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Trade and Wage Inequality in the Indonesian Manufacturing Sector with Firm Heterogeneity and the Impact of Currency Depreciation during the Periods 1997–1998 and 2013–2014

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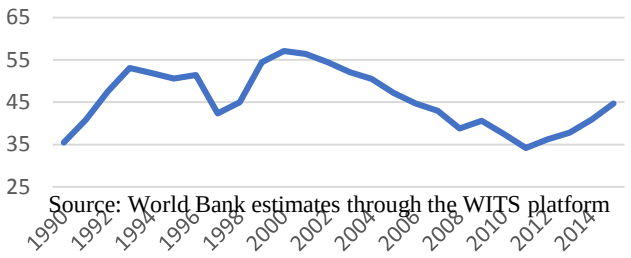
***Abstract*—This study follows Verhoogen (2008) to explore the issue of trade and wage inequality from the perspective of firm heterogeneity and the impact of currency depreciation in Indonesia. The twofold objective of this study is first, to examine whether higher firm entrepreneurial ability leads to better outcome of export shares; white-collar wages; blue-collar wages; the wage ratio; and the share of white-collar workers; and second to understand whether entrepreneurial ability leads to a greater change in the optimization level over time, especially during currency-depreciation periods. This study employs Indonesian manufacturing survey data of 1996 and 2012 in an OLS econometric model. The results show that first, firms that are more productive or more entrepreneurial are more export oriented, have higher wage disparity, and have a higher proportion of white-collar employees. Second, the changes in export and wage disparity during the currency-depreciation periods of 1997-1998 and 2013-2014 show that firms were unable to take advantage of the depreciation to boost their export share. Although firm entrepreneurial ability can explain the greater wage disparity during the two depreciation periods (compared with "normal" periods), it is unclear whether this was driven by quality enhancement or better strategies.**

Keywords: export, inequality, manufacturing sector, trade, trade, inequality

I. INTRODUCTION

In the past two decades, Indonesia has experienced two major currency-depreciation periods: the 1997-1999 Asian Financial Crisis and the 2008 Global Financial Crisis, and the 2013-2015 "Taper Tantrum" period. These periods of depreciation affected the balance of trade. As can be seen from Figure 1, manufacturing exports as a share of total exports increased, which means that manufacturing exports were more responsive to changes in rupiah value. Export intensity in the Indonesian economy peaked in 1998 with an export-to-GDP ratio of 53% amidst a severe economic and political crisis (Figure 1). The share of manufacturing in total exports also peaked in the same period, reaching 57.12% by 2000. A study by Rosner [1] found that Indonesian manufacturing exports outperformed other sectors during the 1997-1998 crisis and its aftermath. After decreasing from 2000, the manufacturing export share began climbing in 2012 even after the rupiah fell to a 15-year low in 2013 - 2015. This unique response of the manufacturing sector affected wage disparity during those periods.

Amiti & Cameron [2] and Takii & Narjoko [3] provided empirical evidence to show the impact of tariff liberalization (especially on input goods) on wage disparity in Indonesia. A 10% reduction in intermediate input tariff reduced the wage skill premium by 10% in the importing firms. By modifying the method of Feenstra & Hanson [4], it has been found that foreign-owned firms substituted skilled workers with a larger import share. On the other hand, employment of skilled workers increased in local firms or firms that imported less, increasing their skill intensity. However, wage equalization can also be caused by an increase in the supply of skilled workers. Meanwhile, theory suggests that trade's impact on wage inequality depends more on internal firm conditions, rather than on a causal relationship between trade and wage inequality and can be affected by external macroeconomic pressures. Internal firm conditions can be explained by their productivity parameters, defined by their entrepreneurial ability or the ability to innovate or produce higher quality products efficiently. To successfully enter the export market, a firm must exceed a certain level of productivity. On the other hand, external macroeconomic pressures can change the firm's optimization level in export shares, wages, and skills composition. Firms with sound entrepreneurial ability respond better to macroeconomic pressure and can even use it as an opportunity for business expansion.



Source: World Bank estimates through the WITS platform

Fig. 1. Manufacturing Exports as a % of Total Merchandise Exports.

For example, with currency depreciation a firm can export more, yet it needs better strategies, or it must sell higher quality products. This leads to an increasing demand for white-collar workers and raises their premium. Verhoogen [5] gave the example of Mexican manufacturing industry during the 1990s Peso crisis.

During the 1997 - 1998 Asian financial crisis, the rupiah depreciated by 525% from 1997 to 1998, contracting the economy by 13.1%. The rupiah was released from its band of intervention and became a floating exchange rate by August 1997, depreciating uncontrollably thereafter, exacerbated by speculation attacks (similar to the Mexican Peso crisis, although on a bigger scale). During the global financial crisis of 2007/2008, although the Indonesian was relatively better off than other economies, the rupiah depreciated by 31% and economic growth slowed from 7.4% in 2007 to 4.7% in 2008 with a quick recovery of the currency and economic growth in just one year, until the rupiah began to crumble and hit a 15-year low in 2013. By this time, the US Federal Reserve had announced its plan to raise the interest rate and halted its quantitative easing process as the US economy began to recover from the crisis. As a result, capital flowed out of emerging markets and Indonesia was among the countries that were worst affected as most of the foreign investment comes in the form of portfolio investment. The rupiah began to appreciate only by the third quarter of 2015. The two depreciation periods of 1997-1998 and 2013-2014 are interesting to look at, given their relative length, which allowed firms to conduct quality enhancements that could result in higher exports and wage disparities.

