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Vietnam: The Next Asian Tiger?

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Abstract

We investigate the growth experience of Vietnam, the country which has been getting recent attention as being the next emerging giant. First, we present an aggregate level investigation of Vietnam's economic growth experience, since the inauguration of reform in 1986 known as *Doi Moi*. Second, we build a two-sector general equilibrium model, investigating the secular decline in agricultural employment. We conduct a quantitative analysis using a theoretical framework, with an emphasis on the counterfactual outcomes of inheriting Chinese sectoral productivity growth rates, where China is recognized as the paragon emerging economy. The main findings are: (i) Vietnam has grown impressively since 1986, but is still a relatively poor country in absolute terms; (ii) Vietnam must decrease its reliance on factor accumulation as its source of growth and increase its technological capabilities; (iii) economic policies should equally target both agricultural and nonagricultural sectors to increase sectoral productivity growth rates in Vietnam.

JEL classification: N10, O47, O53, O57.
Keywords: Vietnam; capital formation; convergence; deagriculturalization

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1 Introduction

Vietnam is on its way to becoming a major development success story. Thirty years after implementing economic reforms, known as *Doi Moi* (usually translated as 'renovation') in 1986, Vietnam has recorded significant and historic achievements. Before 1986, Vietnam had a centrally-planned economy, characterized by low levels of income and widespread poverty. From a poor, insular economy closed off from much of the outside world, Vietnam in a single generation has made the transition to a middle-income country, with a globally integrated, socialist-orientated market economy.

The spectacular growth of large emerging market economies in East Asia over the past six decades has amazed the economics profession, evoking a vast array of literature attempting to explain the phenomenon. First, it was Japan in the post-World War II era[1], followed by the *Four Tigers* (Hong Kong, Singapore, South Korea, and Taiwan)[2] in the 1960s, then China's growth miracle emanating from 1978.[3] All of these countries experienced prolonged periods of economic expansion. Vietnam is seen by many as the next emerging giant. In 2005, Vietnam was included in Goldman Sachs' *Next Eleven*.[4] This was a group of eleven countries whom they believed had the greatest potential to become the next group of major economies in the 21st century, based on a set of indicators, such as education and demographics (O'Neill et al., 2005). In 2009, the Economist Intelligence Unit included Vietnam in *CIVETS*.[5] This was a group of six countries whom they touted to become the next generation of emerging market economies, based on factors such as low public debt, favorable demographics and rising levels of foreign direct investment (FDI) (see Greenwood, 2011). PricewaterhouseCoopers (2015) predicted that Vietnam could be one of the fastest growing economies in the world over the 2015-2050 period.

[1] See Vogel (1979).
[2] See Vogel (1991).
[3] See Vogel (2011).
[4] The *Next Eleven* is comprised of Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, Philippines, South Korea, Turkey, and Vietnam (see O'Neill et al., 2005 for details).
[5] *CIVETS* is comprised of Colombia, Indonesia, Vietnam, Egypt, Turkey, and South Africa (`http://www.economist.com/blogs/theworldin2010/2009/11/acronyms_4`).

Figure 1 illustrates the perception of Vietnam as a nascent Asian Tiger. Early signs indicate that Vietnam is well on its way to emulating the growth miracles of Japan, the *Four Tigers*[6] and China. The average annual growth rate of Vietnam's real GDP per capita between 1986 and 2014 was 5.6% per year.[7] If this current growth trajectory continues for another decade, Vietnam's transition out of an emerging market economy would be similar to the *Four Tigers* seen in Figure 1. The Economist (2016) predicts that if Vietnam can maintain a 7% pace over the next decade, the country will follow the same trajectory as South Korea and Taiwan. However, if annual growth were to fall to less than 4%, Vietnam would follow in the underwhelming footsteps of Latin American economies.[8]

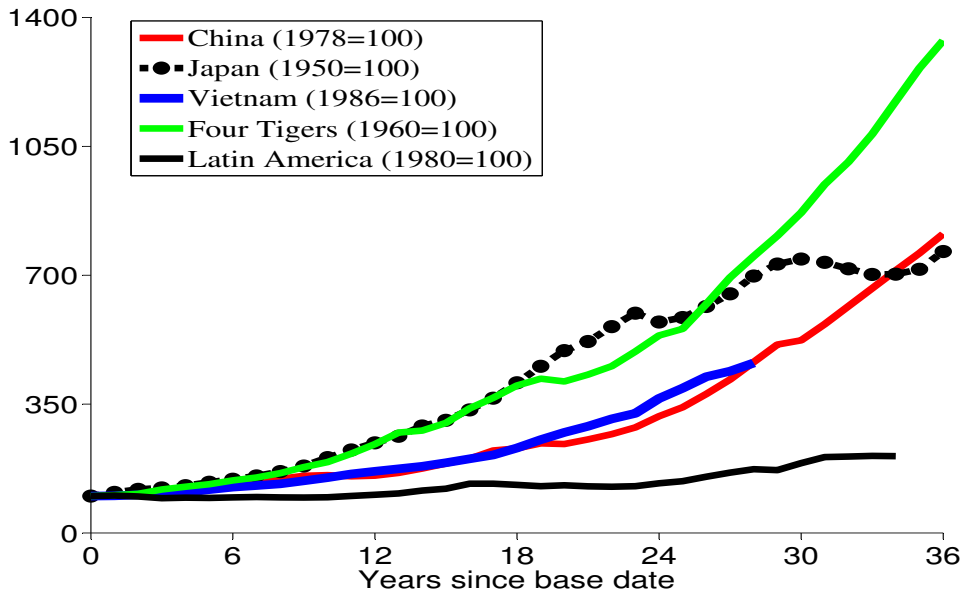

Figure 1: Real GDP per capita indices

This paper picks up Vietnam's economic development at the inauguration of comprehensive reforms. Its purpose is to analyse Vietnam's convergence experience since 1986,

[6]GDP per capita for the Four Tigers and Latin America (Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and Venezuela) are calculated via a population-weighted averages.

[7]We use the variable *rgdpe* from the latest version of the Penn World Table (PWT 9.0). This variable provides expenditure-side real GDP at chained purchasing power parity (PPP) rates (in millions of 2011US$), to compare relative living standards across countries and over time. Population, the variable *pop*, is given in millions of people. GDP per capita is computed as *rgdpe*/*pop*.

[8]Cole et al. (2005) name Latin America as a development outlier.

identifying the drivers of growth emanating from *Doi Moi*. The analysis of Vietnam's economic development is not conducted in isolation. We include the experiences of comparable countries, such that a measure of relative performance is established.

First we break down GDP per capita into three components: labor productivity, the ratio of employment to the working-age population and the ratio of the working-age population to the total population. This decomposition is useful for distinguishing the overall population from the working-age population and providing insights into how shifts in the age structure of a population (in addition to improvements in labor productivity) influence economic growth. This accounting exercise tells two clear stories. First, GDP per capita growth in Vietnam was significantly improved from the mid-1980s, after the introduction of *Doi Moi*. Second, growth in labor productivity was the main source of income per capita growth. Between 1986 and 2014, GDP per person employed in Vietnam improved from 3.6% of the U.S. level in 1986 to 8.6% of the U.S. level in 2014.

Second, after observing the importance of labor productivity growth as the main source of per capita income changes in Vietnam, we decompose changes in output per worker into those stemming from the total factor productivity (TFP) component, those from physical capital per worker and those from human capital per worker. The capital-output ratio in Vietnam decreased from 1.7 in 1970 to 1.3 in 1985. The ratio ranged between 1.3 and 1.5 between 1985 and 1997, before increasing rapidly to 2.0 in 2003 and 2.7 in 2014. This signals a decrease in capital-output efficiency and we find that TFP levels actually declined from 1997 to 2014.

Despite successful growth rates of output per capita/worker in the last three decades, Vietnam is still facing a list of challenges in its efforts to sustain economic development. Focusing on one those challenges, we look at Vietnam through the lens of a structural transformation perspective. Despite notable structural change over the past thirty years, agriculture still has a substantial weight in the Vietnamese economy, absorbing nearly one half of employment, whilst contributing one fifth of GDP in 2013. We introduce a two-

sector general equilibrium model to study the deagriculturalization of Vietnam and conduct a quantitative analysis using the theoretical framework with an emphasis on the counterfactual outcomes of inheriting Chinese sectoral productivity growth rates.

This paper has two distinct contributions. First, we follow a well-established practice in the literature of economic development by assessing whether the Vietnamese economy is getting closer to the world frontier represented by the United States (U.S.) in a process known as "catching-up." We begin with a top-down approach that performs growth and level accounting exercises. These decompositions offer the possibility to track the economic progress of Vietnam and to formulate policy accordingly. Second, we study a two-sector (an agricultural and a non-agricultural sector) general equilibrium model to investigate what we believe is one of the most important facets of Vietnam's future development: explaining the pace of secular decline in agricultural employment, a phenomenon known as deagriculturalization. We conduct a quantitative analysis using a theoretical framework, with an emphasis on the counterfactual outcomes of inheriting Chinese sectoral productivity growth rates to answer the following question: What would have happened to the share of employment in the two sectors and overall GDP per worker if Vietnam had followed Chinese productivity growth rates?

This paper is original in a number of facets. First, to our best knowledge, this is the first detailed study conducted on Vietnam's convergence experience using newly available data from the Penn World Table (PWT) version 9.0. Feenstra et al. (2015) describe the latest developments in the PWT and their relationship to the predecessors. PWT 9.0 features several upgrades in terms of concepts, methods, and data sources, while it also expands the set of variables required by growth and development accounting exercises in a comparative perspective (Harchaoui and Üngör, forthcoming).[9] Therefore, the results we report have a high degree of relevance and accuracy in terms of policy implications for Vietnam. Second, to our best knowledge, this is the first study to employ a two-sector general equilibrium model of

[9] `http://www.rug.nl/ggdc/productivity/pwt/`

structural transformation looking at the sectoral allocation of Vietnam's production factors and the subsequent implications for aggregate productivity with alternative counterfactual experiments. Lastly, although the literature on Vietnam's sources of growth since *Doi Moi* is extensive, this research has predominantly been conducted in isolation. This paper investigates Vietnam's convergence experience through a comparative lens. By doing so, a more definitive conclusion can be reached as to whether Vietnam is likely to emulate the success of past Asian Tigers.

Our theoretical framework for the structural analysis is closely related to a body of literature that studies multi-sector general equilibrium models (i) to understand the sources of structural transformation in factors of production, and (ii) to quantify the impact of the shift of resources across sectors on aggregate productivity.[10] We study a simple and stylized two-sector model to investigate the role of improvements in agricultural and non-agricultural productivity growth rates for (i) secular declines in agricultural employment share in Vietnam during 1990-2013, and (ii) aggregate labor productivity growth in Vietnam during 1990-2013. The model we adopt is based on a two-sector model in which deagriculturalization is generated through non-homothetic preferences and differing productivity growth across sectors, as in Rogerson (2008), Duarte and Restuccia (2010), İmrohoroğlu et al. (2014), Üngör (2017).

The main findings are: (i) Vietnam has grown impressively since 1986, but is still a relatively poor country in absolute terms; (ii) Vietnam must decrease its reliance on factor accumulation as its source of growth and increase its technological capabilities; (iii) the pace at which deagriculturalization occurs in the future is one of the most important determinants of aggregate productivity. These findings provide interesting policy implications. Given Vietnam is still in her early stages of development, the negligible contribution of TFP to growth is somewhat justifiable. However, as Krugman (1994b, p. 63) puts it, "economic growth that is based on an expansion of inputs, rather than on growth in output per unit of

[10]See Herrendorf et al. (2014) for a comprehensive review of the related literature.

input, is inevitably subject to diminishing returns." Vietnam's expansion has occurred with a notable absence of technological advancement since 1997. Given this fact, past rates of economic growth are unlikely to be sustained if they fail to improve their productive capacity and technological proficiency.

This paper is organized as follows: Section 2 provides background information on the Vietnamese economy. Section 3 utilizes GDP per capita in an international context, providing an insight into Vietnam's relative performance either side of 1986, before discussing implications for the Vietnamese economy. Section 4 decomposes changes in output per worker into those stemming from the TFP component, those from physical capital per worker and those from human capital per worker. Section 5 looks at Vietnam through the lens of a structural transformation perspective. Section 6 introduces a two-sector general equilibrium model to study the deagriculturalization of Vietnam and conducts a quantitative analysis using the theoretical framework. Section 7 concludes.

