GLOBALIZATION, TECHNOLOGY AND INCOME INEQUALITY: NEW EVIDENCE

CHATCHAI CHORDOKRAK

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF BUSINESS ADMINISTRATION
(BUSINESS MODELING AND ANALYSIS)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2011**

Thesis
entitled

GLOBALIZATION, TECHNOLOGY AND INCOME INEQUALITY: NEW EVIDENCE

.....
Mr. Chatchai Chordokrak
Candidate

.....
Lect. Pandej Chintrakarn, Ph.D.
Major advisor

.....
Lect. Ornlatcha Sivarak, Ph.D.
Co-advisor

.....
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

.....
Asst. Prof. Yingyot Chiaravutthi
Ph.D.
Program Director
Master of Business Administration
Program in Business Modeling and
Analysis
International College
Mahidol University

Thesis
entitled

GLOBALIZATION, TECHNOLOGY AND INCOME INEQUALITY: NEW EVIDENCE

was submitted to the Faculty of Graduate Studies, Mahidol University for the degree of Master of Business Administration (Business Modeling and Analysis)
on
March 25, 2011

.....
Mr. Chatchai Chordokrak
Candidate

.....
Asst. Prof. Sittisak Leelahanon, Ph.D
Chair

.....
Lect. Ornlatcha Sivarak, Ph.D.
Member

.....
Lect. Pandej Chintrakarn, Ph.D.
Member

.....
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

.....
Assoc. Prof. Rassmidara Hoonsawat,
Ph.D.
Dean
International College
Mahidol University

ACKNOWLEDGEMENTS

This thesis would not have been made possible without the advice, guidance and help of several individuals who contributed and extended their valuable assistance in the preparation and completion of this study.

First and foremost, I would like to express my gratitude to my advisor Mr. Pandej Chintrakarn, Ph.D. who advised, guided and always supported me with his experience until the paper was finished. He has taken great pain to go through the paper and make necessary corrections when needed.

In addition, I am deeply grateful to my co-advisor Ms. Ornlatcha Sivalak, Ph.D. who supported and assisted me all throughout.

I would like to heartily thank the MBA program, lecturers, and my classmates who have given me valuable knowledge throughout my studies at MUIC. Also, I wish to mention MUIC which provided me with the support and equipment I needed to produce and complete my thesis.

In my daily work, I have been blessed with a friendly and cheerful group of colleagues at Ausiris Co., Ltd. who supported and encouraged me to finish this project.

Lastly, I also extend my heartfelt thanks to my family and well-wishers and offer my regards and blessings to all of those who supported me in any way during the undertaking of the project.

Chatchai Chordokrak

GLOBALIZATION, TECHNOLOGY AND INCOME INEQUALITY: NEW EVIDENCE

CHATCHAI CHORDOKRAK 5138386 ICMA / M

M.B.A. (BUSINESS MODELING AND ANALYSIS)

THESIS ADVISORY COMMITTEE: PANDEJ CHINTRAKARN, Ph.D., ORNLATCHA SIVALAK, Ph.D.

ABSTRACT

Employing state-level panel data on 48 States from 1988-2003, we estimate the impact of globalization and technology advances on U.S. States' income inequality. The results obtained from using various econometrics models reveal that inward FDI measured by FDI-related employment has positive and statistically significant effects on five out of six U.S. States' income inequality measures. With first difference estimators, we find some evidence that trade has a positive and statistically significant effect on top-income shares, though there is no evidence on the impact of technology on income inequality.

KEY WORDS: INCOME INEQUALITY / GLOBALIZATION / TECHNOLOGICAL PROGRESS

24 pages

โลกาภิวัตน์, เทคโนโลยี และ ความเหลื่อมล้ำทางรายได้: หลักฐานใหม่

GLOBALIZATION, TECHNOLOGY AND INCOME INEQUALITY: NEW EVIDENCE

ฉัตรชัย ช่อดอกรัก 5138386 ICMA / M

บธ.ม. (การวิเคราะห์และการสร้างตัวแบบธุรกิจ)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: ปานเดช ชินตระการ, Ph.D., อรลัชชา ศิวรักษ์, Ph.D.

บทคัดย่อ

จากแผงข้อมูลของ 48 รัฐในประเทศสหรัฐอเมริกาในปี 1998 – 2003 เราได้ทำการประมาณการผลกระทบของโลกาภิวัตน์ ความก้าวหน้าทางเทคโนโลยี ที่ส่งผลต่อความเหลื่อมล้ำทางรายได้ของรัฐต่างๆในประเทศสหรัฐอเมริกา ผลที่ได้จากการใช้แบบจำลองทางเศรษฐมิติต่างๆ พบว่าการวัดค่าความเหลื่อมล้ำทางรายได้ที่มีผลกระทบจากการลงทุนโดยตรงจากต่างประเทศที่วัดจากการจ้างงานที่เกิดขึ้นทั้งหมดหกวิธี มีห้าวิธีที่มีผลทางสถิติเชิงบวกอย่างมีนัยสำคัญ และด้วยวิธีการประมาณค่าความแตกต่างแรก (First difference estimators) เราพบหลักฐานแสดงว่าวิธีการใช้สัดส่วนรายได้สูงมีผลทางสถิติเชิงบวกอย่างมีนัยสำคัญสำหรับการค้าที่ส่งผลต่อความเหลื่อมล้ำทางรายได้ ถึงแม้จะไม่พบหลักฐานที่แสดงให้เห็นได้ว่าเทคโนโลยีส่งผลกระทบต่อความเหลื่อมล้ำทางรายได้ก็ตาม