This study examines whether differences in exports and wage disparity in Indonesia can be explained by firm heterogeneity in entrepreneurial ability, as in Verhoogen [5]. Trade and wage inequality are both seen as products of firm productivity or entrepreneurial ability and move in parallel directions. The advent of currency depreciation amplifies the effect of firm heterogeneity, when it is hypothesized that throughout the period of currency depreciation, firms become more export oriented and see the wage disparity increasing. Thus, the increases in export shares, wages, and wage disparity must be larger during currency depreciation periods compared with other periods. Did Indonesian manufacturers experience an increase in their export participation and wage inequality during the depreciation periods of 1997-1998 and 2013-2014, especially those with higher productivity or entrepreneurial ability?

II. Theory and Previous Empirical Evidence

In Eric Verhoogen's paper, "Trade, Quality Upgrading, and Wage Inequality in the Mexican Manufacturing Sector" [5], firms are assumed to be heterogenous in their productivity and face a fixed cost to enter export markets (implying only more productive firms can export). Quality and consumer preferences (including willingness to pay) differ across countries with consumers in developed countries demanding higher quality products. Thus, export goods have a higher quality than goods sold for domestic consumption in developing countries. Firms are also assumed to need more high-skilled workers for each occupation to produce goods of higher quality. This means more productive firms faced higher wages, because of a greater skill premium.

There are three underlying elements in Verhoogen [5]'s theory: consumer demand, production, and firm optimization. Let us assume there are two countries, North (developed) and South (developing), facing the same consumer utility function. Consumers in North have more sophisticated demands and a higher willingness to pay because of their higher income. When there are two goods with the same price, consumers will choose the one with better quality, which is the one that brings higher utility.

In each country, there is a continuum of potential entrepreneurs with heterogenous productivity. Product quality depends on worker quality, machine sophistication, and entrepreneurial ability. The quality of the good follows a Cobb-Douglas function, so it depends on the amount of capital and the quality of workers, with decreasing returns to scale. The quality of each worker depends on his or her wages relative to average wages outside the labor market.

The higher the firm's entrepreneurial ability λ, the higher are the wages (especially for white-collar workers), capital intensity, and prices. In both the domestic and the export market, a firm faces higher willingness to pay the from North, which increases the product quality, wages, capital intensity, and prices. On the other hand, the wage of high-skilled workers relative to low-skilled workers depends on how sensitive the product quality is to the quality of each worker.

To enter a market (domestic or export), every firm faces a cut-off value for each destination λ_d^{min} where d is the destination. The level of λ_d^{min} is determined by the additional firm entering the market earning 0 profit after paying a "fixed cost" to enter the destination market. The cost to enter the domestic market is assumed to be smaller than the cost to export ($\lambda_s^{min} < \lambda_n^{min}$) in the South While $q_d^*(\lambda)$ is increasing in λ for both markets, the quality for the export market $q_n^*(\lambda)$ is always higher than quality for the domestic market $q_s^*(\lambda)$, with $\overline{q}^*(\lambda)$ being the average quality for both countries. The solid line in Figure 2 shows the quality trajectory of a firm when λ increases. The firm starts to produce for the domestic market once its productivity passes λ_s^{min} and for both markets after λ_n^{min} (as shown by the jagged trajectory) is reached. The export

share, high-skilled labor wage, low-skilled labor wage, capital intensity, and price run parallel with the quality trajectory.

Gabszewicz *et al.* [6] provides the theoretical framework for explaining the effect of increasing exposure to competition on firm survival. Competition between rival producers can reduce the price of higher quality products until low-quality products are driven out of the market, assuming the price of the higher quality product is low enough for consumers to choose them over the low-quality alternatives even when the alternative has a zero price. When separate economies are combined into a common market, some products may disappear from the market. It can be stated that in international trade (since the market is not fully integrated), only goods with better quality can compete in the export market (which can be viewed as the "combined economy") while lower quality products stay in the domestic market or even disappear because of competition from imports.

When the currency of the South depreciates, goods from the South become cheaper in the North, thus increasing North's purchasing power δ_n or its real exchange rate. As the purchasing power in the South decreases, its consumer base N_s narrows, thus increasing the barriers to entry in the domestic market λ_s^{min}. However, firms in the South now face lower barriers to entry in the export market λ_n^{min}. Meanwhile, currency depreciation/devaluation reduces the quality cost relative to the demand N_s, increasing quality for the export market $q_n^*(\lambda)$ for the same demand and the average quality for both the domestic and the foreign market $\overline{q}^*(\lambda)$.

The increasing λ_s^{min} induces some of the least productive firms to exit the market while the lowering of barriers to entry in export market leads to more firms becoming exporters. The light solid trajectory in figure 2 shows that combined with higher average quality, firms that start to export during the period of depreciation/devaluation experience the highest increase in quality compared with firms that are initially exporters, and hence see the biggest increases in wages and capital intensity.

In the Mexican case studied in Verhoogen [5], the differences in export share, wage ratio, white-collar (high-skilled) wages, blue-collar (low-skilled) wages, and capital intensity are positively correlated with the productivity/ entrepreneurial ability proxy within industries. The study then compares the changes in firm optimization (export share, wage ratio, wages, white-collar employment share, and capital intensity) during the 1993 - 1997 Peso devaluation period and the changes in firm optimizations during the "normal" period of 1997 - 2001. The coefficient for log domestic sales is significantly larger in the devaluation period for export share and wage ratio.

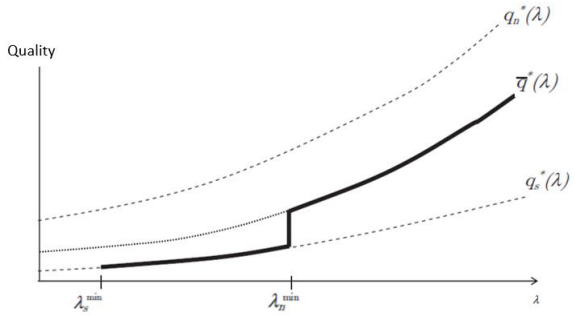


Fig. 2. The relationship between productivity, quality, and the effect of becoming an exporter.