2 Some Characteristics of the Vietnamese Economy

2.1 A Brief Economic History of Vietnam in One Picture

Using PPP-adjusted per capita GDP as a proxy for economic development, we explore the convergence experience of Vietnam since 1950, using the U.S. as a benchmark. Figure 2 displays Vietnamese GDP per capita in relation to that of the U.S. over the 1950-2016 period.[11] In 1950, GDP per capita in Vietnam was 6.8% of the U.S. level. By 2016, this has only improved to 10.9%. Historically, this is a disappointing accomplishment case. We need to delve into the rich history of Vietnam over this time period to investigate why Vietnam's process of catching up has been slow.

[11] We use the variable "GDP per capita in 2015 US$ (converted to 2015 price level with updated 2011 PPPs", which reflects the rapid declines in the prices of information and communication technology goods, from the November 2016 version of the Conference Board Total Economy Database. Note that data for Vietnam in PWT 9.0 start in 1970.

Vietnam gained independence from the French colonial regime in 1954, where after the defeat of France at the Battle of Dien Bien Phu, Vietnam was partitioned in two: the Democratic Republic of Vietnam (known as North Vietnam) and the Republic of Vietnam (known as South Vietnam). North Vietnam pursued the strategy of socialist transformation based on the Soviet and Chinese models. For example, during the 1965-1975 period, the Union of Soviet Socialist Republics (USSR) and China poured more than $3 billion of non-military aid into North Vietnam (Theriot and Matheson, 1985, Table 5). On the other hand, non-military American aid into South Vietnam was more than 30% of GNP in the 1960s (Beresford, 1989, p. 80). The Vietnam War (1954-1975), a conflict that pitted the communist government of North Vietnam against the government of South Vietnam and its principal ally, the U.S., was catastrophic for the Vietnamese economy.[12] GDP per capita fell from 7.0% of the U.S. level in 1954 to under 5% in 1975.

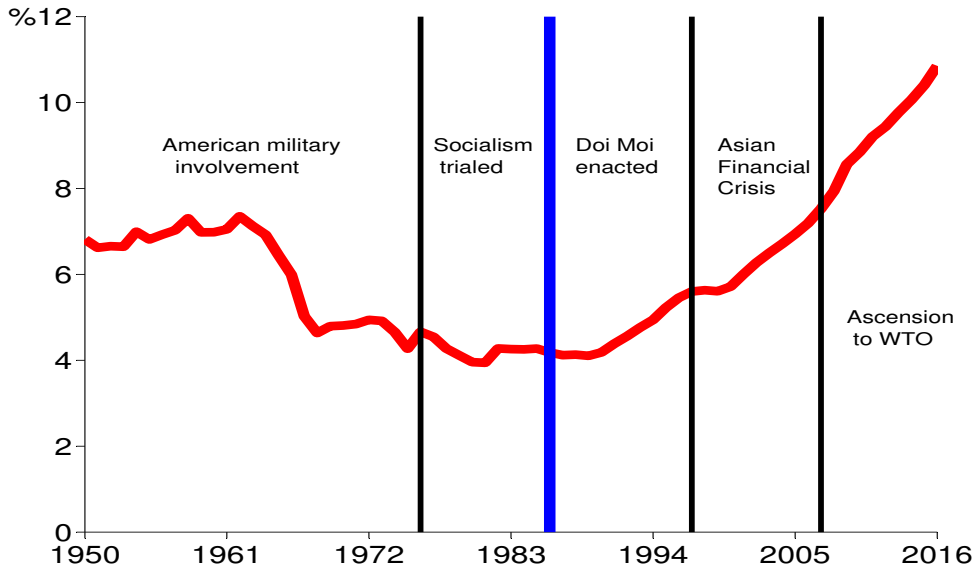

Figure 2: Real GDP per capita relative to the U.S. (%), 1950-2016

Upon formal reunification as the Socialist Republic of Vietnam (commonly known as

[12] "The U.S. did not recognize North Vietnam's government, maintaining the U.S. Embassy in South Vietnam, supporting the South against the North, and entering the war on the South's side. In 1975, the U.S. closed its Embassy and evacuated all Embassy personnel just prior to South Vietnam's surrender to North Vietnamese forces." (`https://www.state.gov/r/pa/ei/bgn/4130.htm`)

Vietnam) in July 1976, the Vietnamese Communist Party (VCP)[13] developed a socialist, centrally-planned economic system in the North with the intention to transfer this model to the South. The Second Five-Year Plan (1976-1980) set extraordinarily high goals "for the average annual growth rates for industry (16 to 18%), agriculture (8 to 10%), and national income (13 to 14%)" (Cosslett and Shaw, 1989, p. 150). State and collective ownership was prioritised to private ownership, with emphasis given to the development of heavy industry. The agricultural sector was populated by cooperatives, with the non-agricultural sector comprised of inefficient state owned enterprises (SOEs). The socialist reform had a particularly poor impact. Misaligned incentives in agriculture and inefficient investment in heavy industry did not help the convergence of Vietnam's economy, with GDP per capita relative to the U.S. remaining below 4.5% by 1985.

It was not until the second half of the 1980s that Vietnam began the catch up process. The first signs of convergence emerged in the late 1980s, sparked by the comprehensive reform program, *Doi Moi*, introduced in 1986. Reforms were announced in 1986, but proceeded gradually. At its core, *Doi Moi* aimed to transition Vietnam's economic system from a centrally controlled command economy to one based on market principles and the profit motive. Under this structure, the development of private sector production was emphasised, the role of SOEs was reduced, with exports and FDI encouraged. *Doi Moi* accelerated from 1989 on. Prices were gradually freed and the dual price system[14] was abolished, thus strengthening the incentive to produce. Trade was progressively liberalised, signified by the signing of various free trade agreements with both Asian and Western countries.[15] These reforms boosted Vietnam's exports from 6.6% of GDP in 1986 to 89.8% in 2015. Similarly,

[13] "Ho Chi Minh founded the Vietnamese Communist Party on 3 February 1930, and the First Congress was held in 1935 at the Portuguese colony of Macau. The Communist Party became the Vietnamese Workers' Party in February 1951 and the Communist Party of Vietnam in 1976" (Jeffries, 2006, pp. 3-4).

[14] A system where most output (both agricultural and industrial) had to be sold to the state at official prices, and the balance could be sold at market prices.

[15] In 1995, the U.S. announced the formal normalization of diplomatic relations with Vietnam. One of the turning points for Vietnam's integration into the global economy came in December 2001 when the U.S.-Vietnam Trade Agreement went into force. In May 2016, President Obama visited Vietnam to celebrate the comprehensive partnership between the two countries.

the import-to-GDP ratio increased from 16.6% in 1986 to 89.0% in 2015.[16]

Although Vietnam did begin to "catch up" following the introduction of *Doi Moi*, this process started from a very low base; Vietnamese per capita GDP was just 4.2% of the U.S. level in 1990. The average annual growth rate of per capita GDP in Vietnam between 1990 and 2016 was 5.5%. This was amongst the best performing countries in the world over this time period. The slowdown in convergence beginning in 1997 can be attributed to the Asian crisis, when the availability of external funds dried up and global demand for Vietnam's exports waned. However, prior to 1997, Vietnam lagged behind most South East Asian countries in terms of international integration. This minimised the headwinds emanating from the crisis, prompting a relatively swift recovery, with annual GDP per capita averaging more than 5.9% during 2000-2007. Following the global financial crisis of 2007-2008, GDP per capita growth in Vietnam eased off, with falling external demand for exports the main culprit. In the 2000s, Vietnam introduced various new economic policies, enabling Vietnam's accession to the World Trade Organisation (WTO) in January 2007 as the 150th member. Vietnam's admission to the WTO has provided a stimulus to growth in recent years (Chaponnière et al., 2008).

2.2 The Relative Size of Vietnam's Economy

The U.S. economy is the largest in the world in terms of nominal GDP. As of 2015, U.S. nominal GDP was $18.0 trillion (measured in current US$ prices), more than one-fifth of gross world product. China, the world's most populous country, was a $11.0 trillion economy in 2015 making it the second largest in the world in terms of nominal GDP. The size of Vietnam's economy pales in comparison to both China and the U.S. Using nominal GDP as a proxy, China's economy was 7.1% of the U.S. in 1985, growing to 61.0% in 2015. By this same measure, Vietnam's economy was 0.3% of the U.S. in 1985, expanding to just over 1% in 2015. However, in terms of PPP-adjusted GDP, China recently overtook the U.S. as the

[16]Export-to-GDP and import-to-GDP ratios are from the World Bank's World Development Indicators (WDI) (World Bank, 2017).

largest economy in the world. By this measure, the size of Vietnam's economy is less than 3% of China's size in 2015.[17]

The World Bank presents a classification system where a country is annually ranked by their level of gross national income (GNI) per capita.[18] There are four possible categories a country can fall into; low income, lower-middle income, upper-middle income and high income. The threshold values are updated annually with adjustments made for inflation. This annual recalibration allows for the development experiences of countries to be documented over time. According to this measure, Vietnam was classified as a low income country till 2009. Starting in 2009, Vietnam has been considered a lower-middle income country. Comparatively, China was classified as a low income economy in 1990, a lower-middle income country in 2000 and an upper-middle income country in 2010.

Vietnam's economy is small in absolute terms, compared with its South East Asian peers. The Association of Southeast Asian Nations (ASEAN) is a political and economic organisation of ten Southeast Asian countries established in 1967. The ASEAN Six Majors refers to the six largest economies in the area that are many times larger than the other four ASEAN countries. These are; Indonesia, Thailand, Malaysia, the Philippines, Singapore and Vietnam. Furthermore, the five countries excluding Vietnam were the "founding fathers" of the association.[19] Throughout this paper, we shall refer to these remaining five countries as the *ASEAN Majors*. They act as comparable countries to ascertain Vietnam's convergence experience. In addition to the the *ASEAN Majors*, we choose to include China as a peer of Vietnam throughout this paper for a number of reasons. First, China is seen as the paragon emerging economy; it has been the fastest growing country in the world since 1978. Second, China provided policy guidance to Vietnam in the 1950s (Vu, 2010, p. 100).[20]

[17] All data are from the WDI (World Bank, 2017).

[18] Classifications by income available at `siteresources.worldbank.org/DATASTATISTICS/Resources/OGHIST.xls`

[19] http://asean.org/the-asean-declaration-bangkok-declaration-bangkok-8-august-1967/

[20] China recognised the government of Ho Chi Minh in 1950 and sent arms, supplies, and advisers in 1952; whereas the U.S. and the USSR supported France in its attempts to regain control over Vietnam (Theriot and Matheson, 1985). China and Vietnam share a border, with their development paths both inspired by the Soviet Union. There is also a literature documenting the ways in which early Vietnamese leaders adapted

Furthermore, analogous to Vietnam in 1986, China underwent a similar reform process starting in 1978. Both countries transitioned from centrally-planned systems, toward market-orientated systems that are integrated into the world economy.

