The Evolution of the Informal Economy in North Korea

Byung-Yeon Kim and Min Jung Kim

This paper uses a survey of North Korean refugees to investigate the evolution of informal economic activities of North Korean households. We find little evidence of increases in informal economic activities in terms of the aggregate participation rate in the informal economy from 1996 to 2009. However, service and manufacturing activities in the informal economy increased during 2005–2009 at the sacrifice of informal agricultural activities. Evidence shows that labor productivity has improved in the informal service sector, whereas the informal manufacturing sector has not experienced increases in productivity. These results imply that expansion of the informal service sector contributes to North Korea's economic growth, but the lack of private property rights constrains the development of manufacturing.

Keywords: North Korea, Informal economic activities, Labor productivity, Propensity score matching model

JEL Classification: J22, J24, O17, P20

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I. Introduction

North Korea's Public Distribution System (PDS) of grain broke down during the so-called "Arduous March" in the mid- and late 1990s. This economic crisis led many households to rely on informal economic activities (IEAs) that had been previously repressed by the North Korean authorities. The authorities decided to tolerate such household activities, without which a considerably worse economic disaster would occur. Consequently, the informal economy in North Korea substantially increased in this period.

The informal economy existed in other socialist countries such as the Soviet Union. The majority of economists maintain that the Soviet informal economy was large (Grossman 1987; Ofer, and Vinokur 1992; Kim 2003). For example, Grossman (1987) estimates that in the late 1970s, private income accounted for 33% of the total income of urban households. By using classified Soviet archival material, Kim (2003) provides annual estimates of the informal economy from 1969 to 1990. The average share of Soviet households' informal expenditure in total expenditure was 23% during the above period. Furthermore, certain economists ascribe the collapse of the Soviet socialist system to IEAs that range from household's private economic activity to bribery and even organized crime (Treml, and Alexeev 1994; Grossman 1998; Solnick 1998; Wintrobe 1998).[1] These debates produced a number of studies on the informal economy in a socialist system.[2]

The emergence of the informal economy in North Korea also elicited considerable research attention. Scholars have not only analyzed the size and determinants of the informal economy, but also its effects on the economy (Lee 2007; Kim, and Song 2008; Haggard, and Noland 2009; Lee 2009; Kim 2009; Kim, and Koh 2011; Kim, and Yang 2012). Most research that uses surveys of North Korean refugees finds that the size of informal economy in the North Korean households is at least 70% in terms of the share of total income as well as labor force participation rate. Therefore, North Korea's informal economy is

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[1] However, Kim (2003) refutes such a claim. By using the Soviet family budget surveys, he finds that the share of informal income (expenditure) out of total income (expenditure) did not grow over time.

[2] As regards the literature on the details of the Soviet informal economy, we refer to Kim (2013).

extremely large with a scale that was not found in any former socialist countries.

Compared with the size of the informal economy, its evolution over time attracted relatively less attention mainly because of the deficiency of the data. This is a significant research gap because the dynamics of the informal economy may have important implications for the future of not only the North Korean economy but also its society. Although studies on this issue have been conducted, their findings are based either on aggregated figures or on some case studies. For example, Kim and Song (2008) find that labor participation rate in plot-related activities or stockbreeding significantly increased from 2002 to 2004, whereas market trading did not during the same period. Kim and Yang (2012) evaluate the effects of different market policies by the North Korean government (*i.e.* appeasement policy *vs.* anti-market policy) on the informal economy, and find little evidence on an increasing trend of the informal economy from 2002 onwards. However, the above studies are based on a simple test of whether significant discrepancies occur in the size of the informal economy between different periods at the aggregated level; that is, the participation rate in the informal economy. As regards case studies on the development of the informal economy, Kim and Yang (2014) report the specialization of IEAs by illustrating diverse cases that include "*suraegi,*" which indicates a manufacturing dealer. By using in-depth interviews of 39 North Korean refugees, Lee *et al.* (2014) assert that markets for consumer goods and services have been expanding. However, these studies are insufficiently rigorous because of the method of analysis based on the small sample.

This study aims to contribute to the literature in two respects. First, we use a large dataset of North Korean refugees settled in South Korea accumulated from 2004 to 2011 to investigate the dynamics of the IEAs in North Korea at the individual level. The surveys were conducted in the four waves of surveys. Thus, we are able to observe the trend of IEAs of North Korean households for a relatively long term. Second, by classifying IEAs into agricultural, service, and manufacturing activities, we evaluate the extent to which IEAs expanded. Moreover, we discuss whether labor productivity has been improved in recent years, particularly in the three sectors of the informal economy.

This paper is organized as follows. Section II provides data description. Section III presents empirical evidence on the evolution of IEAs in North Korea. Section III-A analyzes changes in IEAs using

the probit model. Section III-B tests the robustness of our results using the propensity score matching model. Section III-C provides empirical evidence on the association between diverse IEAs and labor productivity. Section IV summarizes our findings.

