lowering the interest rate on corporate loans results in lower capital costs, which in turn increases future cash flows. Therefore, if there is no disutility of labor in the social welfare function, the optimal social welfare continues to expand due to this financial support. This means that there is no Laffer curve phenomenon that occurs when taxes are applied to the supply side. However, this model does not consider the inefficiency and restructuring costs of marginal firms surviving in the market due to the support of policy-based finance. Returning to the panel again, we see that as τ increases, taxes increase, whereas consumption $C^*(\tau)$ does not decrease but instead steadily increases. In particular, it can be seen here

that τ_1 is more effective than τ_2 .

Panel (C) and Panel (D) show total the labor used in production and the ratio of defaulted debt out of corporate debt. With respect to τ , labor tends to increase monotonically, and the ratio of defaulted debt decreases monotonically with consumption, as described above. Panel (E) and Panel (F) also show the size of the corporate loan market in the banking sector as a whole and the share of corporate loans provided by policy-based finance. In particular, the size of policy-based finance is calculated according to how much the corporate loan market expands from the benchmark model due to financial support. Furthermore, it is important to understand that the range of the optimal level of policy-based finance is 1.6% to 13.7% of the total corporate loan market considering social welfare as displayed in Panel (A). In particular, the optimal social welfare level is achieved when the policy-based finance accounts for 8.6% of the total corporate loan market.

To explain the gap between the model and reality, the reason for the existence of PFS is a function of effectively lending funds to firms before the economy develops, that is, a function of correcting the failure of the financial market. This explains the situation in which PFS basically raises funds at a low interest rate and lends money to firms at a lower interest rate than those offered by the market. In addition, it acts as a buffer in the financial market in response to economic fluctuations. However, as the financial market developed along with the economy, the financial market became decentralized. Nonetheless, policy-based financial institutions continued to expand the size of PFS without considering social welfare while continuing the growth-driven policies of the past. This appears to be the cause of the widening of the difference between the model's results and reality. Also, to explain this in terms of the simulation model, as low-interest loan support is extended to low-productivity firms that need to enter the market after being expelled, an excessive labor demand arises and the social welfare of households decreases. In other words, the current situation is that corporate loans procured at low interest rates encourage production, but the social welfare generated through additional production is rather low due to the excess supply of labor.

On the other hand, our model as described thus far can be criticized in many ways. First, as mentioned above, our economy is structured to impose taxes on the demand side and to support the supply side, which is contrary to the usual fiscal policy of imposing taxes on the supply side and supporting the demand side. Moreover, if corporate taxes are levied on firms and tax revenue from corporations supports households, it can be considered that the effect of financial support on the corporation can be circulated back to households. However, there could be a trade-off effect because corporate taxes have a negative impact on the bankruptcy decisions of firms such that they may reduce the effect of financial support to firms. Second, our model does not explicitly assume social costs such as the inefficiencies or moral hazards of policy-based finance. It is obvious that in assuming so, the optimal level of policy-based finance will be lower than it is currently. Although the efficiency of policy-based finance is assumed to be identical to that of commercial banks, our model shows that the current level of policy-based finance in the Korean financial market needs to be moderated. Third, there is no financial intermediation through equity financing in our model. However, even if there is no stock market, the pecking order theory suggests that equity is the last resort of financing, and if a firm becomes close to insolvent, the cost of equity financing will increase rapidly such that our results would not be fundamentally different from those with equity

financing. The last issue is that in our model, there is no inefficiency in production due to the survival of marginal firms in the market. If firms that will exit exist in the market due to financial support, the effects of policy-based finance may deteriorate due to externalities such as a decrease in the productivity of the same industry.

VI. Conclusions

We investigate the social welfare effect of a policy-based financial system in the financial market. In particular, this paper develops a general equilibrium model: first, firms are heterogeneous; second, commercial banks and policy-based banks have an incomplete information system in corporate lending. In addition, firms make decisions about bankruptcy under this information asymmetry. The last characteristic is that unconditional economic growth may be not best because the disutility of labor is reflected in the social welfare function.

As a result, the optimal level of policy-based finance in the simulation is estimated to be 8.6%. This figure is well below the average of 40.1% in the Korean financial market over the past three years. In addition, it is argued that the policy-based finance scheme implemented by the government in the Korean financial market needs to be moderate given that policy-based finance is more likely to be morally hazardous and less efficient than schemes operated by commercial banks. Finally, our model may be refuted as imperfect to reflect reality in terms of policymaking, but the main result of this paper will be continuously effective to those developing financial policies.

APPENDIX

A. Solving the Operating Profit for Labor

We solve the first-order condition of the operating profit with respect to n ,

$$n^* = \gamma^{\frac{1}{1-\gamma}} w^{\frac{1}{\gamma-1}} e^{\frac{x}{1-\gamma}} k^{\frac{\alpha}{1-\gamma}},$$

then,

$$\begin{aligned} \pi^* &= e^x k^\alpha \left(\gamma^{\frac{1}{1-\gamma}} x^{\frac{1}{1-\gamma}} k^{\frac{\alpha}{1-\gamma}} w^{\frac{1}{\gamma-1}} \right)^\gamma - w \gamma^{\frac{1}{1-\gamma}} e^{\frac{x}{1-\gamma}} k^{\frac{\alpha}{1-\gamma}} w^{\frac{1}{\gamma-1}} \\ &= \frac{1}{k^{\frac{\alpha}{\gamma-1}}} \frac{w^{\frac{\gamma}{\gamma-1}}}{e^{-\frac{x}{1-\gamma}} \gamma^{\frac{\gamma}{\gamma-1}}} - \frac{1}{k^{\frac{\alpha}{\gamma-1}}} \frac{w^{\frac{\gamma}{\gamma-1}}}{e^{-\frac{x}{1-\gamma}} \gamma^{\frac{\gamma}{\gamma-1}}} \\ &= \left(\gamma^{\frac{\gamma}{1-\gamma}} - \gamma^{\frac{1}{1-\gamma}} \right) w^{\frac{\gamma}{\gamma-1}} e^{\frac{x}{1-\gamma}} k^{\frac{\alpha}{1-\gamma}} \\ &= a^* e^{\frac{x}{1-\gamma}} k^{\frac{\alpha}{1-\gamma}}. \end{aligned}$$