3 GDP per Capita

This section focuses on differences in GDP per capita across Vietnam and its comparable peers. GDP per capita is typically seen as an informative indicator of a country's living standards, or of welfare across a broad range of countries.[21]

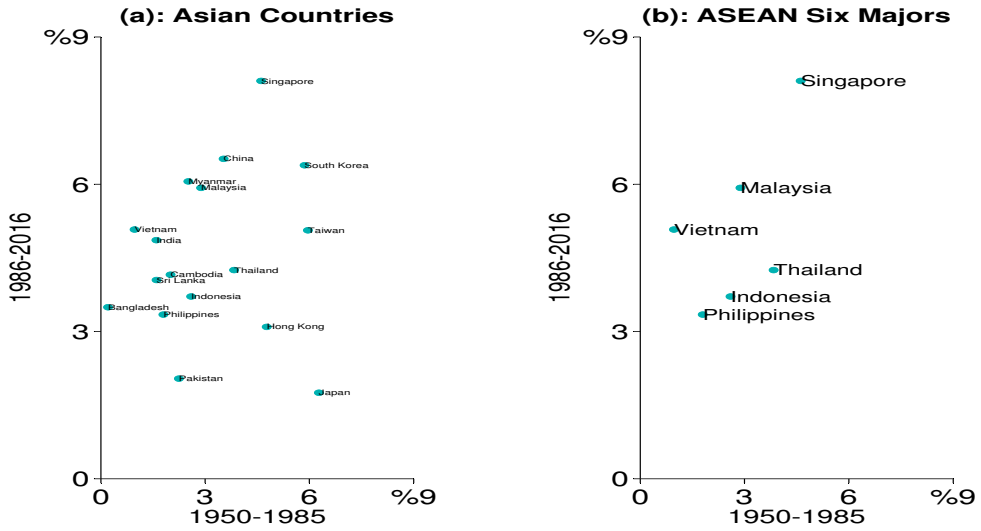

Figure 3: A comparison of GDP per capita growth in Asia (%)

Figure 3 shows annual average growth rates of GDP per capita for a selection of Asian countries. The x-axis represents the time period (1950-1985) before *Doi Moi* occurred in Vietnam. Over this period, average annual GDP per capita growth in Vietnam was slightly less than 1%. This was the worst compared to any other Asian country (except Bangladesh) in Figure 3. The y-axis represents the time period (1986-2016) following the implementation of *Doi Moi*. Average annual GDP per capita growth over this period in Vietnam was

Chinese state institutions (see Dell et al., 2017 and the references therein).

[21]See Jones and Klenow (2016) for a discussion of different welfare measures across countries and time.

considerably higher (slightly over 5%), outperformed by only China, Malaysia, Myanmar, Singapore, and South Korea.

3.1 Decomposing GDP per Capita

Framework. We study the following accounting exercise where GDP per capita for each time period t is broken into three components:

$$(Y/P)_t = (Y/L)_t \times (L/WP)_t \times (WP/P)_t. \tag{1}$$

In Equation (1), Y is real GDP, P is total population, L is the employed population, with WP representing the working-age population (those aged between 15-64). Hence, real GDP per capita (Y/P) is expressed as a product of real GDP per worker (labor productivity) (Y/L), the ratio of employment to the working-age-population (L/WP), and the ratio of the working-age population to the total population (WP/P). Taking logarithms of both sides of Equation (1) allows us to decompose the average annual growth rate of output per capita over z years (from time t to time $t+z$), where ln is the natural logarithm operator:

$$\frac{ln\left(\frac{Y}{P}\right)_{t+z} - ln\left(\frac{Y}{P}\right)_t}{z} = \frac{ln\left(\frac{Y}{L}\right)_{t+z} - ln\left(\frac{Y}{L}\right)_t}{z} + \frac{ln\left(\frac{L}{WP}\right)_{t+z} - ln\left(\frac{L}{WP}\right)_t}{z} + \frac{ln\left(\frac{WP}{P}\right)_{t+z} - ln\left(\frac{WP}{P}\right)_t}{z}. \tag{2}$$

The formulation in Equation (2) helps explain how these three measurable components of the data explain the evolution of GDP per capita in Vietnam. Changes in output per worker (the first term on the right hand side), changes in the employment to working age population ratio (the second term on right hand side), and changes in the demographic ratio (the third term on the right hand side) (referring to effects arising from the higher share of working-age population within the total) all sum to explain changes in GDP per capita.

Data and results. We plug Vietnamese national currency data into the accounting exercise introduced in Equation (2). From the PWT 9.0, we retain the variables for GDP,

employment, and total population. Specifically, we use the variable *rgdpna* (real GDP at constant 2011 national prices (in millions of 2011US$) for GDP. Employment, the variable *emp*, is given as number of persons engaged (in millions). Population, the variable *pop*, is given in millions of people. Population ages 15-64 (% of total population) data are from the WDI (World Bank, 2017). Table 1 presents the results for Vietnam.

Table 1: GDP per capita decomposition in Vietnam

	Average annual changes, %			
Period	Y/P	Y/L	L/WP	WP/P
1970-1985	2.5	1.5	0.4	0.6
1986-2014	5.0	4.1	0.01	0.8
1970-2014	4.0	3.1	0.2	0.7

Source: PWT 9.0 and WDI (World Bank, 2017).

During 1970-1985, per capita income grew at 2.5% per year and output per worker increased 1.5% per year. The expansion in output per worker made up 61.2% of the increase in per capita income between 1970 and 1985. Rising participation rates accounted for 15.6% and enlargement in the working-age share of the total population made up 23.2% of the increase in per capita income between 1970 and 1985. GDP per capita grew 5.0% per year on average over the 1986-2014 period. Labor productivity improvements accounted for 83.0% of this growth. Participation rates accounted for only 0.2% and enlargement in the working-age share of the total population made up 16.7% of the increase in per capita income between 1986 and 2014.

Whilst the contribution of the demographic ratio to annual GDP per capita growth in Vietnam pales in comparison to the contribution of labor productivity improvements, changes in Vietnam's demographic structure should not be overlooked in accounting for income per capita growth over the last three decades. Indeed, Vietnam is currently enjoying a golden population structure, in which the working age population is nearly double the dependent population. The percentage of the population aged between 15 and 64 rose from around

56% in 1986 to slightly over 70% in 2014. This is reflected in our results, with an increase in the working-age population to total population ratio contributing roughly 15% of GDP per capita growth, on average, between 1986 and 2014. This positive contribution is known as the "demographic dividend," or demographics that promote economic growth (see Bloom et al., 2010).[22]

Demographic dynamics. Two common ratios are used to determine whether a country is experiencing favorable demographics. The first is the *dependency ratio*, which is the ratio of the dependent-age group (persons under age 15 and over age 64) to the working-age population (those aged 15 to 64 years old). This ratio provides information about economically inactive cohorts to economically active cohorts, reflecting how many people each working-age person has to support. A low dependency ratio indicates that there are proportionally more working-age adults who can support the young and the elderly of the population. The second is the *support ratio*, which is a measure showing the number of effective workers (those aged 15 to 64 years old) to the total population. The support ratio describes the relationship between the people who are supporting the whole economy and the consumption needs of all of the people in the economy. A rise in the support ratio indicates a lower level of dependence. A growing support ratio implies an expansion of the labour force, promoting savings and investment. Furthermore, a declining dependency ratio implies falling consumption, further supporting savings and investment in an economy.

In panel (a) of Figure 4, we plot the support and dependency ratios for Vietnam. The support ratio ranged between 50.6% and 55.4% during 1960-1985. Then, it increased from 55.7% in 1986 to 70.2% in 2015. The dependency ratio increased from 81.3% in 1960 to 97.5% in 1968; and started to decline after that: it was around 80% in 1986, 59% in 2001,

[22] According to Bloom et al. (2003), countries that reaped the benefits of the demographic dividend have generally shown rapid economic growth that moved them closer to the world frontier. Williamson (2013) goes as far as to conclude that the empirical evidence is in support of the hypothesis that demographic dividend was essential to East Asia's economic record, accounting for as much as one-third of its economic miracle. Nguyen (2009) discusses demographics and economic growth in Vietnam. According to Nguyen (2009), demographic dynamics accounted for around 15% of economic growth during 2002-2007. Our calculations suggest that increases in the working-age share of the total population accounted for 20.1% of the increase in per capita income between 2002 and 2007.

and 42.5% in 2015. This ratio can be further separated into two components, namely the youth dependency ratio (children aged 0-14 divided by persons aged 15-64), and the old-age dependency ratio (persons aged 65 and over divided by persons aged 15-64).

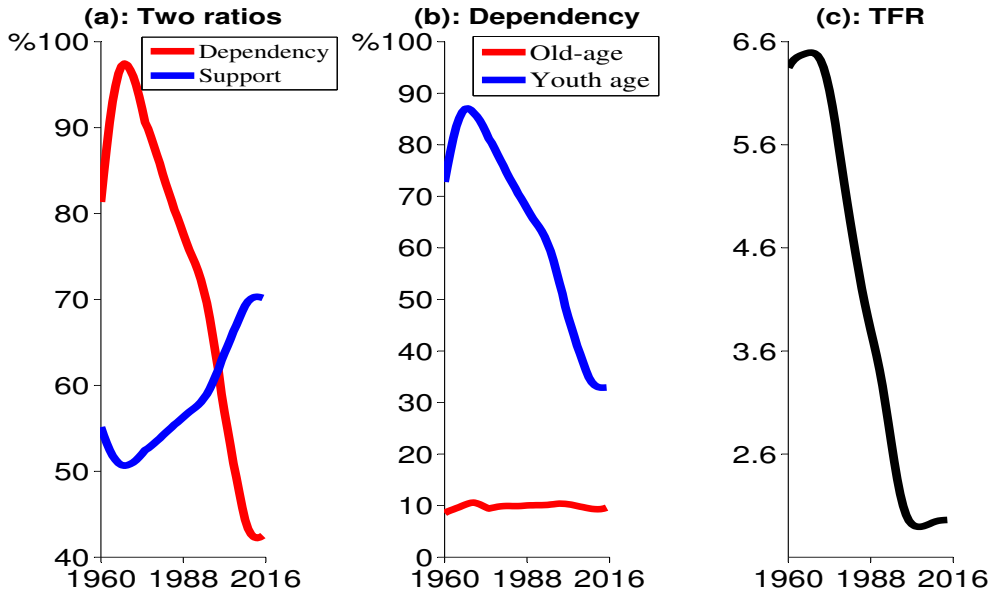

Figure 4: Demographic Dynamics in Vietnam, 1960-2015

In panel (b) of Figure 4, we plot the old-age and youth-age dependency ratios for Vietnam. During the 1960-1985 period, the youth dependency ratio ranged from 70.5% to 87.1%. The old-age dependency ratio, however, ranged between 8.6% and 10.6% during 1960-1985. More than two-fifths of the population was less than 15 years old, on average, between 1960 and 1985 and Vietnam had a high fertility rate when a large percent of its population was young. In panel (c) of Figure 4, we plot the total fertility rate (TFR) for Vietnam between 1960 and 2014. In 1960 Vietnam's TFR was 6.3. This means that an average of 6.3 children would be born if a woman were to live to the end of her childbearing years and bear children in accordance with age-specific fertility rates in 1960. Vietnam's TFR were more than 6 till 1975. This rate started to decline in the mid-1970s and drop sharply after the mid-1980s. Vietnam's TFR was 4.2 in 1985 and plummeted to 2 in 2000. Vietnam's youth dependency ratio has been declining rapidly as there has been less children being born: it was 41.0% in

2005, 33.9% in 2010, and 32.9% in 2015. The sharp fertility drop and sustained long-term lower fertility were behind the further decreases in the youth age dependency ratio.

A comparative perspective. Simply reporting results for Vietnam using their national currency doesn't provide a sufficient gauge of Vietnam's performance relative to its peer countries. To gain a comparative perspective, we utilise data from the PWT 9.0 on GDP per capita in PPP terms and conduct the exercise outlined in Equation (2) for the *Majors* (Indonesia, Thailand, Malaysia, the Philippines, and Singapore). Specifically, we use the variable *cgdpo* (output-side real GDP at current PPPs (in millions of 2011US$)). Employment, the variable *emp*, and population, the variable *pop* are given in millions of people. Population ages 15-64 (% of total population) data are from the WDI as above. The results are presented in Table 2.

Table 2: GDP per capita decomposition (in PPP terms)

	1970-1985					1986-2014			
	Average annual changes, %					*Average annual changes, %*			
Country	Y/P	Y/L	L/WP	WP/P	Country	Y/P	Y/L	L/WP	WP/P
Vietnam	1.9	1.0	0.4	0.6	Vietnam	5.6	4.7	0.01	0.8
ASEAN	4.2	3.1	0.5	0.6	ASEAN	4.4	4.0	-0.1	0.5
China	3.8	2.3	0.6	0.9	China	6.0	5.6	-0.2	0.5

Source: PWT 9.0 and WDI (World Bank, 2017).

Table 2 shows that Vietnamese GDP per capita expanded at an average annual rate of just 1.9% between 1970 and 1985. This was a poor performance when compared to their East Asian counterparts, with the *Majors* achieving average annual GDP per capita growth of 4.2% over this time period. After the implementation of *Doi Moi* in 1986, Vietnam embarked on a high growth period. During 1986-2014, annual GDP per capita expanded at an average annual rate of 5.6%. This made Vietnam the best performer out of the *ASEAN Six Majors*. Over the 1986-2014 period, output per worker increased by 4.7% per year in Vietnam, i.e., labor productivity improvements have accounted for more than four-fifths of the expansion

in GDP per capita since 1986. Hence, the improvement in GDP per capita since *Doi Moi* can largely be attributed to progress made in labor productivity.