24 หน้า

CONTENTS

LIST OF TABLES

CHAPTER I
INTRODUCTION

1.1 Background

Economic growth and improvement of citizens' standards of living in a country have generally been measured by national income figures. National income pertains to the total flow of earnings of factor-owners through the production of goods and services. In another simple perspective, it is also measured as the total amount of income earned by the citizens of a nation. It is often used to describe the standard of living of people in a country. Per capita GNP allows for the comparison of the standards of living of different nations. In general, a nation has a higher standard of living if its per capita GNP is greater than that of another nation. It can also be used as key information for a government in forming policy or making any decision regarding national income. However, the key limitation of the use of national income is that it ignores the distribution of income among people in a country. In a country with high national income, it is often the case that most of this income is distributed to one group of people rather than distributed equally among the people. This causes an income inequality problem in the country.

In the economic sense, income inequality may be an indicator of the failure of implementation of government policy. In a capitalist free economy with fair competition, inequality can occur only when people have different abilities or levels of knowledge. On the other hand, if income inequality is caused by other reasons under free competition, a problem regarding inequality of income occurs. This comes in the form of a minority benefiting from more income compared to the majority of a country with less income.

There are many reasons for the inequality of income. For one, it can be caused by the increase in unemployment rate. People who are unemployed may have no income and will inevitably suffer from poverty. Another is inflation. Once inflation increases, the beneficiaries are producers or business owners. As such, the prices of goods and services increase, which thereby raise the income of producers. At the same time, labor's compensation does not adjust for the increasing rate of inflation, therefore widening the gap between high income people and low income individuals. Lastly, income inequality can also be caused by the unequal treatment of these two groups of people with regard to government policy.

1.2 Objective of the study

This paper aims to examine the impact of globalization, as measured by international trade and FDI, and technology, measured by technological advances, on income inequality by utilizing comprehensive panel data on 48 states from 1988-2003 and aims to contribute several new dimensions to the study of income inequality in the United States.

1.3 Significance of the study

The rising in income inequality has attracted considerable attention from scholars as well as from policymakers as inequality has increased in both developed and developing countries over the past two decades. On one strand of research, there have been extensive empirical researches that explore the consequence of globalization on income inequality.

Globalization is a major issue such that vast literature focused on international trade, with which there is substantial amount of evidence, suggests a contemporaneous increase in globalization-caused inequality in most developing countries (see Goldberg and Pavcnik, 2007, for a survey of country-specific evidence). As the economies continue to be more financially integrated, concern over the effect of FDI on income inequality has received more attention. Empirical evidence surrounding these, however, has been mixed. On one hand, some evidence suggests that FDI does increase wage or income inequality by increasing the relative demand for skilled workers. (e.g., Feenstra and Hanson, 1997; Driffield and Taylor, 2000; Taylor and Driffield, 2005; Choi, 2006; Jaumotte et al., 2008). On the other hand, some studies find FDI does reduce income inequality (e.g., Jensen and Rosas, 2007) or no relationship between inward and outward FDI and skilled labor's compensation share (e.g., Slaughter, 2000; Blonigen and Slaughter, 2001).

On the other strand, economists have long hypothesized that technological advances tend to increase the productivity of highly skilled workers relatively more than that of less-skilled workers and thus cause the real wages of skilled workers to increase relatively faster. Empirical evidence has suggested that industries and firms that spend more on research and development or invest more in information technologies hire relatively more high-skilled workers and spend a relatively larger

share of their payrolls on them (Autor, Katz, and Krueger, 1998; Bartel and Sicherman, 1999; Berndt and Morrison, 1995; Berman, Bound, and Griliches, 1994).

1.4 Scope of the study

Building on this previous work, this paper merges the literature on globalization and income inequality with the literature on technology and income inequality by examining the role of globalization, measured by U.S. states' international trade openness and inward FDI, and technology advances in affecting income inequality of U.S. states using panel data on 48 states from 1988-2003. The paper aims to contribute to the literature along several new dimensions. First cross-country comparisons of inequality are generally plagued by problems of poor reliability and inconsistent methodology.[1] To cast light on this central issue, this paper exploits newly available data on income inequality that produces greater methodological consistency in inequality measurements. The primary innovation of this data is to use IRS income tax filing data to construct a comprehensive state-level panel of annual income inequality measures. Second, analyzing data on U.S. states can help alleviate the heterogeneity and data comparability problems often encountered in cross-country studies as a panel of U.S. states is more homogenous than most a panel of cross-countries data.[2]

1.5 Benefit of the study

Finally, this paper examines the impact of globalization and technology on income inequality by utilizing a comprehensive panel data which is relatively large in both cross-sections and time-series observations whereas the existing literature thus far

1 Goldberg and Pavcnik (2007) and Jaumotte et al. (2008) provide a nice discussion on problem often encountered in cross-country comparisons of inequality.