II. Informal Economic Activities: Data Description

A. Description on Respondents

We use the data from the four surveys of 1,140 North Korean refugees that were conducted from 2004 to 2011. The surveys were carried out in the form of a gang survey in small groups.[3] The surveys cover a variety of information on economic activities in both the formal and informal sector in North Korea. More specifically, questions on occupation, labor supply, income, and expenditure were asked. In addition, questions on participation and activities in the informal economy were included in all surveys. To control for the possible disruptions in a refugee's living conditions caused by her intention to or actual escape from the country, survey questions were designed to provide information on their economic life one year before their departure.[4]

Table 1 presents descriptive statistics of our dataset. In this survey, 62.7% of the total respondents are women. This composition is similar with the population of North Korean refugees who settled in South Korea by the end of 2011.[5] In this dataset, 41.9% of total respondents left North Korea in the late 1990s or 2000, whereas the proportion of refugees who lived in North Korea by the early and late 2000s is 24.9% and 33.2%, respectively. This distribution of years of residence in North Korea enables us to investigate the dynamics of IEAs in North Korean households. As regards education level, more than half of the total respondents were educated up to secondary school. Given that North

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[3] The first, second, third, and fourth surveys were conducted in 2004–2005, 2007, 2009, and 2011, respectively. The sample size of refugees interviewed in each survey is 675, 115, 227, and 134, respectively. Among 1,152 total refugees, 1,140 refugees who lived in North Korea by the end of 2009 are used.

[4] For example, a North Korean woman who escaped from North Korea in 2011 was asked about her economic status in 2010.

[5] By the end of 2011, 23,106 of North Korean refugees settled in South Korea; 69.0% of total refugees are female. (Ministry of Unification of Republic of Korea, http://www.unikorea.go.kr/content.do?cmsid=1440).

Korea implemented the population census in 2008, we can compare the distribution of education between the population as a whole and our sample. The share of education up to secondary school in the population and sample data is 72.8% and 70.1%, respectively.[6] Hence, we can argue that the distribution of education in our sample is not significantly different from that in the population of North Korea. Our dataset is, however, unlikely to be representative of the North Korean population, especially in terms of regions. Of the refugees, 69.0% resided in Hamkyung Province, which shares a border with China. Although this problem is commonly found in other surveys of North Korean refugees, IEAs would be over-estimated if such activities are more widespread in Hamkyung Province than in the other regions. This requires us to control the proportion of different regions and their changes over time in all regressions.

B. Participation of Informal Economic Activities

In our analysis, we consider the following aspects of the IEAs by North Korean households. First, IEAs are diverse. North Korean people have engaged in private plot-related and stockbreeding activities, particularly at the early stage of the development of IEAs. They also engaged with street vending, transportation services, and repair, among other activities. Manufacturing activities are also practiced, such as production of consumer goods or food. By considering such diverse activities, we categorized the IEAs into the following three types:

[6] We can compare the composition of education between population and sample data as follows:

Education	Source of Data	
	2008 Population Census from DPR Korea[1]	Survey Data[2]
Up to primary school (%)	4.0	4.6
Up to secondary school (%)	72.8	70.1
Up to university (%)	23.2	25.3
Number of observations	13,726,646	174

Note: 1) Source: Central Bureau of Statistics (2009)
　　 2) Refugees who lived in North Korea from 2007 to 2008 are considered because we compare the population census from DPR Korea that was implemented in 2008.

CHARACTERISTICS OF RESPONDENTS

| Characteristics	Persons (unless otherwise specified)	Share (%)
Demographic characteristics		
Men	425	37.3
Women	715	62.7
Age (average)	37.6 years	
Number of family members (average)	3.64	
Regions		
Pyungyang and Pyungahn Province	178	15.6
Hamkyung Province	787	69.0
Hwanghae Province	33	2.9
Kangwon Province	20	1.8
Jagang Province	34	3.0
Yanggang Province	78	6.8
Other	10	0.9
Reference Year[1]		
1996-99	478	41.9
2000-04	284	24.9
2005-09	378	33.2
Education		
Up to primary school	176	15.5
Up to secondary school	669	58.9
Up to university	291	25.6
Sample Size	1,140	100

Note: 1) Reference year denotes a year before his or her departure from North Korea.

agricultural, service, and manufacturing activities.[7] Second, the trend of the informal economy from 1996 to 2009 is considered. Hence, we divide the period into four sub-periods, namely, 1996–2001, 2002–2004, 2005–2006, and 2007–2009. These sub-periods reflect different government attitudes and policies toward IEAs based on previous studies (Kim 2012; Kim, and Yang 2012; Oh 2013; Yang 2010; Lim

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[7] Private plot-related activities or stockbreeding activities are categorized into the agricultural sector. Service activities include street vending, transportation, and smuggling. Manufacturing activities include producing consumer goods such as food, cigarettes, and ice cream, or cottage industries.