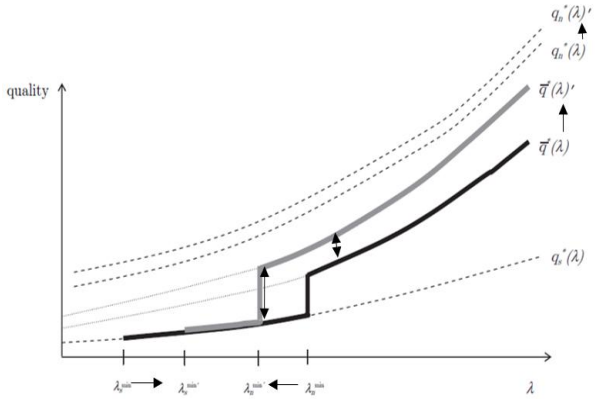


Fig. 3. The relationship between firm productivity, product quality, and the effect of entering an export market during currency depreciation/devaluation.

Every 10% increment in log domestic sales is associated with a 0.72% greater wage increase for white-collar workers during the devaluation period but only a 0.16% increase during the normal period, thus increasing the wage ratio. The result is also consistent for the 1986-1989 depreciation period.

III. RESEARCH METHODOLOGY

This study addresses two research questions: one, whether higher firm entrepreneurial ability leads to higher outcomes for export share, white-collar wage, blue-collar wage, the wage ratio, and the share of white-collar workers. Two, whether higher entrepreneurial ability leads to a bigger change in the optimization level over time, especially during currency depreciation periods. The changes in outcome variables depend on the initial entrepreneurial ability in the period and whether they respond to a crisis better. The effect of the entrepreneurial ability on the dependent variables must be larger during depreciation periods. The OLS econometric models used in this study are as follows:

Equation 1 (first research question): $y_{ijr} = \beta_0 + \tilde{\lambda}_{ijr}\beta_1 + \psi_j + \xi_r + u_{ijr}$

Equation 2 (second research question): $\Delta y_{ijr\ t,t+n} = \beta_0 + \tilde{\lambda}_{ijr\ t}\beta_{1\ t,t+n} + \psi_{j\ t} + \xi_{r\ t} + u_{ijr}$

Here, the independent variables for both equations are β_0 as the constant term; $\tilde{\lambda}_{ijr}$ as the firm entrepreneurial ability proxy with β_1 as the coefficient; and $\psi_{j\ t}$ and $\xi_{r\ t}$ as province and KBLI 4-digit industry fixed effect, respectively. The dependent variable for the first equation is the optimization level in the same year as the observed entrepreneurial ability. For the second equation, the dependent variable is the change over time between the optimization level in the first year (when the entrepreneurial proxy is observed) and the last year of each period.

There five dependent variables of optimization levels are:

Export share of production: More productive firms have a higher export share and see a bigger increase in their share of sales to the export market over time.

White-collar labor wage (non-production wage) as a proxy for high-skilled workers: Owing to data limitations, white-collar wage is proxied by average (annual) non-production wage.

Blue-collar labor wage (production wage) as a proxy for low-skilled workers: The average (annual) wage of production workers is used as a proxy for the blue-collar labor wage.

Wage ratio of white- to blue-collar wage: Over time, increases in white-collar wage is bigger in more productive firms during depreciation periods; hence, they have a higher wage ratio.

White-collar/non-production employment share: Higher entrepreneurial ability ensures a better export strategy and product design. The emphasis is more on non-production activities.

Following Verhoogen [5], we proxy entrepreneurial ability by the log (real) domestic-sales, deviated from its 5-digit KBLI industry mean. The main argument for this proxy is that sales is the only variable that is observed separately by the production line. In cross section data, domestic sales have a smooth, continuous relationship with λ, without the discontinuity at the cutoff λ_{min} level for entry into the export market. However, as domestic sales appear in the denominator of the export share, this can create bias and thus is not the best estimator for the variable. To address this problem, log TFP and log employment are used as the alternative proxies.

To control for the effect of imported materials and foreign ownership, the share of imported material and a dummy for foreign ownership variables are added in both models and presented separately. The imported material share is transformed into changes over time and lagged by one year while the value of foreign ownership dummy is taken at the initial year of every period. Lal & Lowinger [7] found that the trade balance in Indonesia deteriorates immediately after currency depreciation and improves after four quarters because of a high reliance on imported input materials.

We use the Annual Manufacturing Industry Survey datasets published by the Indonesian Statistics Agency (BPS) for our model. We use the 1996 and 2016 data to analyze the first research question. For the second research question, we use two unbalanced panel datasets: 1993–1999 and 2010–2014. The 1993–1999 panel is divided into two three-year periods (1993–1996 and 1996–1999), while the 2010–2014 panel is divided into two, two-year periods (2010–2012 and 2012–2014). Both the 1996–1999 and 2012–2014 depreciation periods are compared with the preceding "normal" periods (1993–1996 and 2010–2012).

IV. RESULTS & DISCUSSION

4.1. Firm Entrepreneurial Ability and Optimization Level

It is hypothesized that a higher level of entrepreneurial ability correlates with more exports. However, the OLS regression analysis yields an ambiguous result as seen by the different coefficient signs. The log domestic sales proxy has a statistically significant negative sign for both the 2012 and 1996 data. This problem is addressed by using other proxies, total factor productivity (TFP) and employment, for entrepreneurial ability (Table I). The coefficients for both proxies are positive in both 2012 and 1996 with a higher coefficient for log employment than TFP (see Table I). This indicates that exports are generally more labor intensive. However, since 76% firms in 2012 and 78% firms in 1996 were non-exporters, this can imply a downward bias for the coefficient when OLS regression is used. Further analysis using Tobit regression yields positive coefficients for all proxy variables, after accounting for non-exporting firms (Table II).