2 As shown by Acemoglu (2003), institution can affect the level of inequality. However it is a very difficult task to find reliable measures for these sources of heterogeneity. As emphasized in Frank (2009), the greater homogeneity of state-level data helps mitigate the difficulty in adequately capturing structural differences across international panels of earlier studies such as Forbes (2000) and Barro and Lee (2001).

has generally relied on few data sets that lacked of both coverage.[3] In light of this, along with the advantages discussed above, the findings herein can well shed some light on the existing literature. In doing so, the results obtained from using various econometrics models reveal that inward FDI measured by FDI-related employment has positive and statistically significant effects on five out of six U.S. States' income inequality measures. With first difference estimator, we find some evidence that trade has positive and statistically significant effect on top-income shares though there is no evidence on the impact of technology on income inequality.

The remainder of the paper is organized as follows. Chapter 2 reviews the previous related literatures. Chapter 3 discusses the empirical model and data. Chapter 4 presents the discussion of the results. Chapter 5 concludes.

3 As noted in Frank (2008), current empirical research on income inequality has benefited primarily from the construction of two prior income inequality data sets: the international panel of Deininger and Squire (1996), and the U.S time-series data of Piketty and Saez (2003).

CHAPTER II
LITERATURE REVIEW

In this section, relevant papers on globalization, technology and income inequality are discussed and explored. The theories and concepts related to all factors as well as insight on measurements will give an idea of how this paper evaluates the topic at hand. Therefore, it is important to understand each measurement and how it is applied. As such, the top 1% income share, top 10% income share, Gini coefficient, the relative mean deviation (RMD), Atkinson index and Theil's entropy index will be mentioned to support the framework of the study.

2.1 Globalization and Income Inequality

Goldberg and Pavcnik (2007) studied how globalization has affected income inequality in developing countries. They measured the effects of globalization by mainly focusing on trade liberalization which relates to change in international trade policies, outsourcing, capital inflow and outflow across countries in the form of foreign direct investment (FDI) and exchange rate shocks. Globalization is commonly evaluated with respect to trade liberalization. However, researchers often use an indirect way to measure trade liberalization by using trade volume of imports and exports, due to the limited availability of data, especially in developing countries. In their study, evidence shows an increase in globalization and income inequality in most developing countries. Moreover, they allude to the improvement of the understanding of consequences of globalization with respect to income inequality using empirical work which includes data on trade in intermediate products, international flows of capital, trade-induced skilled biased technological change, short-run factor immobility, and firm heterogeneity.

2.2 FDI and Income Inequality

Foreign direct investment (FDI) is also a very common component used in the measurement of effects of globalization on income inequality. There are mixed results in the research on the relationship of FDI and income inequality. Some studies say FDI increases income inequality but some say otherwise; or even deny the relationship between FDI and income inequality.

Feenstra and Hanson (1997) examined the relationship between FDI and relative wages of skilled workers in Mexico and found a positive correlation between the two variables. The more growth in FDI, the more need for skilled labor.

Driffield and Taylor (2000) suggest two results regarding the impact of inward FDI on the labor market in the United Kingdom.

First, inequality increases with the entry of a multinational enterprise (MNE). In this sense, it drives the demand for the skilled worker in an industry and the worker becomes more wanted.

Second, when technology spillovers occur from MNCs to domestic firms, the demand for skilled workers increases, as does aggregate wage inequality and skill upgrading.

Choi (2006) studied the effect of FDI on domestic income inequality for 119 countries. He used the Gini coefficient as an indicator for income inequality and came up with mixed results from the study. FDI stock as a percent of GDP increase raises income inequality. The increase in GDP per capita and real GDP per capita brings down domestic income inequality.

Jaumotte (2008) finds two results from studying the relationship between trade and financial globalization and the rise in inequality. Trade globalization reduces income inequality while financial globalization and FDI increase income inequality.

Jensen and Rosas (2007) suggest that the increase in inflow of FDI decreases income inequality in 32 states of Mexico which is defined as a middle-income country.

Slaughter (2000) finds inconsistencies with the models of MNEs in which affiliate activities substitute for parent unskilled-labor-intensive activities. He sees this after studying the relationships regarding transfer of production stages within US-headquartered multinational enterprises (MNEs) between US parents and foreign affiliates, and the within-industry shifts in US relative labor demand toward the more-skilled.

2.3 Technology and Income Inequality

Autor and Krueger (1998) studied the effects of technological skill change measured by computerization on the U.S. educational wage differentials. The study finds evidence that strong upgrading for the skilled worker is greater in more computer-intensive industries.

Bartel and Sicherman (1999) evaluated the impact of technological change on a panel of young workers and found that there is a positive relationship between both technological change and wages, as well as technological change and education premium.

Berman, Bound and Griliches (1994) found three facts related to the shift in demand for unskilled labor toward skilled labor in U.S. manufacturing. Firstly, the increased demand for a skilled worker normally happens within an existing set of 450 manufacturing industries rather than in other industries to which the worker might transfer. Secondly, trade- and defense-demand are associated only with small employment reallocation effects. Lastly, there is a strongly correlated relationship between the increase of nonproduction workers and the investment in computer and R&D.

2.4 Income Inequality Measurement

2.4.1 Top 1% and 10% Income Share

Piketty and Saez (2003) used annual tax return data from the U.S. Treasury Department, Internal Revenue Service, in order to measure income inequality in the United States from 1916 - 1998. There are some limitations using the mentioned data set. The filed tax return contained a very small portion of individuals and it represents

a tax unit instead of individuals. Moreover, the data set for the study using Pareto distributions showed good approximation only for the top tail of the income distribution. Therefore, the study was mainly focused on the top decile of the income distribution.