3.2 Convergence Exercise

Building on the accounting exercise proposed in Equation (1), Vietnamese GDP per capita relative to the U.S. depends on the ratio of the following three factors at time t:

$$\frac{(Y/P)_t^{Vietnam}}{(Y/P)_t^{US}} = \frac{(Y/L)_t^{Vietnam}}{(Y/L)_t^{US}} \times \frac{(L/WP)_t^{Vietnam}}{(L/WP)_t^{US}} \times \frac{(WP/P)_t^{Vietnam}}{(WP/P)_t^{US}}. \tag{3}$$

We use Equation (3) to ask which of these three measurable components of the data explain the evolution of GDP per capita in Vietnam relative to the U.S. Using the same data from Section 3.2.1, combined with Equation (3), we investigate the sources of Vietnam's economic decline between 1970 and 1985, and subsequent convergence since the enactment of *Doi Moi* in 1986.

Figure 5 shows a visual representation of how factors contributing to GDP per capita levels outlined in Equation (1) have evolved since 1970 for Vietnam and its comparable countries, in relation to the U.S. In 1970, GDP per capita in Vietnam relative to that of the U.S. was just 3.6%. The difference can largely be accounted for by poor Vietnamese labor productivity (GDP per person employed), at just 3.9% of the U.S. level. Differences in labour supply were negligible in 1970, as the employment to working-age population ratio in Vietnam was 13.2% higher than the U.S. The working-age population to total population ratio in Vietnam was 82% of the U.S. level in 1970. By 1986, there was little change in Vietnam's comparative level of development.

In 1986, GDP per capita (labor productivity) in Vietnam relative to that of the U.S. was just 3.4% (3.6%). Again, the employment to working-age population ratio in Vietnam was 13% higher than the U.S. The working-age population to total population ratio in Vietnam was 84% of the U.S. level in 1986. By 2014, GDP per capita in Vietnam had converged to

10.5% of the U.S. level. Changes in the age structure of Vietnam's population since 1986 positively contributed to this GDP per capita convergence. The ratio of Vietnam's working age population to total population increased from 84% of the U.S. level in 1986 to 105.6% by 2014; and the employment to working-age population ratio in Vietnam was 15% higher than the U.S. in 2014.

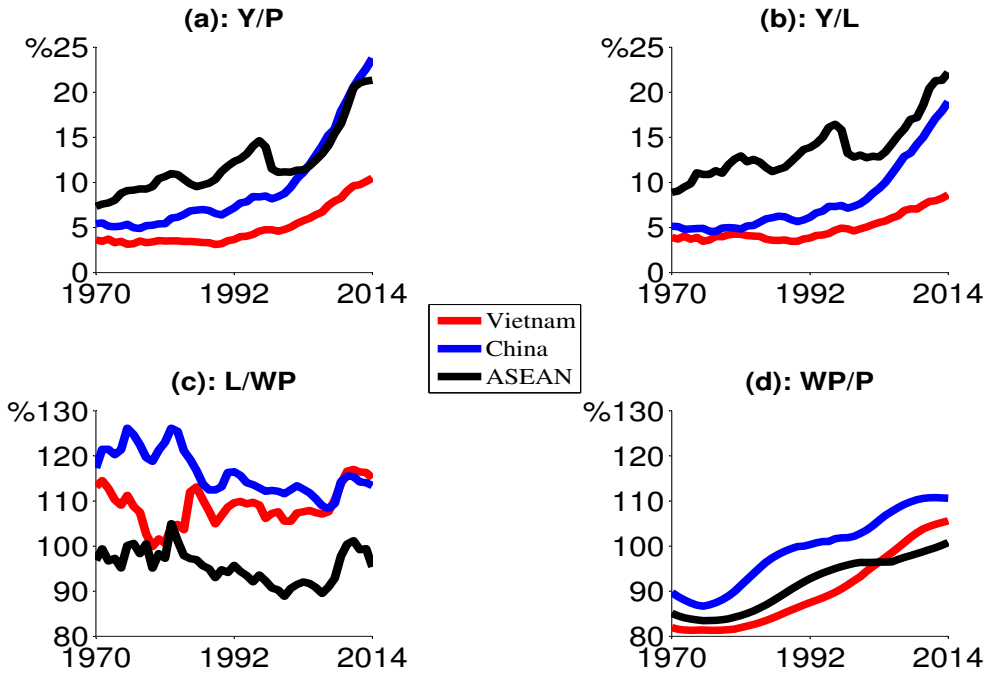

Figure 5: GDP per capita components relative to the U.S.(%)

Panel (a) in Figure 5 shows that whilst Vietnam outperformed its ASEAN peers in terms of GDP per capita growth since 1986, in terms of its level, Vietnam is still a comparatively poor country. In 2014, ASEAN's level of GDP per capita was two times higher than that of Vietnam. Looking at Panel (b), in 1977, China and Vietnam had similarly poor levels of labor productivity; 4.0% and 4.6% of the U.S. level, respectively. From this point, the remarkable convergence of China is visible, with labor productivity reaching 19.0% of the U.S. level by 2014. At 8.6% of the U.S. productivity level in 2014, Vietnam's labor force is the least productive compared to China and the *Majors*.

When Vietnam and China are compared between 1970 and 2014, similar changes in the

demographic ratio for both countries positively contribute to growth in GDP per capita. However, the contribution of labor productivity in China is far more impressive than in Vietnam. In 1970, Vietnamese GDP per capita was 66.8% of the Chinese level. However, superior labor productivity growth in China since 1960 has seen GDP per capita in Vietnam amount to just over 44% of the Chinese level in 2014. The employment to working-age population ratio in Vietnam has averaged around 110% of the U.S. level since reform occurred in 1986. Therefore, over the last three decades, employment of the working-age population in Vietnam has been roughly 10% higher than the U.S. Finally, looking at Panel (d), the working-age population to total population ratio in Vietnam consistently rises since the late 1970s in relation to the U.S. This is evidence of the aforementioned "demographic dividend."

4 Labor Productivity

Given our analysis in Section 3, it is clear that Vietnam's economic resurgence since 1986 is predominantly due to improved labor productivity. This section investigates the factors which constitute the first term on the right-hand side of Equation (1); GDP per worker (Y/L).

4.1 Growth Accounting

Framework. Using output per worker as a proxy for productivity confounds the effects of capital accumulation (both physical and human) and technological progress, both of which increase output per worker. To portray this, we consider the following aggregate production function:

$$Y_t = A_t K_t^{\alpha} (hE)_t^{1-\alpha}, \tag{4}$$

where A_t, K_t, h_t are, respectively, TFP, the stock of physical capital, and human capital per worker at time t and α denotes capital factor income share. The total output of an

economy is a function of of its resource endowments (labor, physical capital, human capital) and the productivity (TFP) with which these endowments are deployed to produce GDP. Equation (4) expresses this relationship in the form of an economy-wide production function. TFP captures not only the technical efficiency (and technological advancement) level of the economy, but also the allocative efficiency with which resource endowments are distributed across economic activities (Rodrik, 2003, p. 4).

We re-write Equation (4) in an intensive form to arrive at the following decomposition of labor productivity:

$$y_t = A_t k_t^{\alpha} {h_t}^{1-\alpha}, \tag{5}$$

where y_t represents output per worker (Y_t/L_t), with k_t representing the capital-labor ratio (K_t/L_t) at time t. Taking logarithms of the terms in Equation (5) and decomposing the average annual growth rate of output per worker over z years (from time t to time $t+z$) yields:

$$\frac{lny_{t+z} - lny_t}{z} = \frac{lnA_{t+z} - lnA_t}{z} + \alpha \frac{lnk_{t+z} - lnk_t}{z} + (1-\alpha)\frac{lnh_{t+z} - lnh_t}{z}. \tag{6}$$

The growth of output per worker is expressed in terms of the three *proximate* determinants: (i) physical capital deepening, (ii) human capital accumulation, and (iii) TFP growth.

Data. From the PWT 9.0, we retain the variables for GDP, physical capital, human capital, and employment. Specifically, we use the variable *rgdpna* (real GDP at constant 2011 national prices) for GDP; and the variable *rkna* (capital stock at constant 2011 national prices) for physical capital. Human capital is proxied by years of schooling (and returns to education).[23] PWT 9.0 follows the procedure implemented by Hall and Jones (1999) and Caselli (2005). Specifically, data on average years of schooling are converted into human

[23]It is important to note that the PWT 9.0 only reports the measure the quantity of human capital a country possesses. Recently, studies have tried to incorporate the quality of human capital into the analysis of cross-country differences in output per worker. See Appendix A for an analysis of the quality dimension of human capital in the context of Vietnam.

capital, using the formula $h = \varphi(s)$, where s is average years of schooling, and the function $\varphi(s)$ is piecewise linear and is defined as:[24,25] Employment, the variable *emp*, is given as number of persons engaged (in millions). Finally, we need a value for α. Labor's share of national income (1-α) has been seen as a particularly sensitive issue. PWT 9.0 reports labor shares for the *Majors* (no data for Vietnam are reported).[26] The simple average of the labor share for *Majors* for the 1970-2014 data period is 0.5. This figure is consistent with recent research on factor income shares in developing countries.[27] Accordingly, we set $\alpha = 0.5$. TFP is computed as residual $A_t = \frac{y_t}{k_t^{\alpha} h_t^{1-\alpha}}$.[28]

Results. The purpose of this decomposition is to uncover the sources of economic growth in Vietnam post the introduction of *Doi Moi* in 1986 (the high-growth era), compared to the 1970-1985 period. Table 3 presents the average annual growth rate of output per worker and its three factors shown in Equation (6) for Vietnam before and after the introduction of *Doi Moi*. Table 3 also shows the contributions of changes in capital intensity, human capital per worker, and TFP to GDP per worker growth.

During 1970-1985, output per worker increased at just 1.5% per year. For the pre-1986 period, there was no capital deepening, causing the capital-labor ratio to decline. TFP growth accounted for more than four-fifths of the growth of output per worker between 1980

[24]In PWT 9.0, data for average years of schooling are from Barro and Lee (2013), Cohen and Soto (2007) and Cohen and Leker (2014); and data for returns to education are from Psacharopoulos (1994). Data sources are discussed in detail in PWT 9.0 (`www.rug.nl/ggdc/docs/human_capital_in_pwt_90.pdf`).

[25]For the first four years of education, it is assumed a rate of return of 13.4%, corresponding to the average Psacharopoulos (1994) reports for for Sub-Saharan Africa (SSA). For the next four years it is assumed a value of 10.1%, the average for the world as a whole. For the education beyond the eight year it is assumed the value Psacharopoulos (1994) reports for the OECD, 6.8% (Hall and Jones, 1999; Caselli, 2005).

[26]Gollin (2002, Table 2) reports that the 'naive' calculation of labor share–using employee compensation as a fraction of GDP– is 0.594 in 1989 for Vietnam.

[27]There has been a tradition arguing that the factor shares in national income are roughly constant over time. Gollin (2002) argues that factor shares adjusted for self-employed income and sectoral composition are remarkably constant across both time and countries, and that the capital shares cluster around one-third. In line with Gollin (2002), Bernanke and Gürkaynak (2001) find no systematic tendency for country labor shares to vary with per capita income. Setting a common value of $\alpha = 1/3$ for each country has been a widely used practice in cross-country studies since then. Recent cross-country studies point to the observation that factor income shares might differ between developed and developing countries (Izyumov and Vahaly, 2015; Trapp, 2015). In addition to cross-country studies, there are some country-specific studies that argue that the value of labor share parameter in developing countries such as China is around 0.5 (see Bai et al., 2006; Brandt et al., 2008; Zhu, 2012).

[28]There is no TFP series available for Vietnam from the PWT. We therefore constructed our own series.

and 1985. Post-1986, the economic fortunes of Vietnam changed considerably. Output per worker grew at an annual rate of 4.0% during 1986-1996 and during 1997-2014. The relative improvement was almost entirely due to high annual growth in physical capital per worker over the 1997-2014 period. In the post-1986 period, growth has been mainly coming from increases in both physical and human capital rather than increases in TFP. In fact, a negative contribution from the TFP component acted as a headwind to growth in output per worker during 1997-2014. There was a positive TFP growth before *Doi Moi* and a negative TFP growth after the first decade of *Doi Moi*.