Besides export share, firms with a higher level of entrepreneurial ability are also associated with a higher wage ratio. The regression coefficients for both the log domestic sales and log employment proxies in 2012 proves the hypothesis with statistical significance. Firms with higher entrepreneurial ability have more white-collar workers and thus their wage, relative to the wage of blue-collar workers, is higher. However, the coefficient for the TFP proxy in 2012 contradicts the hypothesis.

TABLE I. COEFFICIENTS FOR THE EFFECT OF ENTREPRENEURIAL ABILITY ON FIRM OPTIMIZATION LEVEL

2012					
VARIABLES	Export share	Log Wage Ratio	NP Emp. Share	Log Real NP wage	Log Real Prod wage
Log Dom-sales	**-1.508*** **	**0.0346** **	**0.00537** **	**0.0372*** **	**0.00266**
	(0.352)	(0.0147)	(0.00232)	(0.0133)	(0.0114)
R-squared	0.180	0.043	0.161	0.085	0.091
Log Employ.	**5.766*** **	**0.115*** **	**-0.00151**	**0.0634*** **	**-0.0512*** **
	(0.340)	(0.0144)	(0.00224)	(0.0133)	(0.00996)
R-squared	0.228	0.055	0.160	0.088	0.095
Log TFP	**1.516*** **	**-0.0543*** **	**0.00907*** **	**-0.176*** **	**-0.122*** **
	(0.339)	(0.0162)	(0.00248)	(0.0147)	(0.0130)
R-squared	0.180	0.045	0.162	0.113	0.111
N	5,442	5,442	5,442	5,442	5,442
1996					
VARIABLES	Export share	Log Wage Ratio	NP Emp. Share	Log Real NP wage	Log Real Prod wage
Log Dom-sales	**0.151**	**0.109*** **	**0.0112*** **	**0.295*** **	**0.186*** **
	(0.363)	(0.0118)	(0.00217)	(0.0117)	(0.00876)
R-squared	0.145	0.063	0.137	0.283	0.297
Log Employ.	**6.317*** **	**0.107*** **	**-0.000705**	**0.199*** **	**0.0918*** **
	(0.331)	(0.0105)	(0.00194)	(0.0107)	(0.00765)
R-squared	0.214	0.065	0.132	0.230	0.238
Log TFP	**0.849** **	**0.0137**	**0.00696*** **	**-0.0444*** **	**-0.0581*** **
	(0.385)	(0.0135)	(0.00219)	(0.0127)	(0.0108)
R-squared	0.147	0.044	0.134	0.174	0.222
N	4,997	4,997	4,997	4,997	4,997

Note: All variables are regressed with OLS method with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. Level of significance: ***p<0.05, *p<0.1

TABLE II. COEFFICIENT FROM THE TOBIT REGRESSION MODEL FOR EXPORT SHARE

	2012			**1996**		
Proxy	**Log DS**	**Log TFP**	**Log Emp.**	**Log DS**	**Log TFP**	**Log Emp.**
Coefficient	**4.4101*** **	**7.2736*** **	**25.3612*** **	**12.9237*** **	**4.2026*** **	**30.3014*** **
	(1.2829)	(1.2676)	(1.0518)	(1.4347)	(1.4737)	(1.2101)
Constant	0.502	0.377	-8.218	-92.00***	-90.10***	-80.37***
	(9.275)	(9.126)	(8.719)	(22.31)	(22.03)	(21.30)
Sigma	66.1170	65.4864	61.1531	69.3168	68.8081	62.1714
	(1.1408)	(1.1451)	(1.1190)	(1.3425)	(1.3183)	(1.2611)
Uncensored Obs	1298	1298	1298	1078	1078	1078
N	5,442	5,442	5,442	4,997	4,997	4,997

Note: All variables are regressed with province with OLS method with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. Level of significance: ***p<0.01, **p<0.05, *p<0.1

Productive firms (as measured by TFP) have lower internal wage differentials, implying all workers are more or less equally productive. The marginal product of higher skilled workers does not differ greatly from that of lower skilled workers. As expected, the third dependent variable--non-production employment share--increased in firm domestic sales and in TFP in 1996 and in 2012. A one-unit increase in the proxy is associated with a 0.0054 higher and a 0.0112 higher non-production employment share (with log domestic sales proxy) in 2012 and 1996, respectively. The result is also consistent when log TFP is used as the alternative proxy.

We also conducted a beta regression analysis on the non-production employment share, since the data ranges between 0 and 1 and follows a beta distribution. The coefficients of beta regression for log domestic sales and log TFP are in line with the coefficients for log domestic sales under OLS regression. The use of log domestic sales and log employment also shows a positive relationship with the non-production employment share. Thus, with higher entrepreneurial ability, firms put a higher premium on skill. It is assumed that non-production workers are highly skilled and work on activities such as quality enhancement, marketing, etc.

that can be related to higher exports. The result for production wage is more puzzling. Log domestic sales has a statistically insignificant coefficient for the year 2012 but a statistically significant one for 1996. In theory, production work should benefit blue-collar workers as well since to produce a higher quality product, production workers must be more skilled. However, this does not seem to be the case in Indonesia. The fact that entrepreneurial ability explains almost all variables (except blue-collar wages) for both 1996 and 2012 proves the first hypothesis. Firms with higher entrepreneurial ability or technical know-how sell more of their products in the export market, assuming the demand in the export market is driven more by higher quality products, compared with the domestic market. To successfully enter export markets, firms must have better strategies, which is reflected in a higher share of non-production workers and their wages. However, further research is needed to determine whether those firms sell higher quality products.