Andrew Leigh (2007) also used taxation statistics to find a relationship between individuals in the top 1% and 10% income shares with other measurements for income inequality such as the Gini coefficient. After studying the dataset of 13 developed countries, the result showed a statistically significant relationship between these. Therefore, he concluded that those in the top 1% and 10% income shares are suitable for measuring and analyzing income inequality when there is no other income distribution measurement or when these are of low quality.

This paper is also uses the top 1% and 10% income shares to evaluate the income distribution and examine the inequality level for 48 states from 1988-2003.

2.4.2 Other Income Inequality Measurements

Mark W. Frank (2008) studied a state-level panel of inequality measures over 1916-2005 which also employed the top income share and 4 more measures which are the Gini coefficient, the relative mean deviation (RMD), Atkinson index and Theil's entropy index to evaluate the inequality. The author mentions each measure in summary as follows:

2.4.2.1 The Gini coefficient represents the average distance between all pairs of proportional income in the population which vary between zero and one. A larger amount indicates a greater income inequality.

2.4.2.2 The relative mean deviation (RMD) is the absolute distance between each person's income and the mean income of the population. The value varies between zero and two and likewise, the larger amount indicates greater income inequality.

2.4.2.3 The Atkinson index is a social welfare function based measure of inequality. The Atkinson index employs a level of inequality aversion represented by ϵ and varies between zero and one. If ϵ approaches 0, the Atkinson index becomes more sensitive to changes at the lower end of the income distribution.

On the other hand, if ε approaches 1, the Atkinson index becomes more sensitive to changes in the upper end of the income distribution.

2.4.2.4 Theil's entropy index is an unbounded derivative of statistical information theory where larger values indicate greater income inequality.

As this paper employs inward FDI intensity to measure globalization, there are two dimensions of the inward FDI. The real dimension of FDI related to employment (FDIEMP) is defined as:

$$FDIEMP = \frac{No.of\ employees\ in\ foreign\ affiliates}{State - level\ total\ employment}$$

Another dimension of FDI is the monetary dimension which is related to property, plant and equipment owned by foreign affiliates (FDIPPE) defined as:

$$FDIPPE = \frac{PPE\ gross\ value\ owned\ by\ foreign\ affilates}{Gross\ state\ product}$$

FDIEMP Studies

Blonigen and Slaughter (2001) analyzed the impact of inward FDI on U.S. wage inequality. They studied the relationship between activities of foreign affiliates and the improvement of U.S. labor skill.

FDIPPE Studies

Leichenko and Erickson (1997) studied the relationship between FDI and state export performance by using the gross value of foreign-owned property, plant and equipment as an FDI pattern used for analysis. They found that the increase of FDI levels has a positive relationship on future improvements in state manufacturing export performance.

Bobonis and Shartz (2007) used real book value of gross property, plant, and equipment (PPE) of all foreign-owned PPE relative to gross state product (GSP) to study the relationship between agglomeration forces and speed of adjustment, and effects of fiscal policy and investment incentives.

CHAPTER III
DATA AND METHODOLOGY

To assess the effects of globalization and technology on U.S. states' income inequality, we employ the following two-way fixed effects model.

$$y_{it} = \beta_0 + \beta_1 FDI_{i,t} + \beta_2 Trade_{i,t} + \beta_3 Tech_{i,t} + Controls + \alpha_i + \gamma_t + trend + \varepsilon_{i,t} \quad \text{Eq. (1)}$$

$$, i = 1, ..., 48 ; t = 1988, 1989..., 2003$$

where y (U.S. state's measures of inequality) is subscripted with i (U.S. state) and t (year). Here the model includes series of dummy variables capturing both unobserved time invariant state-specific component, α_i and year-specific component, γ_t. In addition, the model also includes time trend to control trend effect. The data covers 48 states observed for the period 1988-2003.[1]

We utilize six different measures of U.S. states' income inequality from Frank (2009). These measures are top 1% income share, top 10% income share, Gini coefficient, the relative mean deviation (RMD), Atkinson index and Theil's entropy index. Unlike the two top income shares, the other four additional measures focus on accessing inequality over the entirety of the income distribution. These income inequality measures are derived from tax data reported in Statistics of Income published by the Internal Revenue Service (IRS). It should be noted, however, that a limitation of IRS income data is the omission of some individuals earning less than a threshold level of gross income.[2] In this light, we follow Piketty and Saez (2003) and Frank (2009) in focusing on measures of top-income shares (top 1% and top 10%) as

[1] The data coverage is determined jointly by the availability of variables.

2 As noted in Frank (2008), while the four additional measures are analytically more appealing, this feature comes with a drawback in the context of IRS income data, given the omission of some individuals at the low-end of the income distribution. See Frank (2008; 2009) for more discussion on the inequality data. The U.S. states' inequality data can be obtained online at http:\\www.shsu.edu\~eco_mwf

our primary indicators of income inequality as Leigh (2007) also suggests that there is a strong and significant relationship between top income shares and broader inequality measures and suggests that top income shares may be a useful substitute for other measures of inequality over periods when alternative income distribution measures are of low quality, or unavailable.[3]