Table 3: Decomposing Vietnam's Growth: 1970-2014

	Growth (%)				Contributions (%)			
Period	y	A	k	h	y	A	k	h
1970-1985	1.5	1.2	-0.3	0.6	100	81.0	-17.4	36.3
1986-1996	4.0	1.1	2.6	0.3	100	27.2	66.1	6.7
1997-2014	4.0	-0.7	3.7	1.0	100	-17.4	92.9	24.5
1970-2014	3.1	0.4	2.1	0.6	100	12.5	66.8	20.7

Source: PWT 9.0.

4.2 Labor productivity components relative to the U.S.(%)

Expressing country i's performance relative to that of the U.S. leads to the following expression for labor productivity:

$$\frac{y_t^i}{y_t^{US}} = \frac{A_t^i}{A_t^{US}} \times \left(\frac{k_t^i}{k_t^{US}}\right)^{\alpha} \times \left(\frac{h_t^i}{h_t^{US}}\right)^{1-\alpha}, \tag{7}$$

From the PWT 9.0, we retain the variables for GDP, physical capital, human capital, employment, and population. We use the variable *cgdpo* for GDP. This variable, which was first introduced in PWT 8.0, provides a more accurate measure of the productive capacity of an economy than previous real GDP measures in PWT by accounting for differences in

the terms of trade.[29] The human capital index, the variable *hc*, is constructed from the combination of returns to schooling and years of schooling, while physical capital input, the variable capital stock *ck*, is measured in terms of current PPPs (in millions of 2011 US$). In measuring capital, total investment is split up to a wide range of assets (with their geometric depreciation rates) and covers structures (residential and non-residential), transport equipment, computers, communication equipment, software, and other machinery and assets. Employment, the variable *emp*, and population, the variable *pop* are given in millions of people.

Physical capital deepening (K/L). Our growth accounting results show that physical capital per worker was the main driver of economic growth in Vietnam post 1986. Given its importance, Panel (a) in Figure 6 looks at Vietnamese capital accumulation in a comparative lens, whilst also linking the results of our growth accounting exercise to policy. The capital-labor ratio shows the extent to which the labor force is engaged in production activities using capital. Physical capital per worker in Vietnam up until the late 1980s was very low. By 1986, the stock of physical capital per worker had regressed to 1.1% of the U.S. level. However, as part of *Doi Moi* policy introduced in 1986, the VCP adopted a principle of turning Vietnam into a "multi-sector economy." The importance of the private sector and foreign investors was acknowledged.[30]

In an effort to "mobilize every means and use every form to attract foreign capital," the VCP passed the Law on Foreign Investment in 1987, with consequent revisions made in 1990 and 1992. These laws set the foundation for a more favorable investment environment in Vietnam. Furthermore, the cut-off of financial assistance from the Soviet Union in 1991 hastened the need for foreign investment reform, with foreign capital becoming a substitute for direct assistance. These policy changes stimulated both foreign and domestic investment, such that the level of Vietnam's physical capital per worker relative to the U.S. tripled in

[29] Detailed discussions are available at: `www.rug.nl/ggdc/docs/what_is_new_in_pwt_81.pdf`

[30] According to Sakata (2013, p. 9), in the 1990s, the basic attitude of the VCP toward the private economic sector shifted from "acceptance" to "encouragement."

the 14 years post-*Doi Moi*.

In the 2000s, negotiations over accession to the WTO were expedited in order to improve market access for Vietnam's exports. Accession required the VCP to liberalise foreign investment in a wide range of business areas, with the exception of some sensitive sectors, such as national defence. Consequently, the Law on Enterprise Income Tax in 2003 established a unified tax system for foreign and domestic investors, with adjustments made to the Foreign Direct Investment Law in 2005. These important policy changes created a "level playing field" environment for investment in the domestic private sector and foreign-invested private sector. Although these policy changes helped to grow investment in the Vietnamese economy, there is still much room for improvement. In 2014, physical capital per worker in Vietnam was 7.6% of the U.S. level, the lowest out of the ASEAN Six Majors.

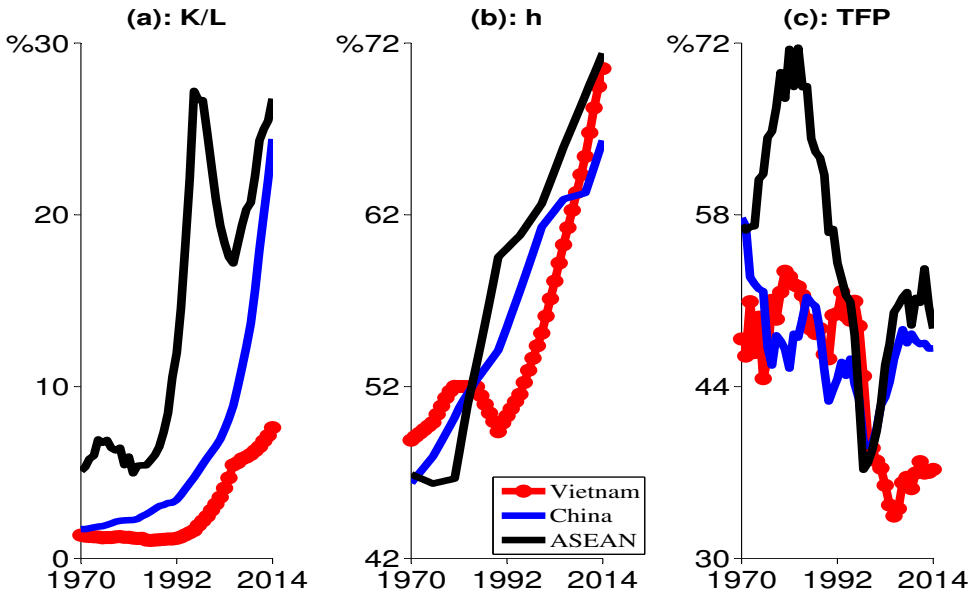

Figure 6: Labor productivity components relative to the U.S.(%)

Human capital (h). Panel (b) in Figure 6 shows that growth in the stock of human capital in Vietnam was relatively constant, on average, either side of economic reform in 1986. Up until 1981, human capital stock in Vietnam ranked third out of the ASEAN Six Majors and China, at 52% of the U.S. level. Van Arkadie and Mallon (2003, p. 258)

state that in the period before *Doi Moi*, Vietnam conducted substantial human capital investment. This contributed to the Vietnamese people enjoying much higher levels of basic literacy than those in countries with a similar income level. However, up until the late 1980s, Vietnam's education system was highly specialized. This socialist model produced several labour market distortions. For example, higher education was reserved for a small number of students and was primarily a means of grooming for public sector employment (World Bank, 2008). Consequently, by 1986, human capital stock in Vietnam was the lowest out of its peers at 51.5% of the U.S. level.

As economic growth started to improve in the late 1980s as a direct consequence of *Doi Moi*, Vietnam accomplished notable progress in the field of education. Enrolment rates in primary education increased, with the transition rate from primary to lower-secondary education also increasing. This allowed the majority of Vietnamese to access at least nine years of basic education. Furthermore, reform outlined in *Doi Moi* allowed higher education in Vietnam to be more accessible. Between 1991 and 2001, total tertiary enrolments increased more than fivefold. These educational improvements helped to reverse the relative decline of human capital in the years prior to *Doi Moi*.

Vietnam's basic education system is excelling in providing young workers with the basic skills needed to participate in the workforce; the ability to read and write at an adequate level. However, despite impressive literacy and numeracy achievements among Vietnamese workers, many firms report difficulties in finding workers with adequate skills as a significant obstacle to their activity (World Bank, 2013). Judging by the development experiences of past Asian Tigers, Vietnam can expect a shift in labour demand from today's predominantly manual and straightforward jobs, towards more skill-intensive modern jobs that will require new competencies. Therefore, Vietnam needs a long-term plan to develop human capital through education, research and development, in order to produce a sufficient number of high-skilled personnel to work with new technologies, machinery and equipment in the future.[31]

[31]Le et al. (2014) suggest that the VCP can accelerate this process by reducing the proportion of tax revenue spent on inefficient SOEs, then reallocating this capital to improve the quality of Vietnam's education

TFP differences. Expressing country i's performance relative to that of the U.S., following Equation (7), leads to the following ratio of TFP levels:

$$\frac{A_t^i}{A_t^{US}} = \frac{\frac{y_t^i}{(k_t^i)^\alpha \times (h_t^i)^{1-\alpha}}}{\frac{y_t^{US}}{(k_t^{US})^\alpha \times (h_t^{US})^{1-\alpha}}}. \tag{8}$$

We set a common value of $\alpha = 1/2$ for country i and the U.S. We use the same value of α for both country i and the U.S., since the Cobb-Douglas framework suffers from the unit-invariance problem when the factor shares are indexed by country (see Sturgill, 2014). Panel (c) in Figure 6 shows that in 1970, TFP in Vietnam was 47.9% of the U.S. level. It increased to 53.4% of the U.S. level in 1980 and decreased to 48.7% of the U.S. level in 1986. By 2005, Vietnamese TFP had regressed to 33.5% of the U.S. level. Although the decline in TFP has seemingly stopped since 2005, it is clear that Vietnam hasn't become more efficient in using capital and labour inputs to produce output since 1970. In 2014, TFP in Vietnam was 37.3% of the U.S. level.[32] TFP in China was 47.1% of the U.S. level in 2014 and the corresponding figure for the ASEAN group was 48.1% in that year. What might be the causes of Vietnam's lack of technological progress since *Doi Moi*?

One reason could be due to the Soviet-styled centrally-planned economic system which Vietnam had developed prior to 1986. It is a common notion in the literature that such a system, which promotes the role of the state, is inefficient and doesn't possess incentives for firms to innovate or adopt new technologies from overseas (see Gomulka, 1984; Hanson, 1985; Winiecki, 1988). It is likely that such influences were still prominent throughout the early years post-reform, contributing to minimal TFP growth. Indeed, Phan and Ramstetter (2004) show that SOEs still accounted for nearly 40% of GDP in 2000, with the IMF (1999) reporting that more than half of SOEs were loss-making and inefficient.

system. They note that policy makers should look past the temporary negative employment shock because the amount of redundant workers in the state sector will soon be absorbed by the private sector.

[32]It is important to note that the value of α matters significantly in interpreting the level changes. If we set $\alpha = 1/3$ for each country, then we find that TFP in Vietnam was 26.3% of the U.S. level in 1970. It increased to 28.6% of the U.S. level in 1980 and decreased to 25.4% of the U.S. level in 1986. By 2005, Vietnamese TFP had regressed to 22.4% of the U.S. level. In 2014, TFP in Vietnam was 25.7% of the U.S. level.

5 Deagriculturalization in Vietnam

Figure 7, using data from Tombe (2015), places Vietnam's structural transformation in an international context in 2005. Figure 7, with observations for 90 countries in 2005, portrays the well-established fact that poor countries tend to have higher agricultural employment shares than rich countries (see Restuccia et al., 2008; Lagakos and Waugh, 2013). Vietnam has a relatively high employment share in agriculture and the agricultural employment share of Vietnam is only lower than those of the least developed Sub-Saharan African countries (such as Burkina Faso, Ethiopia, Guinea, Malawi, Mozambique, Rwanda).

Figure 7: Employment share in agriculture vs GDP per worker

Panel (a) in Figure 8 shows the historical pattern for Vietnamese agricultural employment (1990-2010), in comparison to the U.S. (1800-2008), Japan (1872-2003), China (1970-2010) and the *Majors* (1975-2010).[33] The speed at which Vietnam has reduced its employment share in agriculture is impressive when compared with the historical transition of now developed countries. According to Kuznets (1973), a drop of 30 to 40 percentage points in the

[33]Historical data for Japan and the U.S. are from Herrendorf et al. (2014). ASEAN covers Indonesia, Malaysia, Philippines, and Thailand. Singapore is excluded due to the fact that the size agricultural sector is almost negligible. Sectoral data for ASEAN countries and China are from the 10-Sector Database (`http://www.rug.nl/ggdc/productivity/10-sector/`) (Timmer et al., 2015).

share of agricultural sector employment of the labor force in the course of a single century is a strikingly fast structural change. Vietnam has reduced its agricultural employment share by 21.9 percentage points in just two decades, from 71.4% in 1990 to 49.5% in 2010.