4.2. The Second Research Question: Firm Entrepreneurial Ability and Change in Optimization Levels During Currency Depreciation.

From the OLS regression of the 2012–2014 and 2010– 2012 periods, we see the log domestic sales proxy produces a positive coefficient for export share for both periods, where the larger the size of the firm (as measured by their domestic sales), the larger is the increase in export share over time (Table III). However, the coefficient for the 2012-2014 period is smaller than the 2010-2012 coefficient and even negative (negative triple differences), proving the hypothesis that higher entrepreneurial ability leads to a bigger change in export allocation throughout the currency crisis period. The results for the 1993 - 1999 period are not very different as the triple differences are negative for all alternative proxies. In other words, firm heterogeneity can explain changes in export share over time, but the effect is much higher during the non-depreciation period, which contradicts the hypothesis.

TABLE IIA. ESTIMATION FOR THE EFFECT OF ENTREPRENEURIAL ABILITY ON NON-PRODUCTION EMPLOYMENT SHARE USING BETA REGRESSION METHOD

	2012			**1996**		
Proxy	**Log DS**	**Log TFP**	**Log Emp.**	**Log DS**	**Log TFP**	**Log Emp.**
Coefficient	**0.0232*** **	**0.0435 *** **	**-0.0291*** **	**0.0583*** **	**0.0461*** **	**-0.0162**
	(0.0110)	(0.0118)	(0.0107)	(0.0110)	(0.0113)	(0.0099)
Constant	-1.5209***	-1.5249***	-1.5119***	-0.9211***	-0.9381***	-0.9151***
	(0.0727)	(0.0729)	(0.0731)	(0.1610)	(0.1642)	(0.1611)
/ln_phi	1.8165***	1.8183***	1.8166***	2.0973***	2.0947***	2.0918***
N	5,442	5,442	5,442	4,997	4,997	4,997

Note: Beta regression model assumes the dependent variable follows a beta distribution and ranges between 0 and 1. All variables are regressed with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. Level of significance: *** p<0.01, ** p<0.05, * p<0.1

TABLE III. COEFFICIENTS FOR THE ANALYSIS OF CHANGES OVER TIME IN FIRM OPTIMIZATION LEVELS

2010 - 2014 (2012 - 2014 depreciation period vs 2010 - 2012 "normal" period)					
VARIABLES	Δ export share	Δ log wage ratio	Δ NP emp. Share	Δ log real NP wage	Δ log real prod. Wage
2012-2014	**1.298*** **	**-0.0181**	**0.0327**	**0.0584*** **	**0.0764*** **
	(0.249)	(0.0136)	(0.0216)	(0.0136)	(0.0128)
R-squared	0.034	0.042	0.036	0.083	0.095
2010-2012	**2.881*** **	**-0.105*** **	**-0.0266**	**-0.208*** **	**-0.103*** **
	(0.275)	(0.0184)	(0.0210)	(0.0183)	(0.0169)
R-squared	0.070	0.047	0.016	0.120	0.105
N	5,442	5,442	5,442	5,442	5,442
Triple Differences	**(–)**	**(+)**	(+)	**(+)**	**(+)**
1993 - 1999 (1996 - 1999 depreciation period vs 1993 - 1996 "normal" period)					
VARIABLES	Δ export share	Δ log wage ratio	Δ NP emp. share	Δ log real NP wage	Δ log real prod. Wage
1996 - 1999	**1.196*** **	**0.0450*** **	**0.00882**	**0.0496*** **	**0.00463**
	(0.367)	(0.0146)	(0.0212)	(0.0140)	(0.0100)
R-squared	0.025	0.026	0.021	0.030	0.018
1993 - 1996	**3.775*** **	**0.00979**	**-0.00637**	**-0.0262** **	**-0.0359*** **
	(0.349)	(0.0134)	(0.0156)	(0.0132)	(0.00992)
R-squared	0.058	0.015	0.015	0.015	0.025
N	4,997	4,997	4,997	4,997	4,997
Triple Differences	**(–)**	**(+)**	(+)	**(+)**	**(+)**

Note: All variables are regressed with OLS method with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. The signs in the triple differences table shows whether the effect of entrepreneurial ability is stronger during depreciation period (+) or during normal period (-). The signs in bold are those with at least one significant coefficient of entrepreneurial ability in either periods. Level of significance: ***p<0.01, **p<0.05, *p<0.01

The 2013–2015 rupiah depreciation was caused mainly by external pressure. The US Federal Reserve decided to stop their quantitative easing even as the world economy was still ridden by uncertainties after the 2008 financial crisis. From 1996 to 1999, the average value of imported materials declined by 645.9 million rupiah while it rose by 920.7 million rupiah during the 1993 to 1996 period. Furthermore, most Indonesian manufacturers operate lower in the regional and global value chains and are highly dependent on imported inputs, especially higher quality products [8]. Coupled with a weak physical and regulatory infrastructure and lower global demand, firms found themselves unable to seize export opportunities during the "taper tantrum" period.

The coefficients for the changes in the wage ratio over time was higher during the depreciation period of 2012-2014, compared with the preceding normal period, or in other words, there were positive triple differences. However, the negative coefficient shows that in the Indonesian case wage disparity closed as firm entrepreneurial ability rose. Currency depreciation has a small impact by halting the rate of decrease in wage disparity, which is consistent with the hypothesis. In the 1996-1999 depreciation period, the effect of firm entrepreneurial ability on the change in the wage ratio is statistically significant and positive, but not for 1993 -1996 period. In fact, the minimum wage increased by 28.45% in real terms between 1993 and 1996; this was the highest rate increase compared with other periods (a 26.58% decline in 1996 to 1999; a 9.02% increase in the 2010-2012 period; and a 21.98% increase in the 2012-2014 period).