Our measures of globalization are U.S. states' international trade openness defined as state export in percent of GSP and inward FDI intensity.[4] We consider two alternatives of FDI intensity. The reason for considering two alternative measures of FDI is that measurement is likely to matter for FDI effects (Keller and Yeaple, 2003). The first measure (FDIEMP), inward FDI-related employment, emphasizes the real dimension of FDI, given by the number of employees in foreign affiliates as percentage of state-level total employment.[5] The second measure (FDIPPE), the stock of inward FDI, emphasizes the monetary dimension of FDI, given by the value of gross property, plant and equipment owned by foreign affiliates in constant prices as percentage of gross state product (GSP). These FDI data are widely used as measures of U.S. states' inward FDI by many scholars (e.g., Leichenko and Erickson, 1997; Blonigen and Slaughter, 2001; Bobonis and Shatz, 2007; Fredriksson et al., 2003; Henderson and Millimet, 2007; Keller and Levinson, 2002). The data on U.S. states' export (Trade) and inward FDI are obtained from Statistical Abstract of the United States (various issues). For technology, the perpetual inventory method was applied to data on state-level new R&D expenditure (as share of Gross State Product) obtained from Science and Engineering Indicators (various issues) to derive state-level technology capital stock (Technology).[6] It should also be noted that R&D expenditure

[3] However, the omission issue becomes less problematic overtime as the yearly increases in the number of tax returns filed after 1947 follow closely the changes in the U.S. population

[4] The U.S. Government does not publish imports by individual States.

[5] A U.S. affiliate is a U.S. business enterprise in which one foreign owner (individual, branch, partnership, association, trust corporation, or government) has a direct or indirect voting interest of 10 percent or more.

[6] In the similar spirit, Cohen and Morrison Paul (2004) used the perpetual inventory method to obtain private manufacturing capital stock and public capital stock estimates. A limitation of the method is the need to specify a depreciation rate. As in Coe and Helpman (1995), we assume an annual depreciation rate of 5%. R&D expenditure in year 1987 is used as the initial value for calculating the series of estimated technology capital stock.

includes R&D performed by federal agencies, business, universities, other nonprofit organizations, and state agencies.[7]

Several control variables which are considered to affect income inequality in the literature have been included in the model. Per capita GSP, and the squared of per capita GSP are obtained and calculated using data from Bureau of Economic Analysis (BEA). U.S. states' unionization rates defined as percent of employed workers who are covered by a collective bargaining agreement obtained from unionstats.com.[8] Unemployment rates (%) for each state are obtained through U.S. Bureau of Labor Statistics. Human capital attainment variables, the proportion of the population with at least a college degree, are obtained from Frank (2009).[9] Financial development variables measured by share of "finance and insurance" (FIN) in US states in percent of GSP and net loans and leases (Loan) of Federal Deposit Insurance Corporation (FDIC)-insured commercial banks, balances at year end, in percent of GSP are obtained from BEA and FDIC.[10] Summary statistics are provided in Table 1.

[7] The data on state-level R&D for years 1988, 1990, 1992, 1994, 1996, 2001 and 2003 are not available. To circumvent the problem, we use the state-level average values as the proxy for missing data.

8 The database, constructed by Barry Hirsch and David Macpherson, is updated annually. For greater details, see Hirsch and Macpherson (2003). These state-level union data have also been utilized by empirical studies investigating the impact of labor union on U.S. states' efficiency (e.g., Chintrakarn and Chen, 2010).

9 Given that human capital attainment information is unavailable on an annual state-level basis for much of sample period, Frank (2009) constructed measures of human capital attainment using the perpetual inventory method. The U.S. states' human capital attainment data can be obtained online at http:\\www.shsu.edu\~eco_mwf

[10] The author is grateful to Peter Nunnenkamp for making the data available.

Table 3.1: Summary Statistics

Variable	Year	Mean	Std. Dev.	Min	Max
Top 1% income share	1988-2003	0.142	0.030	0.095	0.275
Top 10% income share	1988-2003	0.396	0.033	0.342	0.527
Gini coefficient	1988-2003	0.568	0.026	0.501	0.656
Relative mean deviation	1988-2003	0.793	0.037	0.718	0.939
Atkinson index	1988-2003	0.248	0.030	0.183	0.380
Theil's entropy index	1988-2003	0.719	0.153	0.359	1.326
FDIEMP intensity	1988-2003	0.032	0.013	0.007	0.103
FDIPPE intensity	1988-2003	0.096	0.054	0.016	0.554
Trade	1988-2003	0.056	0.035	0.001	0.251
Technology	1988-2003	53.88	50.00	2.68	289.13
Per capita GSP	1988-2003	29400	5796	18173	55282
College (%)	1988-2003	14.54	3.36	6.86	25.48
Union (%)	1988-2003	15.08	5.74	3.80	31.70
Finance and insurance	1988-2003	6.82	4.05	2.37	33.54
Net loans and leases	1988-2003	40.35	46.79	1.14	381.27
State unemployment (%)	1988-2003	5.19	1.45	2.30	11.30

CHAPTER IV
EMPIRICAL RESULT

Table 2 and 3 reports the estimation results of the Eq. (1) with FDIEMP and FDIPPE specifications, respectively. In term of control variables, coefficient estimates of per capita GSP and per capita GSP squared appear to be statistically significant with negative and positive signs, respectively except for per capita GSP on Theil's entropy index in FDIPPE specification. The results appear to be in line with long-run positive relationship between inequality and growth found in Frank (2009). While we find that unionization rate does not affect the two top income shares, it does statistically reduce some income inequality measures based on the entirety of income distribution such as Gini coefficient and RMD (FDIEMP specifications). The results also suggest that access to education in the population reduces inequality, presumably because it enables more people to gain equitable benefits from education except for the case of Gini coefficient and RMD where the effect are not statistically significant. As for financial development, the results are mixed whereas we find some evidence of negative and statistically significant impact of net loans and leases (FDIEMP specifications) on income inequality measured by top 10% and the results also suggest the positive and statistically significant effect of net loans and leases on RMD in FDIPPE specification.