2009; Joung 2014). In more detail, the first period from 1996 to 2001 refers to that during which IEAs were tolerated and implicitly allowed. From 2002 to 2004, government policy changed in the direction that the North Korean authorities even encouraged such activities mainly for tax purposes. In particular, the July 1st Measures of Improvement for Economic Management in 2002 resulted in the construction of general markets to allow fee-paying traders to display and sell their goods. However, starting from 2005, the authorities began to impose restrictions on market activities such as setting age limitations and shortening the opening hours of the markets. Anti-market policies were further strengthened from 2007 when Kim Jong-il criticized markets as the habitat of capitalism. Some markets scaled down or even closed. For example, Pyungsung wholesale market, one of the largest wholesale markets in North Korea, closed in June 2009. The currency denomination, which was announced in November 2009, marked the peak of such policies. To sum up, the period from 1996 to 2009 can be divided into the sub-period of implicit permission of market activities from 1996 to 2001, the appeasement period from 2002 to 2004, anti-market policies from 2005 to 2006, and further anti-market policies from 2007 to 2009.

The trends of aggregate participation rates in the formal and the informal economy are demonstrated in Figure 1. The average participation rate in the informal economy is 70.8% from 1996 to 2009, whereas that in the formal economy is 47.7% during the same period. The participation rate in the former has consistently been higher than that in the latter for the entire period. This implies that the high level of participation of households in the informal economy has become
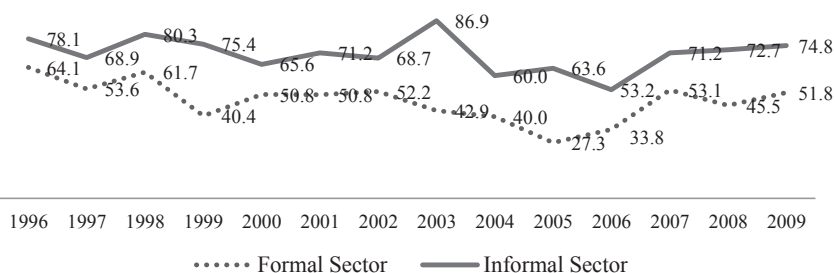
FIGURE 1

ANNUAL PARTICIPATION RATE IN THE FORMAL AND INFORMAL SECTORS BY NORTH KOREAN HOUSEHOLDS
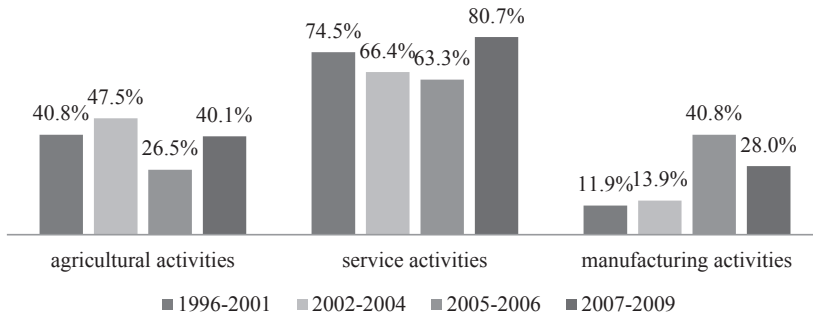
FIGURE 2

AVERAGE LABOR FORCE PARTICIPATION RATES IN THE INFORMAL ECONOMY DURING SUB-PERIODS

a permanent feature of the North Korean economy. However, small sample size particularly for some years and non-representativeness of the sample suggests caution in interpreting these trends.

Figure 2 presents the changes in participation rate in IEAs during the four sub-periods.[8] The most popular IEAs are conducted in the service sector, such as market trading. The share of the participants in the manufacturing sector increased from 11.9% in the first sub-period to 28.0% in the last sub-period. In contrast to the rising trend in manufacturing activities, the participation rate in the agricultural sector reduced from 47.5% in the appeasement period to 37.5% in the period of anti-market policies from 2005 to 2009.

III. Empirical Analysis

A. Changes in Informal Economic Activities: Probit Model

We conduct the following two tests on the evolution of the informal economy. First, we test whether the informal economy quantitatively changed from 1996 to 2009. Second, we aim to identify the qualitative changes of IEAs in North Korea. More specifically, we investigate the effects of different policies on the informal economy implemented in four sub-periods, namely, 1996–2001, 2002–2004, 2005–2006, and

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[8] The three types of informal economic activities are not mutually exclusive. Thus, the summation of all sectors' labor participation rates exceeds 100%.

2007–2009. Throughout all regressions, we examine not only the informal economy in aggregate form but also the three sub-sectors of the informal economy.