The coefficients of the impact of entrepreneurial ability on the change in non-production employment share are not statistically significant for both 2010-2012 and 2012-2014 periods. Alternative proxies also did not yield a more conclusive result (see Table IV). The change over time in the non-production employment share cannot be explained by firm heterogeneity, and thus the triple differences value is obsolete. The non-production employment share is better explained by rising minimum wages. According to Carpio *et al.* [9], the effect of the minimum wage policy on wages are more pronounced for non-production workers as firm size increases. Non-production workers lose their manufacturing jobs when the minimum wage rises, especially for those performing low-skill activities. Despite the statistical insignificance, the positive triple differences for both periods may indicate higher demand for non-production-based activities.

Both production and non-production wages show positive and significant triple differences for all alternative proxies. For both the currency-depreciation periods, the impact of entrepreneurial ability on wages is magnified. For both the non-production and production wage, the signs for the coefficient of the impact of firm entrepreneurial proxies are positive for the 2012–2014 period. The coefficients for all alternative proxies are also higher during the 1996 -1999 period compared with the 1993–1996 period. Larger (or more productive) firms experience bigger increases in wages during depreciation periods. With currency depreciation, the change over time in non-production worker wage is higher and positive. However, the reason behind the increasing wages cannot be attributed to higher quality and higher exports since the coefficient of export share is larger for the non-crisis period. Firms could not use the depreciation as an opportunity to increase exports through quality enhancements.

Blalock & Roy [10] found that although many firms were able to take advantage of export opportunities, a large number of pre-crisis exporters quit exporting during the Asian Financial Crisis. Foreign-owned firms and firms that allocate their spending on research and development fared better than their counterparts and were more likely to continue exporting. Despite a huge proportion of exporting firms ceasing export activities after the crisis, the finding can explain that firms that were initially productive and innovative fared better. Exporters became more concentrated into fewer and more productive firms. According to Thee [11], improved export competitiveness did not happen because financial markets crashed. Export competitiveness also increased in other crisis-ridden East Asian countries while the Japanese economy became stuck in the 1990s.

TABLE IV. COEFFICIENTS FOR THE ANALYSIS OF THE EFFECT OF ENTREPRENEURIAL (Λ) PROXY OF LOG EMPLOYMENT AND LOG TFP ON THE CHANGES OVER TIME IN FIRM OPTIMIZATION LEVELS

	Log Employment					Log TFP				
VARIABLES	Δ Export Share	Δ log wage ratio	Δ NP share	Δ log real wage NP	Δ log real wage Prod.	Δ Export Share	Δ log wage ratio	Δ NP share	Δ log real wage NP	Δ log real wage Prod.
2012-2014	**-0.38**	**-0.0782*****	**0.0675*****	**0.00335**	**0.0815*****	**-0.153**	**0.0396****	**0.0147**	**0.236*****	**0.197*****
	-0.243	-0.0128	-0.0203	-0.0132	-0.0114	-0.25	-0.0158	-0.0207	-0.0157	-0.0149
R-squared	0.029	0.049	0.037	0.08	0.096	0.028	0.043	0.035	0.128	0.129
2010-2012	**1.359*****	**-0.111*****	**0.016**	**-0.0893*****	**0.0218**	**0.745*****	**-0.0871*****	**0.0215**	**-0.0746*****	**0.0125**
	-0.26	-0.018	-0.0208	-0.0165	-0.0154	-0.262	-0.0173	-0.0197	-0.019	-0.0183
R-squared	0.048	0.048	0.016	0.099	0.097	0.043	0.044	0.016	0.097	0.097
N	5,442	5,442	5,442	5,442	5,442	5,442	5,442	5,442	5,442	5,442
Triple Differences	(–)	(+)	(+)	(+)	(+)	(–)	(+)	(–)	(+)	(+)

TABLE IV. *CONTINUE*

	Log Employment					Log TFP				
VARIABLES	Δ Export Share	Δ log wage ratio	Δ NP share	Δ log real wage NP	Δ log real wage Prod.	Δ Export Share	Δ log wage ratio	Δ NP share	Δ log real wage NP	Δ log real wage Prod
1996-1999	**-1.669*****	**0.0576*****	**0.025**	**0.0910*****	**0.0334*****	**-0.930****	**0.005**	**-0.01**	**0.0843*****	**0.0793*****
	-0.352	-0.0135	-0.0212	-0.0126	-0.00812	-0.366	-0.0165	-0.0195	-0.0152	-0.0114
R-squared	0.028	0.028	0.021	0.038	0.021	0.024	0.024	0.021	0.035	0.034
1993-1996	**0.877*****	**-0.01**	**0.0266***	**0.00958**	**0.0197****	**0.215**	**0.0045**	**0.011**	**0.0567*****	**0.0523*****
	-0.312	-0.0128	-0.0159	-0.0115	-0.00845	-0.34	-0.0137	-0.0169	-0.0127	-0.00958
R-squared	0.028	0.015	0.015	0.014	0.023	0.026	0.014	0.015	0.019	0.029
N	4,997	4,997	4,997	4,997	4,997	4,997	4,997	4,997	4,997	4,997
Triple Differences	(–)	(+)	(–)	(+)	(+)	(–)	(+)	(–)	(+)	(+)

Note: All variables are regressed with OLS method with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. The signs in the triple differences table shows whether the effect of entrepreneurial ability is stronger during depreciation period (+) or during normal period (-). The signs in bold are those with at least one significant coefficient of entrepreneurial ability in either periods. Level of significance: ***p<0.01, **<0.05, *p<0.1

The fact that non-oil export values denominated in dollar declined can be attributed to the decline in the export dollar prices, which fell 26% between Q2 1997 and Q2 1999, according to a study of non-oil exporters by Rosner [1]. However, when measured at constant prices, non-oil exports grew 24% while manufacturing exports grew by 31% in the same period. Lower commodity prices could explain this phenomenon. The export volume growth peaked by the third quarter of 1997 before slowing down in mid-1998, but still managed to be above its historical levels. The decline in export volume growth in 1998 can be explained by the civil unrest in May 1998, or the recovery of the rupiah and of local prices by Q3 1998.