Turning to the effects of globalization, the estimation of the model shows that both FDI measures have positive and statistically significant impacts on all U.S. states' income inequality measures while regarding trade and technology, all estimates are not statistically significant.

Table 4.1: Estimation results (FDIEMP specification)

	Income inequality measures					
	Top 1%	Top 10%	Gini Coef.	RMD	Atkinson index	Theil index
FDIEMP	**5.27E-01**	**6.01E-01**	**5.66E-01**	**8.48E-01**	**5.47E-01**	**2.10E+00**
	3.54	5.51	5.57	6.09	5.99	4.52
Trade	-7.35E-03	-1.73E-02	1.97E-02	1.65E-02	-2.16E-02	-1.49E-01
	-0.24	-0.8	0.83	0.63	-1.15	-1.3
Technology	-2.71E-05	-1.31E-06	-4.77E-05	-6.34E-05	-7.93E-06	-2.96E-05
	-0.61	-0.04	-1.39	-1.71	-0.27	-0.17
Per capita GSP	**-6.83E-06**	**-8.18E-06**	**-1.05E-05**	**-1.46E-05**	**-5.57E-06**	**-2.06E-05**
	-3.38	-6.03	-8.14	-8.88	-4.4	-2.78
Per capita GSP Sq.	**1.19E-10**	**1.43E-10**	**1.55E-10**	**2.21E-10**	**1.11E-10**	**4.63E-10**
	4.24	7.48	8.35	9.03	6.6	5.14
College	**-2.20E-03**	**-1.09E-03**	-5.98E-04	**-7.98E-04**	**-1.51E-03**	**-1.09E-02**
	-4	-3.05	-1.87	-2.07	-4.5	-5.11
Union	1.04E-04	-4.67E-06	**-6.24E-04**	**-5.73E-04**	-3.26E-04	-2.53E-03
	0.27	-0.02	-2.44	-1.99	-1.39	-1.79
FIN	2.37E-04	1.16E-04	2.58E-04	-1.05E-04	-1.37E-04	-2.27E-03
	0.31	0.21	0.5	-0.16	-0.3	-0.81
Loan	-3.18E-05	**-3.05E-05**	6.65E-07	6.25E-06	-2.24E-05	-1.08E-04
	-1.66	-2.09	0.05	0.39	-1.77	-1.47
State unemp.	-3.77E-04	**-9.60E-04**	2.93E-04	3.35E-04	**-2.28E-03**	**-1.81E-02**
	-0.56	-2.12	0.73	0.75	-6.27	-7.31

Notes: *1. State, year, and trend effects are not reported.*
2. Bold indicates significance at 5% level.
3. t-statistics are reported under the estimates.
4. We employ the robust or sandwich estimator of variance.

Table 3: Estimation results (FDIPPE specification)

	Income inequality measures					
	Top 1%	Top 10%	Gini Coef.	RMD	Atkinson index	Theil index
FDIPPE	**1.32E-01**	**1.05E-01**	**8.42E-02**	**1.01E-01**	**1.06E-01**	**5.82E-01**
	5.37	5.64	5.81	4.9	5.28	4.52
Trade	6.99E-03	3.55E-03	3.91E-02	**5.07E-02**	-1.49E-03	-8.67E-02
	0.22	0.15	1.58	1.9	-0.08	-0.72
Technology	-2.08E-06	2.30E-05	-2.61E-05	-3.51E-05	1.75E-05	7.55E-05
	-0.04	0.66	-0.69	-0.85	0.53	0.42
Per capita GSP	**-5.72E-06**	**-6.67E-06**	**-9.41E-06**	**-1.31E-05**	**-4.03E-06**	**-1.33E-05**
	-2.94	-4.21	-5.86	-6.25	-2.92	-1.81
Per capita GSP Sq.	**1.10E-10**	**1.32E-10**	**1.48E-10**	**2.13E-10**	**1.00E-10**	**4.08E-10**
	3.83	5.7	6.25	6.75	5.15	4.28
College	**-1.85E-03**	**-8.54E-04**	-4.09E-04	-5.67E-04	**-1.40E-03**	**-1.04E-02**
	-3.58	-2.54	-1.28	-1.46	-4.5	-5.27
Union	3.47E-04	1.68E-04	-4.84E-04	-4.59E-04	-1.99E-04	-1.87E-03
	0.92	0.69	-1.86	-1.53	-0.85	-1.37
FIN	-3.68E-04	-7.62E-04	-7.59E-04	**-1.68E-03**	-8.74E-04	-4.16E-03
	-0.46	-1.11	-1.19	-1.92	-1.44	-1.29
Loan	-1.56E-05	-9.33E-06	2.59E-05	**4.16E-05**	-1.24E-06	-3.46E-05
	-0.89	-0.62	1.85	2.29	-0.09	-0.47
State unemp.	-2.03E-04	-7.38E-04	5.61E-04	6.73E-04	**-2.21E-03**	**-1.84E-02**
	-0.29	-1.46	1.31	1.29	-5.63	-7.22

Notes: *1. State, year, and trend effects are not reported.*
2. Bold indicates significance at 5% level.
3. t-statistics are reported under the estimates.
4. We employ the robust or sandwich estimator of variance.