Table 2 shows that the aggregate labor participation rate in the informal economy decreased over time. However, when we divide the aggregate IEAs into three sectors (*i.e.* agricultural, service, and manufacturing), we find that labor participation rates in service and manufacturing activities increased over time. This trend is consistently observed in the sub-period model presented in Table 3. In the period from 2005 to 2006, the participation rate in the informal economy decreased compared to the reference sub-period, that is, from 1996 to 2001. However, after categorizing the IEAs into three sectors, we find that service and manufacturing activities measured by participation rate significantly increased in the period from 2005 to 2009, but agricultural activities decreased in the period from 2005 to 2006.[9]

These findings suggest that overall, the share of the informal sector in which North Korean households participate did not grow over time, and even shrank from 2005 to 2006 driven by decreases in agricultural activities. This finding may be interpreted in two ways. The first is that restrictions towards market activities started from 2005 were effective in North Korea. The second interpretation is that increases in grain production and food aid from South Korea in 2005 discouraged households from participating in agricultural activities. Based on the estimate by Rural Development Administration, the amount of available grain which includes both domestic production and aid from South Korea increased by 10.7%; that is, from 5.16 million ton in 2004 to 5.71 million ton in 2005 (Kim, and Lim 2014). Hence, the shortage of grain was the smallest in 2005 among all the years from 2000 to 2009. Concluding which interpretation is valid from the above findings is difficult. However, government policies that restrict market activities in this period targeted mainly trading at markets. As seen below, however, the informal service sector in which market trading operates did not shrink from 2005 to 2006. This result implies that a decrease in the informal agricultural activities in the period from 2005 to 2006 was affected by rises in food availability rather than the direct effects of

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[9] When we merge two periods of anti-market policies and consider three sub-periods, namely 1996–2001, 2002–2004, and 2005–2009, our main findings change little.

government policies.[10]

In contrast to the agricultural sector, we find that participation rate in the informal service and manufacturing sector increased from 2005 to 2009 compared with the reference period of 1996–2001. This finding indicates that the main domain of the informal economy in North Korea has been shifting from agriculture to the service and the manufacturing sector. In addition, multiple jobs holding also increased in the period of 2007–2009. The fact that this evolution took place in the period of anti-market policy suggests that such policy cannot successfully impede the progress of informal economy in the situation in which the planned economic system malfunctions and market demand expands. One reason for such an ineffective government policy was widespread corruption by government officials who overlook market activities by taking bribes from market participants (Kim, and Koh 2011).

The results on various control variables are in line with our expectation. First, we find that the lower the real wage from the formal economy, the greater the increase in the informal labor participation rate, particularly in the service sector. This result implies that certain households participate in the informal service sector for survival. In contrast, the results show that a subjective standard of living is positively associated with participation rate in the service sector. These results are consistent with the findings by Kim and Song (2008), who suggest that both the survival and the profit-taking motive co-exist in the informal sector.[11] Second, women rather than men are associated with informal economic activities such as street vending or handcraft.

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[10] An increase in crop production may discourage households from participating in agricultural activities. Lee *et al.* (2013) suggest an increase in grain production as one of the major reasons of stability in rice prices in North Korea in the period from 2005 to 2007.

[11] Kim and Song (2008) explain various possibilities for these contrasting results. First, this result may be plagued by the endogeneity of the variable of rank. The income of an individual would increase if he or she works in the informal sector, which causes the positive correlation between rank and informal economy participation. Other interpretation is that motives for IEAs have been changing from mere survival to exploiting opportunities over time, and the negative coefficient on real wages refers to the survival motive, whereas the positive one on subjective rank reflects the profit motive. Another possibility is that respondents over-reported their subjective standard of living even though they were objectively poorer in North Korea.

<div align="center">TABLE 2</div>

<div align="center">TRENDS OF PARTICIPATION IN THE INFORMAL ECONOMY</div>

	(1)	(2)	(3)	(4)	(5)
	Aggregate	Agricultural	Service	Manufac- turing	Multiple Jobs
Trend (t)	-0.020*	0.009	0.019*	0.057***	0.014
	(-1.778)	(0.832)	(1.770)	(4.207)	(1.217)
Job in the formal economy (=1)	-0.030	0.075	0.146	-0.127	0.119
	(-0.251)	(0.673)	(1.275)	(-0.939)	(1.035)
Real wage from formal economy (log)	-0.077***	-0.007	-0.060***	-0.018	-0.024
	(-4.661)	(-0.418)	(-3.730)	(-0.857)	(-1.401)
Subjective rank of living	0.098**	0.035	0.119***	-0.099*	0.077*
	(2.313)	(0.858)	(2.948)	(-1.951)	(1.770)
Gender (male=1)	-0.179**	-0.017	-0.388***	-0.423***	-0.313***
	(-1.961)	(-0.191)	(-4.363)	(-3.469)	(-3.187)
Age	0.117***	-0.005	0.071***	0.085***	0.047**
	(5.563)	(-0.227)	(3.653)	(3.326)	(2.218)
Age squared	-0.001***	0.000	-0.001***	-0.001***	-0.000*
	(-4.256)	(1.310)	(-3.671)	(-2.939)	(-1.774)
Number of family members	0.009	0.058**	0.017	0.046	0.028
	(0.325)	(2.035)	(0.608)	(1.341)	(0.963)
Edu. (Secondary=1)	-0.132	-0.283**	0.172	0.080	-0.107
	(-1.029)	(-2.400)	(1.475)	(0.516)	(-0.845)
Edu. (University=1)	-0.216	-0.367***	0.043	0.048	-0.155
	(-1.475)	(-2.700)	(0.321)	(0.272)	(-1.069)
Regional dummies	Yes	Yes	Yes	Yes	Yes
# of Observations	1,090	1,092	1,073	1,092	1,092
Pseudo R^2	0.102	0.0446	0.0637	0.0853	0.0287

Note: Z-value is reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively.