The same impact on manufacturing exports was not seen during the global financial crisis of 2008 because of lower world demand since most of Indonesia's major export markets were affected by the crisis. Exports of almost all countries saw a decline in this period. Indonesia was relatively unharmed by the crisis because of the small share of exports and an insulated capital market. The decline in exports was driven mainly by a lower demand for raw materials from China, Korea, and Japan. It was mainly driven by export value rather than volume because of price collapses. However, the decline in export value was observed mostly in the manufacturing sector, in industries such as clothing, footwear, and automotive products, alongside other local suppliers that served those industries [12]. According to the IMF, as of 2016, the trend in slower global growth persisted, fueled by China's economic slowdown.

4.3 Econometric Analysis using Models with Control Variables

Various studies have shown that Indonesian manu-facturers are dependent on imported materials. Besides, as shown by Takii & Narjoko [3], the relative wages of skilled workers in foreign-owned firms are much higher than those in other firms, despite declining faster.

Our study takes into account both imported materials and foreign ownership in both models. It should be noted that the inclusion of these control variables does not change the sign and statistical significance of the entrepreneurial ability proxy (although the effect is a bit smaller than in the original model as reflected in the slightly smaller coefficient). For the sake of simplicity, the control variables shown in Table V are those that are used to control for log domestic sales.

Meanwhile, the foreign ownership dummy shows a more consistent result for all optimization levels in both years. Foreign-owned firms exported 16.58% and 15.69% higher in 1996 and 2012, respectively. The wage ratio was also 11% and 4.86% higher in 1996 and 2012, respectively. On the other hand, non-production employment share was higher by 0.037 and 0.032**,** respectively, in 1996 and 2012. Real non-production wages in foreign-owned firms were 44% higher in 1996 and 16.5% higher in 2012, compared with purely domestic firms. The real production wage was also 33% higher in 1996 and 11.6% higher in 2012 for foreign-owned firms. This supports the idea that foreign-owned firms are more export oriented with better product quality and higher demand for wage ratio and non-production employment.

When the dependent variables are the changes over time in the optimization level, the result can be different. Over time, increases in the share of imported materials (lagged by one year) increased more of an export share in the 2012 - 2014 depreciation period than in the 2010–2012 period. However, the results are not statistically significant for 1996- 1999 and 1993-1996. During the "taper tantrum" depreciation period, the export share increased in firms that became more dependent on imported material goods in their production. The situation was much different from that during the Asian Financial Crisis of the late 1990s owing to the sharper depreciation and financial constraints.

TABLE V. COEFFICIENTS FOR THE ANALYSIS OF THE EFFECT OF ENTREPRENEURIAL (Λ) PROXY OF LOG-DOMESTIC SALES ON FIRM OPTIMIZATION LEVEL WITH IMPORT SHARE AND FOREIGN OWNERSHIP AS DUMMY VARIABLES

2012

VARIABLES	Export share	Log Wage Ratio	NP Emp. Share	Log Real NP wage	Log Real Prod wage
log dom sales	**0.945*** **	**-0.0567*** **	**0.00793*** **	**-0.182*** **	**-0.126*** **
	(0.327)	(0.0163)	(0.00248)	(0.0148)	(0.0130)
Import share, lag	**12.26*** **	**0.0741**	**0.0238** **	**0.129** **	**0.0545**
	(1.740)	(0.0682)	(0.0104)	(0.0580)	(0.0495)
Foreign own.	**15.69*** **	**0.0486**	**0.0317*** **	**0.165*** **	**0.116*** **
	(1.512)	(0.0593)	(0.00914)	(0.0516)	(0.0416)
R-squared	0.235	0.045	0.167	0.117	0.113
N	5,442	5,442	5,442	5,442	5,442

1996

VARIABLES	Export share	Log Wage Ratio	NP Emp. Share	Log Real NP wage	Log Real Prod wage
log dom sales	**-0.963** **	**0.0999*** **	**0.00840*** **	**0.263*** **	**0.163*** **
	(0.377)	(0.0121)	(0.00219)	(0.0117)	(0.00888)
Import share, lag	**9.885*** **	**0.106** **	**0.0306*** **	**0.329*** **	**0.223*** **
	(1.435)	(0.0500)	(0.00876)	(0.0503)	(0.0330)
Foreign own.	**16.58*** **	**0.110** **	**0.0374*** **	**0.440*** **	**0.330*** **
	(1.831)	(0.0519)	(0.00937)	(0.0527)	(0.0386)
R-squared	0.185	0.066	0.144	0.311	0.325
N	4,997	4,997	4,997	4,997	4,997

Note: All variables are regressed with OLS method with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. Level of significance: ***p<0.01, **p<0.05, *p<0.1

TABLE VI. COEFFICIENTS FOR THE ANALYSIS OF THE EFFECT OF ENTREPRENEURIAL (Λ) PROXY ON FIRM OPTIMIZATION LEVELS WITH IMPORT SHARE AND FOREIGN OWNERSHIP AS DUMMY VARIABLES