So far, the results with two-way fixed effects models indicate that inward FDI, a component of globalization, increases income inequality in U.S. That being said it is important to check the sensitivity of the finding. To check the robustness of our findings, we apply first difference method on variables in Eq. (1) and re-estimate the model (see Eq. (2)). In this way, we not only control time invariant unobserved effects as two-way fixed effects model does, but also reduce the risk of the spurious regression problem than may arise (Wooldridge, 2009).

$$\Delta y_{it} = \phi_0 + \phi_1 \Delta FDI_{it} + \phi_2 \Delta Trade_{it} + \phi_3 \Delta Tech_{it} + Controls + \tau_t + \varepsilon_{it} \quad \text{Eq. (2)}$$

The results from first difference estimators are reported in Table 4 (FDIEMP) and Table 5 (FDIPPE). Whereas FDIEMP measures have positive and statistically significant impacts on U.S. states' income inequality measured by the top 1%, top 10%, Gini coefficient, RMD, and Atkinson index except for Theil index, FDIPPE measure appears to have no statistically significant effect on all income inequality measures. Thus, the result suggests that different FDI measures are likely to matter for FDI effects on income inequality. We also find evidence that trade measured by U.S. states' export in percent of GSP has positive and statistically significant effect on top 1% though there is no evidence on the impact of technology on income inequality.

Table 4.3: Estimation results with first difference estimator (FDIEMP)

	Income inequality measures					
	Top 1%	Top 10%	Gini Coef.	RMD	Atkinson index	Theil index
FDI	**4.15E-01**	**2.18E-01**	**1.95E-01**	**2.84E-01**	**2.13E-01**	8.11E-01
t-stats	3.31	2.59	2.45	2.92	2.55	1.51
Trade	**8.19E-02**	5.79E-02	5.77E-02	5.35E-02	4.74E-02	2.13E-01
t-stats	2.02	1.64	1.77	1.3	1.42	1.11
Tech.	-1.26E-04	-1.47E-05	-1.18E-04	-1.06E-04	-4.64E-05	-3.25E-04
t-stats	-0.7	-0.12	-0.93	-0.73	-0.39	-0.47

Notes: *1. Year specific effects and other control variables are not reported.*
2. Bold indicates significance at 5 % level.
3. We employ the robust estimator of variance.
4. All variables above are first differenced.

Table 4.4: Estimation results with first difference estimator (FDIPPE)

	Income inequality measures					
	Top 1%	Top 10%	Gini Coef.	RMD	Atkinson index	Theil index
FDI	2.43E-02	1.62E-02	4.37E-03	3.32E-03	1.49E-02	1.48E-02
t-stats	0.74	0.75	0.26	0.14	0.64	0.1
Trade	**8.86E-02**	6.24E-02	5.05E-02	5.57E-02	5.56E-02	2.48E-01
t-stats	2.11	1.74	1.51	1.3	1.64	1.27
Tech.	-1.51E-04	-4.48E-05	-1.29E-04	-1.46E-04	-7.54E-05	-5.03E-04
t-stats	-0.84	-0.36	-1.01	-1	-0.63	-0.71

Notes: *1. Year specific effects and other control variables are not reported.*
2. Bold indicates significance at 5 % level.
3. We employ the robust estimator of variance.
4. All variables above are first differenced.

CHAPTER V
CONCLUSION

Employing state-level panel data on 48 states from 1988-2003, the researcher estimates the impact of globalization and technology advances on U.S. states' income inequality. The results from the two-way fixed effects model indicate that inward FDI measured by both FDIEMP and FDIPPE show a statistically significant increase in income inequality while international trade openness and technology advance do not. Some of the control variables showed that they have an effect on income inequality. As such, per capita GSP reduced income inequality in most measures except Theil's entropy index (FDIPPE specification) while per capita GSP square increased income inequality. Moreover, education of the people in the state somehow reduced income inequality in most measures.

After applying first difference method models, the results show that inward FDI measured by FDI-related employment has positive and statistically significant effects on five out of six U.S. states' income inequality measures. With the first difference estimator, the researcher finds some evidence that trade has positive and statistically significant effects on top-income shares though there is no evidence on the impact of technology on income inequality.

In line with the results summarized above, if governments or policymakers wish to stimulate inward FDI-related employment or impose any regulation on inward FDI-related employment, they need to pay close attention to the income inequality issue as the study shows more significant effects from FDIEMP on income inequality rather than from FDIPPE. Meanwhile, international trade and technology advances have no statistically significant impact on income inequality.

Finally, there are some interesting variables among the control variables in the model which show some statistical significance such as per capita GSP, unionization rate, college degrees and unemployment rate which may be further investigated in future research.

BIBLIOGRAPHY

Acemoglu, D. (2003). Cross-country inequality trends, *Economic Journal, 113*, 121-149.

Autor, D. H., Katz, L.F. & Krueger, A.B. (1998). Computing inequality: have computers changed the labor market? *Quarterly Journal of Economics, 113*, 1169–1213.

Barro, R. J. & Lee, J.-W. (2001). International data on educational attainment: updates an implication. *Oxford Economic Papers, 53*, 541-563.

Bartel, A.P. & Sicherman, N. (1999). Technological change and wages: an interindustry analysis. *Journal of Political Economy, 107*, 285–325.