Third, the labor participation rate in the agricultural sector significantly increases as the number of family members increase and level of education decreases. This finding can be understood from the fact that agricultural activities such as private plot-related or stockbreeding activities may need the cooperation of family members and require

TABLE 3

PARTICIPATION IN THE INFORMAL ECONOMY DURING SUB-PERIODS

	(1)	(2)	(3)	(4)	(5)
	Aggregate	Agricultural	Service	Manufac-turing	Multiple Jobs
Appeasement time (02-04)	0.195 (1.420)	0.194 (1.578)	-0.046 (-0.382)	0.149 (0.920)	0.039 (0.292)
Anti-market policies (05-06)	-0.657*** (-3.991)	-0.460** (-2.417)	0.362** (2.077)	0.516*** (2.812)	-0.308 (-1.605)
Further anti-market policies (07-09)	-0.122 (-0.971)	0.141 (1.193)	0.276** (2.252)	0.643*** (4.560)	0.250** (2.059)
Job in the formal economy (=1)	-0.047 (-0.391)	0.057 (0.509)	0.136 (1.183)	-0.144 (-1.060)	0.099 (0.855)
Real wage from formal economy (*log*)	-0.079*** (-4.727)	-0.007 (-0.419)	-0.057*** (-3.553)	-0.014 (-0.680)	-0.022 (-1.332)
Subjective rank of living	0.096** (2.249)	0.038 (0.906)	0.116*** (2.885)	-0.099* (-1.957)	0.078* (1.789)
Gender (male=1)	-0.206** (-2.245)	-0.024 (-0.267)	-0.385*** (-4.321)	-0.430*** (-3.497)	-0.326*** (-3.311)
Age	0.117*** (5.496)	-0.007 (-0.347)	0.072*** (3.722)	0.083*** (3.268)	0.045** (2.124)
Age squared	-0.001*** (-4.206)	0.000 (1.402)	-0.001*** (-3.710)	-0.001*** (-2.854)	-0.000* (-1.686)
Number of family members	0.024 (0.814)	0.063** (2.219)	0.010 (0.368)	0.035 (1.002)	0.028 (0.950)
Edu. (Secondary=1)	-0.073 (-0.559)	-0.239** (-2.002)	0.135 (1.144)	0.044 (0.279)	-0.100 (-0.780)
Edu. (University=1)	-0.196 (-1.321)	-0.360*** (-2.622)	0.026 (0.197)	0.022 (0.124)	-0.168 (-1.152)
Regional dummies	Yes	Yes	Yes	Yes	Yes
# of Observations	1,090	1,092	1,073	1,092	1,092
Pseudo R^2	0.115	0.0536	0.0678	0.0907	0.0357

Note: Z-value is reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent level, respectively.

relatively low levels of education compared to other activities.

B. Robustness test: Propensity Score Matching (PSM) Model

One possible bias that can affect previous regression results is that the demographics of the respondents are not the same across the different years. In other words, addressing the sample selection bias is necessary as the characteristics of respondents in the earlier surveys are significantly different from those in the later surveys. If the changes in the informal economy are attributed to the different propensities caused by dissimilar groups of the respondents, findings from this sample will be biased. We mitigate such a sample selection bias by using propensity score matching (PSM) model and show the average difference of IEAs between similar pairs of refugees but belonging to different escape year from North Korea.[12] The treatment group refers to the latest refugees who lived in North Korea from 2005 to 2009, whereas refugees who lived in North Korea from 1996 to 2004 are regarded as the control group.

The main feature of the matching procedure is the creation of the conditions of a randomized experiment, thereby evaluating a causal effect as in a controlled experiment. Thus, we need the conditional independence assumption (CIA), which states that treatment is random and uncorrelated with outcome, once selected observable characteristics are controlled for. Based on CIA, the treatment effect could be estimated with matching estimators on selected observable characteristics. Another condition that we need to impose is that the propensity score is bounded away from 0 and 1, that is, the common support condition. The common support condition that drop treatment observations whose p-score is higher than maximum or less than the minimum p-score of the controls is imposed in all regressions. In addition, the balancing property is set and satisfied in all regressions at 1% significance level. Based on CIA and common support condition, we may well specify the propensity scores for treatment variables and the treatment effect is estimated non-parametrically. That is, the treated groups were matched with non-treated groups on the basis of p-scores and the average

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[12] We perform PSM using the STATA command 'psmatch2,' which is commonly applied. Leuven and Sianesi (2003) provide the program *psmatch2* for implementing different types of matching estimators including covariate and propensity score matching. Furthermore, this program includes routines for common support graphing and covariate imbalance testing. Standard errors are obtained via bootstrapping methods.