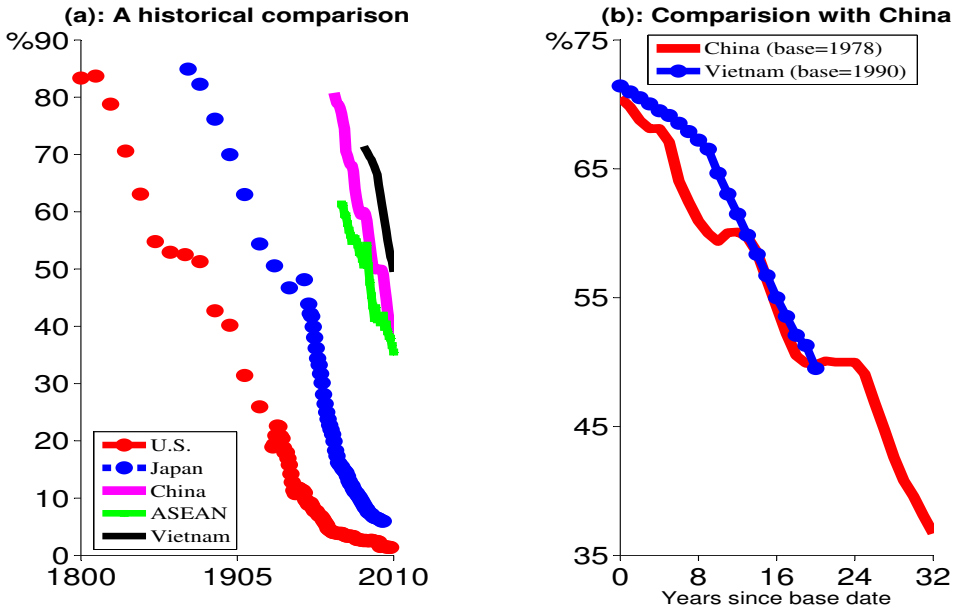

Figure 8: Employment shares in agriculture

Putting these 21.9 percentage points decline in a comparative context, for example, agricultural employment decreased 21.4 percentage points in a quarter century (from 70.5% in 1978 to 49.1% in 2003) in China, and 21.5 percentage points in 29 years (from 61.3% in 1975 to 39.8% in 2004) in the ASEAN group. However, Vietnam's employment share in agriculture is comparatively high relative to today's most prosperous countries. For example, in 2009 the share of agricultural employment in Vietnam was 51.3%. This is equal to that of the U.S. in 1880 (51.3%) and similar to that of Japan in 1930 (50.6%). This is further evidence that whilst the pace of Vietnam's structural transformation is impressive, there is still a long way to go until she can be classed as a developed country.

Panel (b) in Figure 8 displays the deagriculturalization process of China and Vietnam, since their respective reform years of 1978 and 1986. Comparing the reallocation of labour in Vietnam with China's progress to date is a worthwhile exercise to offer a measure of relative

progress. In the immediate 20 years after the initiation of economic reform, the percentage of employment in agriculture in both countries fell higher than 20 percentage points. Over the next 15 years, between 1998 and 2010, a further 13.1 percentage points reduction in the agricultural employment share occurred in China. If Vietnam continues to emulate China's pattern of deagriculturalization, the resulting efficiency gains will support future economic growth.

6 A Two-Sector Model of Deagriculturalization

We employ a two sector model of the Vietnamese economy and adopt a model with an agricultural and a non-agricultural sector, to focus on explaining the secular decline in agricultural employment; a phenomenon known as deagriculturalization. The model economy we study is closed: domestic production meets the food needs, and food consumption is subject to a minimum consumption requirement. Therefore, when agricultural labor productivity is low, a large amount of labor is needed in agricultural production to satisfy the subsistence food consumption demands. As agricultural labor productivity improves, less labor will be needed for food requirement, thereby allowing the share of labor in agriculture to decline. Non-homothetic preferences[34] and relative differences in sectoral productivity growth rates[35] both act as drivers of the sectoral reallocation of resources across sectors.[36] Below we describe the economic environment and characterize a competitive equilibrium for this economy following İmrohoroğlu et al. (2014).

[34]See, for example, Echevarria, 1997, Kongsamut et al., 2001.

[35]See, for example, Baumol, 1967, Ngai and Pissarides, 2007.

[36]Gollin et al. (2002, 2007), Alvarez-Cuadrado and Poschke (2011), Üngör (2013, 2017) provide theoretical frameworks and empirical evidence regarding the impact of improvements in agricultural productivity on the movement out of subsistence agriculture. See Gollin (2010) for a comprehensive review of theoretical arguments and empirical evidence for the hypothesis that agricultural productivity improvements lead to economic growth in developing countries.

6.1 Model

Technology. At each date t, there are two sectors, agriculture (A) and non-agriculture (I). The non-agricultural sector incorporates both services and manufacturing. The production function for sector j=A,I is given by:

$$Y_{j,t} = \theta_{j,t} N_{j,t}, \tag{9}$$

where $Y_{j,t}$ is the output of sector j, $N_{j,t}$ is labor allocated to production, and $\theta_{j,t}$ is sector j's labor productivity at date t. We assume that labor is fully mobile across sectors and the wage rate in the economy is given by:

$$\omega_t = \theta_{j,t} p_{j,t}, \tag{10}$$

where $p_{j,t}$ is the price of good-j and ω_t is the wage-rate in the economy at date t. Given the absence of any distortions, relative prices reflect relative productivity levels in this economy, i.e., $p_{I,t}/p_{A,t} = \theta_{A,t}/\theta_{I,t}$.

Household's problem. The economy is inhabited by a continuum of households of measure one. Each household is endowed with one unit of labor which they supply inelastically to the labor market. Preferences are described by a period utility function given by:

$$U(C_t) = \log(C_t). \tag{11}$$

C_t is a composite consumption good derived from the agricultural, A_t, and non-agricultural consumption, I_t, via a constant elasticity of substitution (CES) aggregator:

$$C_t = \left(\gamma_A^{1/\eta}(A_t - \bar{A})^{(\eta-1)/\eta} + \gamma_I^{1/\eta} I_t^{(\eta-1)/\eta}\right)^{\eta/(\eta-1)}.$$

The parameter $\bar{A}$ represents the subsistence level of agricultural good consumption and

satisfies at each date t:

$$\theta_{A,t} > \bar{A} > 0. \tag{12}$$

The first inequality states that the economy's agricultural sector is productive enough to provide the subsistence level of food to all households (see Matsuyama, 1992). The second inequality implies that preferences are non-homothetic and the income elasticity of demand for the agricultural good is less than unity. It is also assumed that the representative household has enough income to purchase more than $\bar{A}$ units of agricultural good. The weight γ_j influences how consumption expenditure is allocated between the two sectors, with $\gamma_A, \gamma_I > 0$, and $\gamma_A + \gamma_I = 1$. The parameter $\eta > 0$ is the (constant) elasticity of substitution.

Households use their income to consume. At each date, the household chooses consumption of each good to maximize its lifetime utility subject to the budget constraint:

$$p_{A,t}A_t + p_{I,t}I_t = 1, \tag{13}$$

taking prices as given. The demand for labor must equal the exogenous labor supply at every date:

$$N_{A,t} + N_{I,t} = 1. \tag{14}$$

The following conditions hold at each date, implying that the market must clear for each good produced:

$$A_t = Y_{A,t}, \quad I_t = Y_{I,t}. \tag{15}$$

Equilibrium. A competitive equilibrium consists of consumption decisions $\{A_t, I_t\}$ of the households, factor allocations $\{N_{A,t}, N_{I,t}\}$, sectoral output decisions $\{Y_{A,t}, Y_{I,t}\}$ of the firm, and prices $\{p_{A,t}, p_{I,t}\}$ such that given prices, the firm's allocations solve its profit maximization problem, the household's allocations solve the household's utility maximization problem, and all product and factor markets clear.

One can combine the first-order conditions for the household maximization problem with

the market-clearing conditions to obtain the following equation that explicitly characterizes the equilibrium employment share in agriculture:

$$N_{A,t} = \left(\frac{\gamma_A \theta_{A,t}^{\eta-1}}{\gamma_A \theta_{A,t}^{\eta-1} + \gamma_I \theta_{I,t}^{\eta-1}} \right) + \left(\frac{\gamma_I \theta_{I,t}^{\eta-1}}{\gamma_A \theta_{A,t}^{\eta-1} + \gamma_I \theta_{I,t}^{\eta-1}} \right) \frac{\bar{A}}{\theta_{A,t}}. \tag{16}$$

The equilibrium employment share in the non-agricultural sector is given by $N_{I,t} = 1 - N_{A,t}$.

6.2 Quantitative Analysis of the Model

6.2.1 Data and Calibration

Our sample period is between 1990 and 2013, since there is no publicly available data on employment and GDP by sector prior to 1990 even at a high level of aggregation. This point is also made by McCaig and Pavcnik (2013). Data are from the Asian Productivity Database (30 September 2015 version) (APO, 2015). Although this is only a 24-year period, Vietnam's employment share in agriculture fell from 71.4 to 46.8% over this time (see Figure 8).

We calibrate the model to the Vietnamese data. To abstract from short-run fluctuations in real GDP and employment by sector we filter them using the Hodrick and Prescott filter for yearly observations and keep the trend component of these time series. Specifically, all series are de-trended using the Hodrick-Prescott filter with a smoothing parameter of 6.25 before any ratios are computed.[37] We normalize the level of labor productivity in both sectors to one in 1990, that is, $\theta_{A,1990} = \theta_{I,1990} = 1$. We need the values of the following four parameters in our model: γ_A, γ_I, η, and $\bar{A}$. For a given value of η, we jointly determine the value of γ_A, γ_I, and $\bar{A}$. to match the following set of statistics of the Vietnamese data: (i) the employment share in agriculture in 1990; (ii) the employment share in non-agriculture in 1990; and (iii) the aggregate labor productivity growth between 1990 and 2013. We set η=0.45 following the structural transformation literature.[38] Then we determine the values

[37] See Ravn and Uhlig, 2002; İmrohoroğlu et al., 2014; Üngör, 2017.

[38] See the related discussions in Rogerson, 2008; Duarte and Restuccia, 2010; İmrohoroğlu et al., 2014; Üngör, 2017 for values of η.

for the remaining three parameters; $\gamma_A = 0.4982$, $\gamma_I = 0.5018$, and $\bar{A} = 0.4104$.

6.2.2 Benchmark Results

Figure 9 shows the model-predicted sectoral employment shares and compares them with the data from Vietnam between 1990 and 2013. By construction, model-predicted employment shares are equal to those of the data in 1990. The model captures the secular decline in the share of employment in agriculture remarkably well. The model predicts a decline in the agricultural employment share of 24.9 percentage points between 1990 and 2013, which is equal to the actual decline. Most importantly, the model under predicts the agricultural employment share by only 2.7% on average during 1991-2013.