Berman, E., Bound, J. & Griliches, Z. (1994). Changes in the demand for skilled labor within U.S. manufacturing: evidence from the annual survey of manufacturers. *Quarterly Journal of Economics, 109*, 367–397.

Berndt, E.R. & Morrison, C.J. (1995). High-Tech capital formation and economic performance in U.S. manufacturing industries: an exploratory analysis. *Journal of Econometrics, 65*, 9–43.

Blonigen, B.A. & Slaughter, M.J. (2001). Foreign-affiliate activity and U.S. skill upgrading. *Review of Economics and Statistics, 83*, 362-376.

Bobonis, G.J. & Shatz, H.J. (2007). Agglomeration, adjustment, and state policies in the location of foreign direct investment in the United States. *Review of Economics and Statistics, 89*, 30–43.

Chintrakarn, P. & Chen, Y. (2010). Do unions impact efficiency? evidence from the U.S. manufacturing sector. *Contemporary Economic Policy,* no. doi: 10.1111/j.1465-7287.2010.00228.x

Choi, C. (2006). Does foreign direct investment affect domestic income inequality? *Applied Economics Letters, 13*, 811-814.

Coe, D.T. & Helpman, E. (1995). International R&D spillovers. *European Economic Review, 39(5),* 859-887.

Cohen, J.P. & Morrison Paul, C. (2004). Public infrastructure investment, inter-state spatial spillovers, and manufacturing costs. *Review of Economics and Statistics, 86*, 551-560.

Deininger, K. & Squire, L. (1996). A new data set measuring income inequality. *World Bank Economic Review, 10*, 565-591.

Driffield, N. & Taylor, K. (2000). FDI and the labour market: a review of the evidence and policy implications. *Oxford Review of Economic Policy, 16*, 90-103.

Feenstra, R. C. & Hanson, G. H. (1997) Foreign direct investment and relative wages: evidence from Mexico's maquiladoras. *Journal of International Economics, 42*, 371–93.

Forbes, K.J. (2000). A reassessment of the relationship between inequality and economic growth. *American Economic Review, 90*, 869–887.

Frank, M.W. (2008). A new state-level panel of income inequality measures over the period 1916-2005. *SHSU Economics & Int. Business.* Working Paper no. SHSU_ECO_WP08-02.

Frank, M.W. (2009). Inequality and growth in the United States: evidence from a new state-level panel of income inequality measure. *Economic Inquiry, 47*, 55-68.

Fredriksson, P.G., List, J.A. & Millimet, D.L. (2003). Bureaucratic corruption, environmental policy, and FDI: theory and evidence from the United States. *Journal of Public Economics, 87*, 1407-1430.

Goldberg, P.K. & Pavcnik, N. (2007). Distributional effects of globalization in developing countries. *Journal of Economic Literature, 45*, 39–82.

Henderson, D.J. & Millimet, D.L. (2007). Pollution abatement costs and foreign direct investment inflows to U.S. states: a nonparametric reassessment. *Review of Economics and Statistics, 89*, 178-183.

Hirsch, B.T. & Macpherson, D.A. (2003). Union membership and coverage database from the current population survey: note. *Industrial and Labor Relations Review, 56*, 349-354.

Jaumotte, F., Lall, S. & Papageorgiou, C. (2008). Rising income inequality: technology, Or trade and financial globalization? *IMF Working Papers 08/185*, International Monetary Fund.

Jensen, N.M. & Rosas, G. (2007). Foreign direct investment and income inequality in Mexico, 1990-2000. *International Organization, 61(3),* 467-487.

Keller, W. & Levinson, A. (2002). Environmental regulations and FDI inflows to U.S. states. *Review of Economics and Statistics, 84,* 691-703

Keller, W. & Yeaple, S.R. (2003). Multinational enterprises, international trade, and productivity growth: firm-level evidence from the United States. *IMF Working Papers 03/248,* International Monetary Fund.

Leichenko, R.M. & Erickson, R.A. (1997). Foreign direct investment and state export performance. *Journal of Regional Science, 37,* 307–329.

Leigh, A.K. (2007). How closely do top income shares track other measures of inequality? *Economic Journal, 117,* 619–633.

Piketty, T. & Saez, E. (2003). Income inequality in the United States, 1913-1998," *Quarterly Journal of Economics, 118,* 1-39.

Slaughter, M.J. (2000). Production transfer within multinational enterprises and American wages. *Journal of International Economics, 50,* 449-472.

Taylor, K. & Driffield, N. (2005). Wage inequality and the role of multinationals: evidence from UK panel data. *Labor Economics, 12,* 223-249.

Wooldridge, J.M. (2009). Introductory econometrics: a modern approach. *South-Western.*

BIOGRAPHY

NAME	Mr. Chatchai Chordokrak
DATE OF BIRTH	11 December 1983
PLACE OF BIRTH	Ang-Thong, Thailand
INSTITUTIONS ATTENDED	Assumption University, 2006 Bachelor of Business Administration Mahidol University, 2011 Master of Business Administration (Business Modeling and Analysis)
HOME ADDRESS	171 Soi Bangwaek 7, Bangwaek Sub-District, Phasicharoen District, Bangkok, Thailand Tel. +66817217511 Email: chatchaicdr@gmail.com
PUBLICATION	"Globalization, Technology and Income Inequality: New Evidence" International Research Journal of Finance and Economics. ISSN 1450-2887 Issue 62 (2011)