TABLE 4

ESTIMATION OF PROPENSITY SCORE

Variable	Coefficient	Z-value
Job from Formal	0.314***	(2.63)
Real Wage from Formal	-0.114***	(-6.42)
Subjective rank of living	0.237***	(5.30)
Gender	-0.068	(-0.69)
Age	-0.019***	(-4.50)
Edu. (Secondary=1)	0.999***	(6.23)
Edu. (University=1)	0.578***	(3.27)
Pyungyang and Pyungahn	-0.267	(-0.52)
Hamkyung	-1.507***	(-2.97)
Hwanghae	-0.583	(-1.05)
Kangwon	-1.319***	(-2.22)
Jagang	0.732	(1.22)
Yanggang	0.052	(0.10)
Observations	1,105	
Pseudo R^2	0.2735	

Note: Dependent Variable is dummy variable that indicates refugees who escape
    from North Korea in the period from 2005 to 2009. Two variables of age
    of squared term and the number of family members, of which statistical
    significance is low, are excluded in the estimation to satisfy the balancing
    properties. Z-value is reported in parentheses. *, **, and *** denote
    significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

treatment effect was calculated as the mean difference in outcome of
the two groups.

Results of probit formulations of the propensity score are reported in
Table 4. Respondents who were working in the formal economy, were
educated more than secondary level, and were fairly content with their
economic life in North Korea are more likely to escape from North Korea
in the period from 2005 to 2009 compared to the period from 1996 to
2004. By contrast, latest refugees are shown to be younger and earned
lower income from formal economy. As regards residential region,
refugees who lived in Hamkyung or Kangwon Province were more likely
to escape from North Korea in the past (*i.e.* 1996–2004) than in recent
years (*i.e.* 2005–2009).

Figure 3 confirms that the overall matching performance is good,
because the bias of all the covariates between treated and control
groups is around zero in the matched sample, contrary to the
unmatched sample. As suggested by Appendix Table 1, the differences
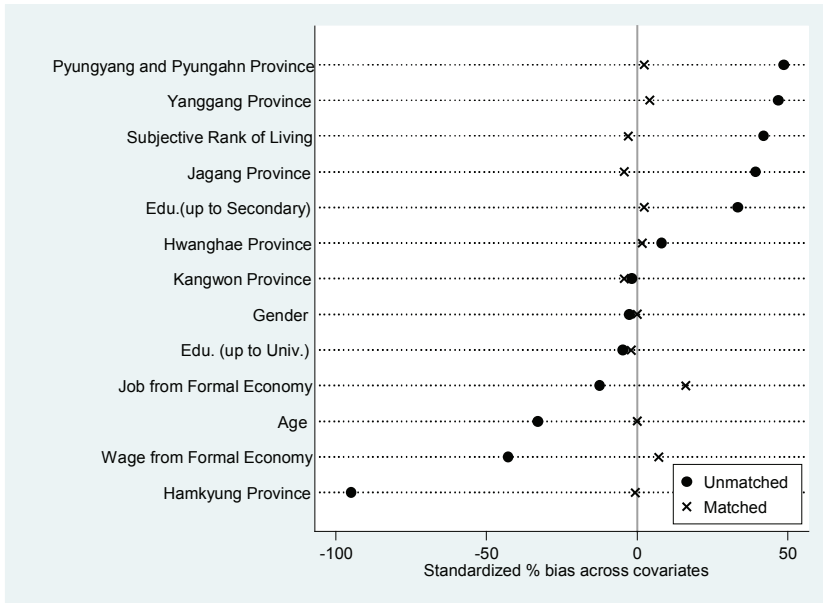
Bias across Covariates between Matched and Unmatched Sample

between control and treatment group for all the variables are not statistically significant after matching, whereas some variables are significantly different between each group before the matching. Particularly, we cannot reject the LR test, a joint test of quality of balancing, for the matched sample. That is, the matched sample appears well-balanced because the means of each covariate do not differ between treated and control units.