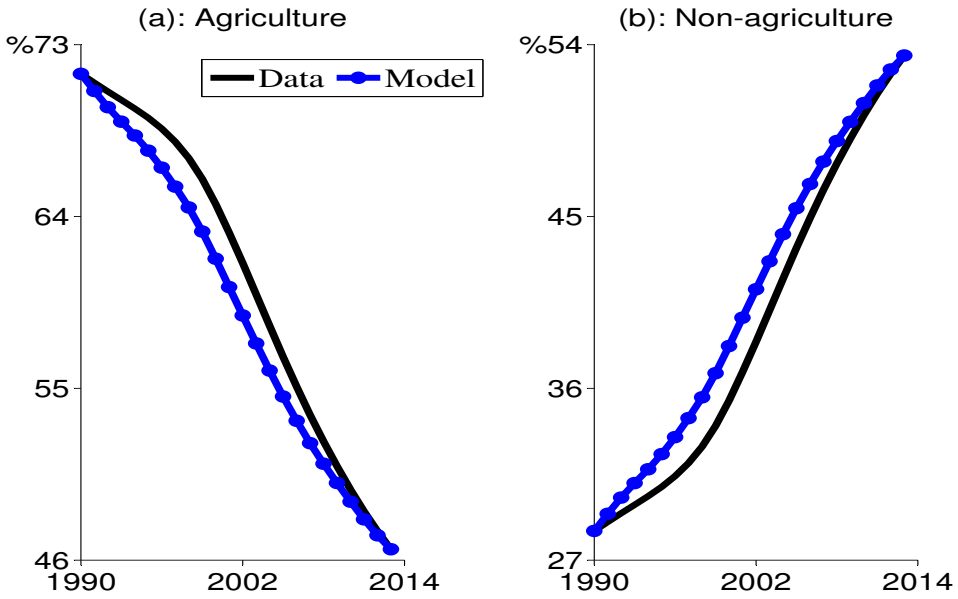

Figure 9: Benchmark results: Sectoral employment shares

We also report two criteria for the performance of the model in replicating the actual sectoral employment share in agriculture. The first statistic is the root mean square error (RMSE) criterion, $RMSE = \sqrt{\frac{\sum_{t=1}^{T}(z_t - \hat{z}_t)^2}{T}}$, where T is number of years, z is the data value and $\hat{z}$ is the model's predicted value. Lower values of RMSE indicate better fit. We calculate the value of the RMSE to be 0.018 for agriculture. The second statistic is the

standard measure of correlation, which is 0.994 for agriculture.

We also consider the implications for different values of η. The benchmark value is 0.45. We present results with two alternative values (0.30 and 0.65) to explore the robustness of the results. Figure 10 presents the sectoral employment shares in Vietnam with different values of η. We find that η plays a quantitatively insignificant role on the share of employment in each sector, as the results with η=0.45, η=0.30, and η=0.65 are very similar.

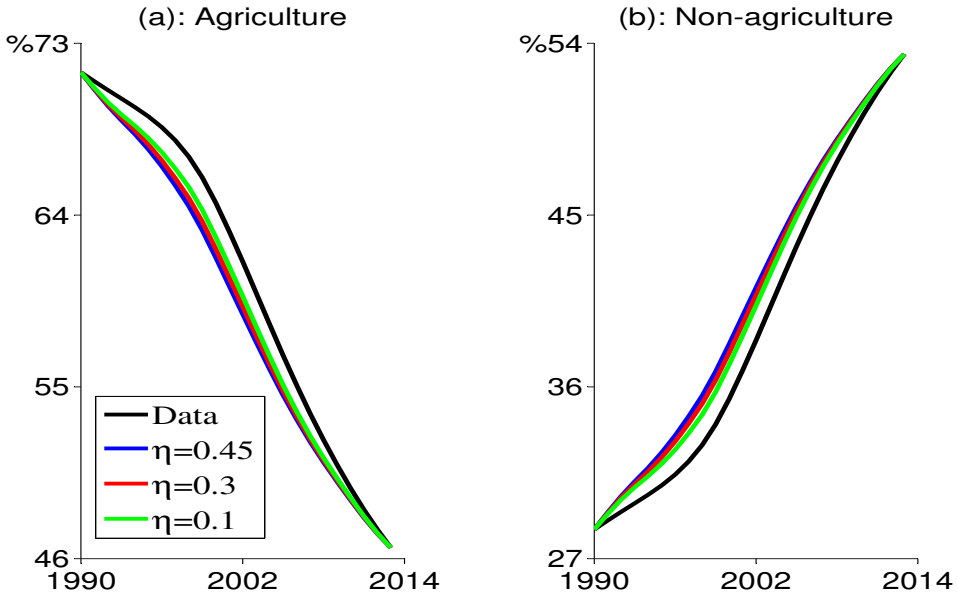

Figure 10: Sensitivity: Sectoral employment shares

6.2.3 Counterfactuals

Experiments. The success of the benchmark model motivates several counterfactual experiments to further investigate the structural transformation experience of Vietnam. We use the model to assess the quantitative role of sectoral labor productivity growth rates in the behaviour of (i) employment share in agriculture; and (ii) aggregate labor productivity in Vietnam. To do so, we perform a series of counterfactual experiments, in the spirit of Duarte and Restuccia, 2010; İmrohoroğlu et al., 2014; Üngör, 2017, whereby we replace observed sectoral labor productivity growth rates in a sector with the ones observed in China.

Figure 11 displays the time paths of labor productivity (measured as output per worker) (1990=1) in Vietnam and in China during 1990-2013. The annualized growth rates in Vietnam labor productivity between 1990 and 2013 are 3.4% and 3.1% for agriculture and non-agriculture, respectively. In China, both sectors experienced rapid labor productivity growth rates, with corresponding figures of 6.2% and 5.1% for agriculture and non-agriculture, respectively.

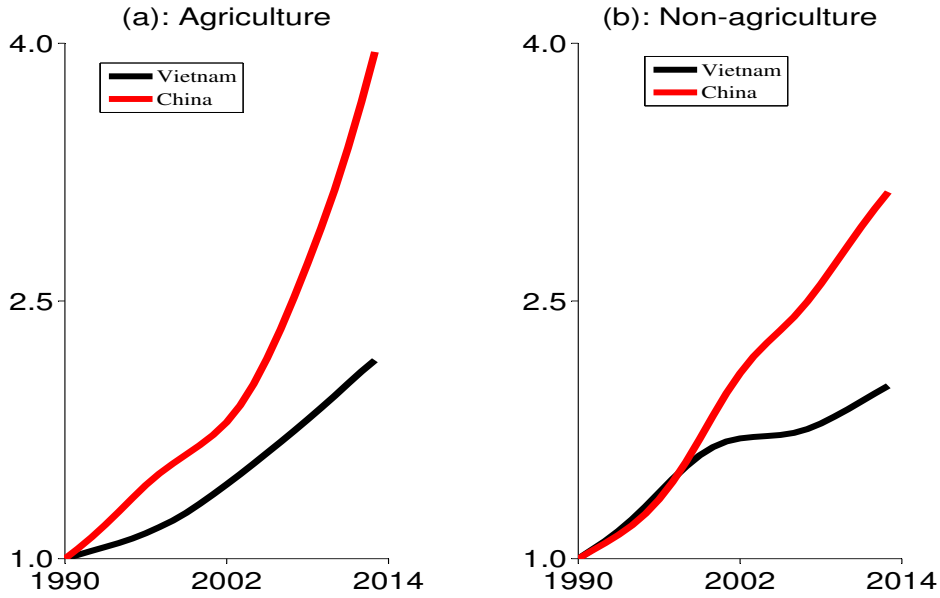

Figure 11: Sectoral productivity differences, China versus Vietnam

Sectoral employment shares. We design counterfactuals to investigate the role of productivity growth in agriculture versus non-agriculture in impacting the speed of deagriculturalization in Vietnam. We conduct counterfactual experiments in which we equip Vietnam with either the agricultural or the non-agricultural productivity growth from China starting in 1990 and construct counterfactual employment shares for Vietnam that would be observed if Vietnam followed the Chinese sectoral productivity paths, since sectoral employment shares are determined endogenously in each counterfactual scenario.

In Figure 12, we display the results of three experiments: first, the agricultural employment shares generated by the model if year-by-year labor productivity growth rates in

agriculture in Vietnam followed the path observed in China during 1990-2013 (labelled "A only"); second, the agricultural employment shares generated by the model if year-by-year labor productivity growth rates in non-agriculture in Vietnam followed the path observed in China during 1990-2013 (labelled "I only"); and, third, the agricultural employment shares generated by the model if year-by-year labor productivity growth rates in both agriculture and non-agriculture in Vietnam followed the path observed in China during 1990-2013 (labelled "A & I").

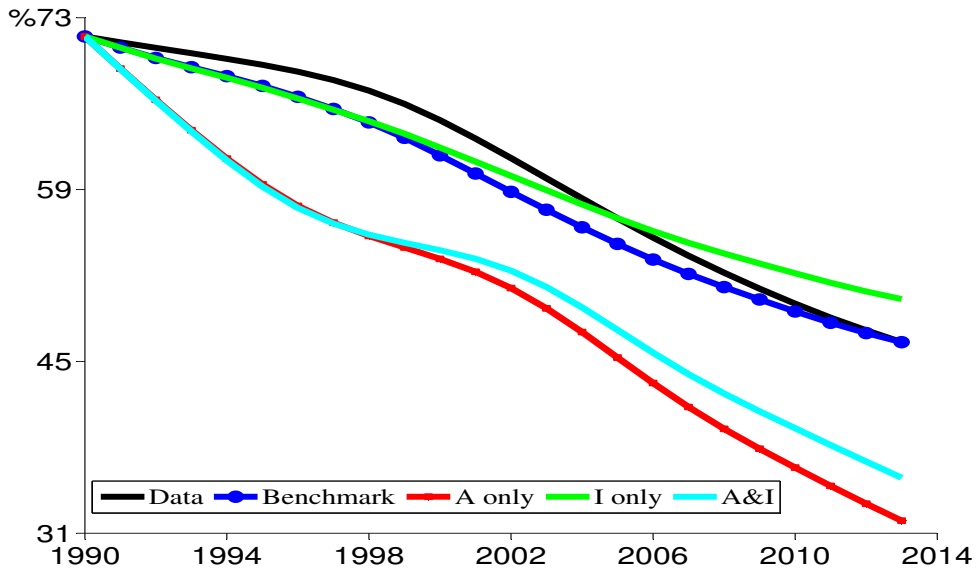

Figure 12: Counterfactuals: Employment share in agriculture, data versus model

Figure 12 shows that if Vietnam had inherited the Chinese agricultural productivity growth from 1990 to 2013, deagriculturalization would have occurred far more quickly (labelled "A only"). If Vietnam had experienced productivity growth in agriculture equal to that of China, then the agricultural employment share in Vietnam would have been 32.0% in 2013 instead of 46.6%. Inheriting the Chinese non-agricultural productivity, on the other hand, would not have contributed to an increased pace of deagriculturalization. The main message from these counterfactual experiments is that growth in agricultural labor productivity plays a more important role than growth in non-agricultural labor productivity in

Vietnam's deagriculturalization experience.[39] This finding is in line with the findings of some recent research that investigates the effects of growth in sectoral productivity (agricultural productivity vs. non-agricultural productivity) growth on deagriculturalization experiences in different countries (see Alvarez-Cuadrado and Poschke, 2011; Üngör, 2013; Chen and Liao, 2015).

Aggregate productivity growth. We now present the results of a series of counterfactuals to quantify the impact on aggregate productivity growth had Vietnam experienced different sectoral productivity paths. The level of aggregate labor productivity is given by a weighted average of the sectoral productivity levels with the weights being the corresponding employment shares. Figure 13 provides an understanding of how aggregate output per worker would have changed under three alternative scenarios: first, the path of aggregate labor productivity generated by the model if year-by-year labor productivity growth rates in agriculture in Vietnam followed the path observed in China during 1990-2013 (labelled "A only"); second, the path of aggregate labor productivity generated by the model if year-by-year labor productivity growth rates in non-agriculture in Vietnam followed the path observed in China during 1990-2013 (labelled "I only"); and, third, the path of aggregate labor productivity generated by the model if year-by-year labor productivity growth rates in both agriculture and non-agriculture in Vietnam followed the path observed in China during 1990-2013 (labelled "A & I").

If agriculture (non-agriculture) in Vietnam had the same annual productivity growth rates as observed in China, then the average annual growth rate of the aggregate labor productivity would have been 4.3% in Vietnam between 1990 and 2013. If both sectors in Vietnam had mimicked the productivity growth paths of Chinese sectors, then the average annual growth rate of the aggregate labor productivity would have been 5.5% instead of 3.2% (the figure observed in the data) during 1990-2013. A comparison of these three experiments reveals that significantly higher growth in aggregate labor productivity would

[39]In Appendix B we discuss the agricultural reforms which have reduced the distortions (and possibly accounted for some of the productivity increases in this sector) in Vietnam in the post-1986 era.

have been accomplished by feeding both sectors' productivity growth rates observed in China. These findings suggest that instead of favoring one sector, economic policies should target both sectors in equal terms to increase sectoral productivity growth rates in Vietnam. The findings of our counterfactual experiments regarding the aggregate labor productivity growth in Vietnam can be considered in line with Johnston and Mellor (1961, p. 590): "[I]t is our contention that 'balanced growth' is needed in the sense of simultaneous efforts to promote agricultural and industrial development".