Variables	Δ Export share	Δ log wage ratio	Δ NP emp.	Δ log real NP wage	Δ log real Prod. wage	Δ prprex	Δ log wageratio	Δ NP emp. share	Δ log real wage NP	Δ log real wage Prod.
Years	**2012-2014**					**1996-1999**				
Log Dom Sales	**1.255*** **	**-0.0166**	**0.0325**	**0.0607*** **	**0.0773*** **	**1.382*** **	**0.0395*** **	**0.0105**	**0.0393*** **	**-0.00015**
	-0.251	-0.0137	-0.021	-0.0136	-0.013	-0.376	-0.0148	-0.0214	-0.0141	-0.0102
Imp. share 2f lag	**1.005**	**-0.0337**	**0.0138**	**-0.0577**	**-0.024**	**-1.831**	**0.0346**	**0.00793**	**0.0333**	**-0.00125**
	-0.964	-0.0504	-0.0784	-0.0487	-0.0402	-1.939	-0.0748	-0.0969	-0.0712	-0.044
Foreign own	**4.059***	**-0.0816**	**-0.321**	**-0.00119**	**0.0804**	**-4.187***	**0.123***	**-0.0367**	**0.229*** **	**0.106** **
	-2.254	-0.114	-0.235	-0.111	-0.0832	-2.155	-0.0694	-0.0874	-0.071	-0.043
Observations	5,442	5,442	5,442	5,442	5,442	4,997	4,997	4,997	4,997	4,997
R-squared	0.024	0.024	0.029	0.066	0.078	0.027	0.027	0.021	0.033	0.02
Years	**2010-2012**					**1993-1996**				
Log Dom Sales	**2.883*** **	**-0.0981*** **	**-0.0205**	**-0.196*** **	**-0.0982*** **	**3.797*** **	**0.0127**	**-0.00733**	**-0.0232***	**-0.0359*** **
	-0.278	-0.0184	-0.0223	-0.0183	-0.0171	-0.357	-0.0136	-0.0159	-0.0134	-0.00997
Imp. share 2f lag	**-0.0162**	**-0.137** **	**-0.104**	**-0.226*** **	**-0.0896***	**0.314**	**0.0164**	**-0.0542**	**0.0049**	**-0.0115**
	-0.974	-0.0634	-0.066	-0.0568	-0.0482	-1.205	-0.0467	-0.0613	-0.0406	-0.0275
Foreign own.	**-0.308**	**0.122**	**-0.216***	**0.154**	**0.0323**	**-0.603**	**-0.0832**	**0.0227**	**-0.0842**	**-0.000963**
	-2.225	-0.137	-0.116	-0.13	-0.103	-1.978	-0.0632	-0.104	-0.0578	-0.0374
Observations	5,442	5,442	5,442	5,442	5,442	4,997	4,997	4,997	4,997	4,997
R-squared	0.07	0.048	0.017	0.123	0.106	0.058	0.015	0.015	0.016	0.025
Difference in difference in difference										
Log Dom sales	(–)	(+)	(+)	(+)	(+)	(–)	(+)	(+)	(+)	(+)
Imp. Share 2f lag	(+)	(+)	(+)	(+)	(+)	(–)	(+)	(+)	(+)	(+)
Foreign own	(+)	(–)	(–)	(–)	(+)	(–)	(+)	(–)	(+)	(+)

Note: All variables are regressed with OLS method with province and 3-digit KBLI industry dummies. Robust standard errors in parentheses. The signs in the triple differences table shows whether the effect of entrepreneurial ability is stronger during depreciation period (+) or during normal period (-). The signs in bold are those with at least one significant coefficient of entrepreneurial ability in either periods. Level of significance: ***p0.01, **p<0.05, *p<0.1

Foreign-owned firms reduced the export share by 4.059% from the beginning to the end of the currency depreciation period of 2012-2014, but the same was not be observed in other periods. Foreign ownership can be attributed for the 22.9% higher non-production wage increases and 10.6% higher production wage increases in 1996 -1999 but it had no significant impact during the 1993-1996 period. For the 2010-2014 period, foreign ownership is associated with decreasing real non-production and real production wage in the 2010-2012 period, but has no effect during 2012-2014 period. For

simplicity, Table VI shows the result of the regression on the controlled second model when log domestic sales is used as the proxy for entrepreneurial ability.

Overall, foreign ownership can explain the variation in wages, while import share can only explain the variation in export share. Firms owned by foreign entities saw higher absolute wages and higher relative wages between their non-production and production workers. On the other hand, changes in import share can explain the changes in export share. However, since not all coefficients are significant, further studies are needed before a conclusion can be drawn for the effect of both foreign ownership and changes in firm imported material share.

V. CONCLUSION

This study examines the issue of trade and wage inequality from the perspective of firm heterogeneity and the impact of currency depreciation, which is usually credited with facilitating exports. Our analysis suggests that higher firm entrepreneurial abilities are behind the higher portion of production allocated to the export market, the higher share of white-collar/non-production worker employment, and the higher wage disparity between blue-collar/production and white-collar/non-production workers. This suggests that firms with higher entrepreneurial ability conduct more non-production activities, such as product quality enhancement. Foreign-owned firms also have higher export intensity, higher wages, a higher wage ratio, and a higher non-production employment share, proving that foreign-owned firms have higher quality products and are more export oriented.

On the other hand, firms do not seem to have used the currency depreciation periods of 1996 -1999 (Asian financial crisis) and 2012-2014 (Fed Taper Tantrum) as opportunities to increase their export share, owing to falling global demand and their high dependence on imported materials. The wage ratio too did not increase in those periods. Despite not supporting the earlier hypothesis, it can be seen as evidence of firms outsourcing high-skilled activities and reduces the skill intensity.

Further studies are highly recommended to include the skill level of workers, where non-production or production workers cannot proxy high-and low-skilled workers. Future analysis is also recommended to quantify the quality upgrading.

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