Table 5 shows the average treatment effect for the treated (ATT) based on three different matching estimators, that is, the nearest neighbor (NN), kernel-based, and radius matching methods. After matching the sample, we found no significant difference in participation rate in the informal agricultural sector between the treated and the control group, whereas the average treatment effect for the treated (ATT) in the service and manufacturing sector are positively significant. This result suggests that participation rate in the informal service and manufacturing sectors increased in the period from 2005 to 2009 compared to the period from 1996 to 2004. By contrast, agricultural activities were

TABLE 5

AVERAGE TREATMENT EFFECT FOR THE TREATED (ATT) BASED ON DIFFERENT
MATCHING ESTIMATORS

Dependent Variable	(1) NN	(2) Kernel[a]	(3) Radius
Agricultural	-0.085	-0.042	-0.026
	(-1.514)	(-1.040)	(-0.850)
Service	0.143***	0.068*	0.105***
	(2.403)	(1.653)	(3.386)
Manufacturing	0.136***	0.115***	0.119***
	(3.405)	(3.195)	(4.643)
Balancing Property Satisfied	Yes	Yes	Yes
Common Support Imposed	Yes	Yes	Yes
Observations			
Treated	362	362	343
Controls	201	656	656

Note: t-statistics is reported in parentheses. [a] denotes bootstrapped t-statistics. *,
     , and * denote significance at the 10 percent, 5 percent, and 1 percent
     level, respectively.

stagnant in the period from 2005 to 2009 compared to the period
from 1996 to 2004. Hence, we can conclude that qualitative changes
occur in IEAs in North Korea from 2005 to 2009 such that households
participate more actively in the informal service and manufacturing
sector despite anti-market policies by the North Korean government.

C. Productivity in the Informal Economic Activities

An interesting question is whether increases in IEAs are accompanied
with rises in productivity. If so, the North Korean economy will
experience positive growth in accordance with the advancement of the
informal economy. We use labor productivity measured by log of hourly
wage as a dependent variable.[13,14] The estimation methods include Tobit

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[13] We converted nominal income to real income by deflating the former using
the consumer price index from 1996 to 2009. The annual consumer price index
is presented in the Appendix Table 2.

[14] Our survey data set contain the information on average working hours in
a week. We calculate the hourly wage from the informal sector by dividing the
weekly income by weekly working hours. Given that questions about weekly

TABLE 6
PRODUCTIVITY IN THE INFORMAL ECONOMIC ACTIVITIES

	OLS	Tobit
	(1)	(2)
Agricultural Activities	0.091	0.100
	(1.358)	(1.335)
Service Activities	0.134*	0.158**
	(1.933)	(2.054)
Manufacturing Activities	0.062	0.070
	(0.938)	(0.965)
Multiple Jobs	-0.125	-0.149
	(-1.476)	(-1.572)
Job in the formal economy (=1)	0.048	0.040
	(1.192)	(0.881)
Real wage from formal economy (*log*)	0.001	-0.000
	(0.166)	(-0.059)
Subjective rank of living	0.078***	0.087***
	(4.253)	(4.270)
Gender (male=1)	0.007	0.020
	(0.176)	(0.464)
Age	-0.001	0.001
	(-0.136)	(0.089)
Age squared	0.000	-0.000
	(0.114)	(-0.151)
Number of family members	-0.012	-0.013
	(-0.879)	(-0.868)
Edu. (secondary=1)	0.066	0.070
	(0.843)	(0.797)
Edu. (University=1)	0.031	0.018
	(0.381)	(0.199)
Regional dummies	Yes	Yes
Time dummies	Yes	Yes
Number of Observations	269	269
R^2	0.182	0.296

Note: Dependent variable is labor productivity, measured by hourly income. Model (1) is estimated via OLS, whereas Model (2) shows the results based on Tobit estimation. T-value is reported in parentheses. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

working hours are not asked in the first survey, we use the survey data from the second to fourth surveys in this analysis.

as well because the data on labor productivity are censored for those whose informal income is zero.

Table 6 presents the relationship between labor productivity and different IEAs. The results suggest a positive correlation between productivity and participation in the informal service sector. On the basis of the results in column (2), labor productivity rises by 15.8 percent if one participates in the informal service sector. This finding has the following implications for the North Korean economy. First, the informal service sector provides opportunities for households to become better off compared to other economic activities including formal work, informal manufacturing, and informal agricultural activities. Second, the shift of working from other areas to the service sector may contribute to increases in labor productivity and thus economic growth. This finding can be understood from the structure of the socialist economy where the service industry has been repressed. The service sector can develop rapidly because of the ample opportunities to meet demand.[15] Third, unlike the service sector, the manufacturing sector fails to contribute to growth. The informal manufacturing sector is likely to be at the primitive stage of development partially because manufacturing requires investment in fixed capital; however, without property rights, such investments would be difficult to make.

IV. Conclusion

This study uses the four waves of the surveys of 1,140 North Korean refugees from 2004 to 2011 to analyze the dynamics of the informal economy in North Korea. The fact that their final year of residence in North Korea was different enables us to identify changes in the IEAs of households for a relatively long-term period. This paper classifies IEAs into three types; agricultural, service, and manufacturing activities, and then divides the period of 1996–2009 into four sub-periods based on North Korea's different policies toward the informal economy, namely, implicit permission of market activities (1996–2001), appeasement period (2002–2004), anti-market policies (2005–2006), and further anti-

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[15] The literature suggests that the service sector may induce economic development in developing as well as transition countries (Ghani 2010; Ghani, and Kharas 2010; McMillan, and Harttgen 2014; Noland *et al.* 2012; Park, and Shin 2012; Easterly *et al.* 1994).

market policies (2007–2009).