B. Computational Algorithm

1. Benchmark Model

We set grids for k , b and x ; real wage $w=1$, with the initial loan price vector Q_b^0 :

1. **Solve Firm's Recursive Problem:** Given w , Q_b^0 , solve the firm problem recursively to obtain k , b , n , and bankruptcy decision rule f as well as the value functions in (1) and (2).
2. **Solve the Firm Distribution:** Given the firm's decision rules and $p(\cdot|\cdot)$, compute the invariant firm distribution μ in (9).
3. **Compute the Loan Price:** Using the firm's decision rules and μ , compute Q_b^1 in (3).
4. If $\|Q_b^1 - Q_b^0\| < \varepsilon_Q$ for a small ε_Q , we set Q_b^1 as the equilibrium loan price Q_b^* and continue to the next step. Otherwise, we update the loan price $Q_b^0 = Q_b^1$

and return to step 1.

5. **Compute Simulated Moments:** Using the firm's decision rules μ , Q_b^* , q and w , compute the simulated moments.
6. **Find λ :** Computing C^* and N^* , find the value of λ in (6).

2. Social Welfare Analysis

We set grids for τ_1 and τ_2 and the initial real wage $w^0 = 1$ and initial loan price vector $Q_b^0 = Q_b^*$, and repeat the following algorithm according to $\tau = (\tau_1, \tau_2)$:

1. **Compute Loan Price w.r.t. τ :** Given Q_b^0 , compute the new loan price vector $Q_b^{\tau_0}$ in (7).
2. **Solve the Firm's Recursive Problem:** Given w^0 , $Q_b^{\tau_0}$, solve the firm problem recursively to obtain k , b , n and the bankruptcy decision rule f as well as the value functions in (1) and (2).
3. **Solve the Firm Distribution:** Given the firm's decision rules and $p(\cdot|\cdot)$, compute the invariant firm distribution μ in (9).
4. **Compute the Loan Price:** Using the firm's decision rules, μ and τ , compute $Q_b^{\tau_1}$ in (7).
5. If $\|Q_b^{\tau_1} - Q_b^{\tau_0}\| < \varepsilon_Q$ for a small ε_Q , we set $Q_b^{\tau_1}$ as the equilibrium loan price $Q_b^{\tau^*}$ and continue to the next step. Otherwise, we update the loan price $Q_b^{\tau_0} = Q_b^{\tau_1}$ and return to step 1.
6. **Compute Real Wage:** Using the firm's decision rules, μ , $Q_b^{\tau^*}$, q and w^0 , compute C^* and N^* , then compute w^1 in (6).
7. If $\|w^1 - w^0\| < \varepsilon_w$ for a small ε_w , we set w^1 the equilibrium real wage w^{τ^*} and continue to the next step. Otherwise, we update the real wage $w^0 = w^1$ and return to step 1.
8. **Compute Tax:** Using μ , b , $Q_b^{\tau^*}$ and Q_b^* from the benchmark model, compute the tax T^* in (8).
9. **Compute Social Welfare and Simulated Moments:** Using the firm's decision rules, μ , $Q_b^{\tau^*}$, q , w^{τ^*} and T^* , compute the social welfare $W^*(\tau)$ in (5) and the simulated moments.

C. Generation of Data Moments

The data used here are provided by FISIS (<http://fisis.fss.or.kr>), KISVALUE or BOK (<https://ecos.bok.or.kr/>).

1. Defaulted Debt/Corporate Debt on Credit

- a. **Defaulted Debt:** [Allowance for bad debts] for all domestic banks from FISIS (<http://fisis.fss.or.kr>)
- b. **Corporate Debt on Credit:** [Corporate loan balance - (Collateralized loan balance - Household collateralized loan balance)] for all domestic banks from FISIS (<http://fisis.fss.or.kr>)
- c. **Defaulted Debt/Corporate Debt on Credit:** Average from 2008 to 2020

2. Net Investment Ratio

- a. **Net Investment:** [Increment of accumulated depreciation for tangible assets + Net increment of tangible assets] from KISVALUE
- b. **Net Investment Ratio for each Firm:** Average of [Net investment/Tangible assets] from 2001 to 2020 for each unlisted non-financial firm audited externally
- c. **Net Investment Ratio:** Average of all net investment ratios

3. Debt/Equity and Standard Deviation

- a. **Debt/Equity for each Firm:** Average of [Total liabilities/Equity] from 2001 to 2020 for each unlisted non-financial firm audited externally from KISVALUE
- b. **Debt/Equity:** Average of Debt/Equity ratios between 0% and 1,000%
- c. **Standard Deviation of Debt/Equity:** Standard deviation of Debt/Equity ratios between 0% and 1,000%

4. Real Interest Rate on Corporate Loans

- a. **Annual Real Interest Rate on Corporate Loans:** [Annual average interest rate on corporate loans - Annual CPI inflation] from the BOK
- b. **Real Interest Rate on Corporate Loans:** Average from 2001 to 2020

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