The main findings of this research can be summarized as follows. First, little evidence exists on increases in IEAs in terms of the aggregate participation rate in the informal economy from 1996 to 2009. Given the expanding nature of the informal economy, this finding can be interpreted as evidence of the effectiveness of anti-market policy implemented from 2005 to 2009. However, the finding that only informal agricultural activities were negatively affected by such policy implies that IEAs are firmly rooted in the economy as major means of survival and business. Second, service and the manufacturing activities in the informal economy increase during 2005–2009 despite anti-market policies. One possible explanation is widespread corruption of bureaucrats who receive bribes from participants in markets (Kim, and Koh 2011). Third, labor productivity is improved in the service sector, such as market trading, transportation service, and repair. This result implies that the expansion of the informal service sector contributes to North Korea's economic growth. However, our finding that rise in productivity was not observed in other areas especially in the manufacturing sector implies a lack of private property rights as a source of constraining development of manufacturing.

Appendix

APPENDIX TABLE 1
TEST FOR BALANCING AFTER MATCHING

Variable	Sample (U or M)	Mean		% reduct		t-test	
		Treated	Control	% bias	|bias|	t	p>|t|
Job from Formal	U	0.4751	0.5370	-12.4		-1.93	0.053
	M	0.4714	0.3914	16.0	-29.3	2.14	0.033
Wage from Formal	U	1.5910	2.9909	-42.7		-6.49	0.000
	M	1.6275	1.3930	7.2	83.2	1.06	0.287
Subjective rank of living	U	2.9475	2.5168	42.0		6.41	0.000
	M	2.9286	2.9600	-3.1	92.7	-0.41	0.683
Gender	U	0.3619	0.3742	-2.5		-0.40	0.692
	M	0.3657	0.3657	0.0	100.0	0.00	1.000
Age	U	34.9610	38.7250	-32.9		-5.09	0.000
	M	35.2370	35.2310	0.0	99.8	0.01	0.994
Edu. (Secondary=1)	U	0.6961	0.5357	33.4		5.14	0.000
	M	0.6971	0.6857	2.4	92.9	0.33	0.744
Edu. (University=1)	U	0.2431	0.2638	-4.8		-0.74	0.460
	M	0.2400	0.2486	-2.0	58.6	-0.26	0.792
Pyungyang and Pyungahn	U	0.2845	0.0983	48.7		8.17	0.000
	M	0.2943	0.2857	2.2	95.4	0.25	0.803
Hamkyung	U	0.4116	0.8277	-94.8		-15.50	0.000
	M	0.4257	0.4286	-0.7	99.3	-0.08	0.939
Hwanghae	U	0.0387	0.0242	8.3		1.34	0.179
	M	0.0400	0.0371	1.6	80.2	0.20	0.845
Kangwon	U	0.0166	0.0188	-1.7		-0.27	0.791
	M	0.0171	0.0229	-4.3	-152.0	-0.54	0.590
Jagang	U	0.0829	0.0040	39.4		7.40	0.000
	M	0.0543	0.0629	-4.3	89.1	-0.48	0.630
Yanggang	U	0.1519	0.0229	46.9		8.41	0.000
	M	0.1543	0.1429	4.2	91.1	0.42	0.671

Sample	Ps R^2	LR chi^2	p>chi^2	MeanBias	MedBias	B	R	%Var
Unmatched	0.274	382.35	0.000	31.6	33.4	136.5*	1.37	54
Matched	0.006	5.94	0.948	3.7	2.4	18.4	0.82	23

APPENDIX TABLE 2
ESTIMATED CONSUMER PRICE INDEX BASED ON PRICES OF PORK (NORTH KOREAN WON)

Year	1996	1997	1998	1999	2000	2001	2002
CPI	100.00	109.73	110.75	153.25	108.55	126.89	184.60
Year	2003	2004	2005	2006	2007	2008	2009
CPI	561.42	1503.98	1530.54	1766.27	3515.93	3458.67	3708.63

Note: Corn and rice are the most important food items for North Korean households. However, constructing the consumer price index of North Korea according to the market prices of these items may yield inaccurate estimations because the prices for such goods are heavily affected by international aid. In other words, constructing a consumer price index according to both prices will underestimate a true price index because rice and corn are supplied partially by foreign governments and international aid organizations. Therefore, we use pork price to represent the prices of other goods and services that are unaffected by international aid.

Sources: For price of pork between 1996 and 1997, information was gathered from our surveys of North Korean refugees that were conducted in 2004–2005, 2007, 2009, and 2011. From 1998 to 2001, the data from the South Korean government provided by Lee (2006) are used. The data from our survey are used for the period from 2002 to 2007. Lastly, the weekly and bi-weekly prices in 2008 and 2009 were obtained from NK daily, a South Korean NGO, and averaged for the respective year.

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