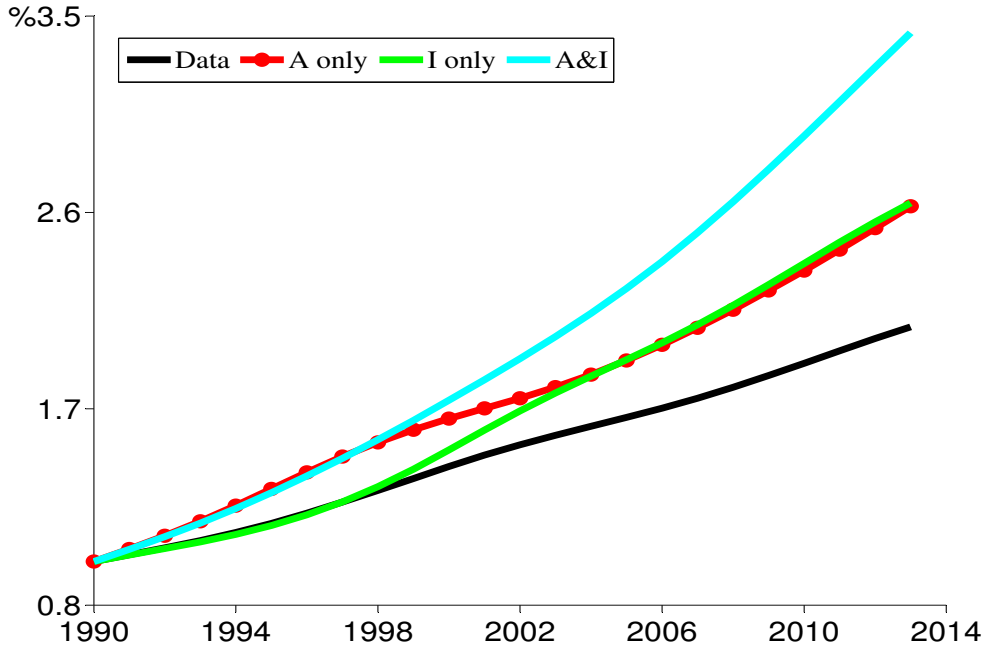

Figure 13: Aggregate labor productivity in Vietnam (1990=1), 1990-2013

6.3 Discussion of the model

In our model, structural change occurs due to two channels. The first channel is non-homothetic preferences because of the subsistence level of consumption in agriculture. The second channel is differences across sectors in productivity growth. The model abstracts from capital accumulation, intersectoral wedges, and international trade. In this paper labor is the only factor of production. This choice is largely driven by a lack of reliable data on

the evolution of capital stocks at a sectoral level in Vietnam. This is a general problem in many developing countries as acknowledged by Święcki (2017) and Üngör (2017). In addition, there is evidence arguing that having capital in the model may not matter a lot for the structural change. For example, Dennis and İşcan (2009) study a two-sector model for the U.S. (agriculture and non-agriculture) to illustrate the potential relevance of the three channels of the structural change mentioned: (i) a demand-side effect due to the low income elasticity of demand for agricultural goods; (ii) a supply-side effect due to differential sectoral productivity growth rates; and (iii) another supply-side effect due to differential capital deepening. They find that differential capital deepening is the least important factor contributing to the structural change during 1950-2000.

Święcki (2017) studies the quantitative contribution of four channels on structural change, in a three-sector model (agriculture-manufacture-services), across an unbalanced panel of between 26 and 44 countries over the period 1970-2005 (including Vietnam over the 1971-2005 period using the APO database): (i) sector-biased technological change; (ii) non-homothetic preferences; (iii) international trade; and (iv) intersectoral wedges. Święcki (2017) finds that the sector-biased technological progress and non-homethetic preferences (the two channels we utilize in this paper) together can explain 70% of the labor relocation for the median country (across 45 country in his sample).[40]

7 Conclusions

The rise of emerging market economies has interested economists and political scientists in recent years. In particular, a surge of research on China has provided new theoretical and empirical insight, turning the development experiences of emerging giants into a vibrant area of enquiry. Vietnam's success and economic development merits a careful systematic look.

[40] Święcki (2017) finds that international trade and changes in intersectoral wedges play a more idiosyncratic role in accounting for labor relocation, i.e., ignoring either channel would not lead to a systematic bias in predicting the changes in labor allocation over time.

This paper investigates the convergence experience of Vietnam to date. Following this, a critical approach is adopted to ascertain whether Vietnam can emulate the success of its predecessors, in its journey to becoming an economic powerhouse, not only in Asia, but on the global stage.

There are several factors working in Vietnam's favor for sustaining its high growth episode. The factories which have powered China's expansion since 1978 are being squeezed by a shortage of workers, rising wages and waning global demand.[41] As China is gradually losing its cost advantage, many companies in China are looking to diversify their operations by expanding into other Asian countries. This strategy has been coined the "China plus one" model.[42] These developments have caused many companies to relocate their factories across the border to Vietnam.[43] The attractiveness of low value-added production is apparent, in terms of the cost and abundance of labor. However, growth based on the accumulation of factor inputs will eventually experience diminishing returns (each additional unit of capital or labour will produce less output than the previous unit).[44] Given that our results suggest Vietnam has relied on factor accumulation (primarily capital) for growth especially in the last two decades, this purports she is still in her early stages of development. A question to be raised is whether Vietnam will manage to transition to a productivity-driven growth trajectory, as Krugman (1994a, p. 13) puts it, "productivity isn't everything, but in the long run it is almost everything." Given these facts, past rates of economic growth are unlikely to be sustained if they fail to improve their productive capacity and technological capabilities. Cheap labour emanating from rural areas will eventually run out, causing wages to start rising.[45]

[41] In 2013, based on wage levels for countries with broadly comparable data, the average monthly wage in Vietnam was $197, compared to $613 for China. Data are from the International Labour Organisation's Global Wage Report 2014/2015 (`http://www.ilo.org/asia/whatwedo/publications/WCMS_325219/lang--en/index.htm`).

[42] `ftijournal.com/article/china-plus-one`

[43] For example, in 2015 Microsoft closed two manufacturing facilities in China and transferred its production line to a plant in northern Vietnam.

[44] Jiang and Yi (2015) expand on this statement and place its implications in a historical context for Japan and South Korea.

[45] This is a phenomenon known as the Lewis Turning Point (named after Sir Arthur W. Lewis), one that

According to our findings, both agricultural and non-agricultural sectors deserve similar attention to increase aggregate labor productivity growth rate in Vietnam. Our findings suggest that the problem of convergence in Vietnam is broad-based and research and policy making should place the emphasis on an economy-wide explanation rather idiosyncratic factors. The VCP are beginning to put in place incentives to attract high-value, high-tech companies. The Law on High Technology (originally passed in 2009) specifies a list of high tech products that are given investment priority. Companies investing in R&D for items on the list are entitled to enjoy corporate tax rates of 10% for the first 15 years of operation, as opposed to the normal rate of 22%. This has seen an influx of multinational high-tech companies flood into Vietnam, including Bosch Vietnam (a subsidiary of Bosch), US-based chipmaker Intel, Samsung LG, Nokia, Microsoft with Apple planning to build a new $1 billion Research and Development Center in Da Nang.[46]

Although promising signs, Vietnam's government must build on these foundations in order to avoid slipping into the so-called middle-income trap. The debate around the middle-income trap is mainly on the observation that a number of emerging markets have grown rapidly at low income levels but were ultimately unable to move beyond middle income status (see Eichengreen et al., 2014 for a detailed discussion). Pritchett (2003) argues that institutional requirements of reigniting growth in a middle-income country can be significantly more demanding than those of kindling growth at low levels of income.

China has experienced of late (see Gollin, 2014 for a recent discussion).

[46] `http://www.vir.com.vn/policy-opens-door-to-hi-tech-investors.html`

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Appendix A Alternate Measure of Human Capital

Recent evidence identifies the shortcomings of measuring human capital with school attainment and highlights the importance of the knowledge and skills actually learned (rather than formal educational attainment) as measured by achievement tests such as the Programme for International Student Assessment (PISA)(Hanushek and Woessmann, 2015; Barro and Lee, 2015). PISA assesses the extent to which 15-year old students have acquired key knowledge and skills that are essential for full participation in modern societies.[47] Table A1 reports the mean scores of 15-year-old students on the PISA mathematics, reading, and science literacy scales for Shanghai-China, Indonesia, Malaysia, Singapore, Thailand, Vietnam, the U.S., and the OECD average in 2012. These average performances refer to all 15-year-old students in an economy regardless of the school type and grade attended. We also report the simple averages of the mean scores in mathematics, reading and science. The last column in Table A1 presents the achievement gap relative to the U.S. based on the average score we calculate for each country.

Table A1: Average scores of 15-year-old students in the PISA 2012

	Mathematics	Reading	Science	Average	Relative to the U.S.
Shanghai - China	613	570	580	588	1.19
Indonesia	375	396	382	384	0.78
Malaysia	421	398	420	413	0.84
Singapore	573	542	551	555	1.13
Thailand	427	441	444	437	0.89
Vietnam	511	508	528	516	1.05
U.S.	481	498	497	492	1.00
OECD average	494	496	501	497	1.01

Source: OECD, PISA 2012 (`http://www.oecd.org/pisa/`).

Vietnam's 15-year old students participated in the PISA for the first time in 2012 and ranked 17th in mathematics, 8th in science, and 19th in reading among 65 participating nations, placing Vietnam above the OECD average and outranking the U.S. These results are even more striking considering the fact that Vietnam is a country with the lowest per capita income amongst all PISA participants.[48] Parandekar and Sedmik (2016) study the success story of Vietnam in PISA 2012 and discuss that the following features are important in explaining the performance of Vietnam in PISA 2012: (i) Vietnamese students work harder and they are more disciplined and focused on their studies; (ii) Vietnamese teachers are working in a more disciplined environment; (iii) Vietnamese parents taking an active part in combining high expectations of their children. In addition, investments in pre-school education and in school infrastructure may also explain the Vietnam's results in PISA 2012.[49]

[47] `http://www.oecd.org/pisa/`

[48] Test scores for 2015 are also available. The average science score of Vietnam's students (525 points) was higher than the OECD average (493 points). Vietnam ranked 8th in PISA 2015 science performance. Vietnam students' average score for reading in PISA 2015 (487 points) was lower than the OECD average (493 points). Vietnamese students, at 495 points on the PISA mathematics scale, performed slightly above the OECD average of 490 points.

[49] Some argue that Vietnam's PISA score does not fully reflect the reality of its education system. See the

We follow Islam et al. (2014) and Harchaoui and Üngör (forthcoming) and study the following simple adjustment for measuring cross-country differences in human capital for 2012. We extend the usual Mincer model that considers only years of schooling (see Section 4.1) to one that additionally considers PISA score performance and suggest the following measure of human capital:

$$\underbrace{\frac{h_i^*}{h_{US}^*}}_{\substack{\text{Considering years of schooling} \\ \text{and PISA scores}}} = \underbrace{\frac{h_i}{h_{US}}}_{\substack{\text{Considering only} \\ \text{years of schooling}}} \times \underbrace{\frac{PISA_i}{PISA_{US}}}_{\text{Pisa scores}} \tag{A.1}$$

Figure A1 shows the conventional measure of human capital (considering only years of schooling, h) and the alternate measure of human capital (considering years of schooling adjusted with PISA scores, h^*) for the countries we are interested in this study. All figures are relative to the U.S. There are no data for Philippines in PISA 2012. If we scale the human capital level of Vietnam relative to the U.S. with relative average PISA scores in 2012, quality-adjusted human capital level of Vietnam is 71.5% of the U.S. level in 2012. Malaysia and Thailand have higher human capital levels than that of Vietnam in 2012 if we look at the conventional measure of human capital. Once we adjust these levels with the average PISA scores in that year, then Vietnam's (quality-adjusted) human capital level is higher than those of Malaysia and Thailand. We also note that Shanghai-China has the highest mean scores in mathematics, reading and science in PISA 2012. That being said there is no reason to interpret Shanghai's scores as if they are indicative of China's national performance in education.

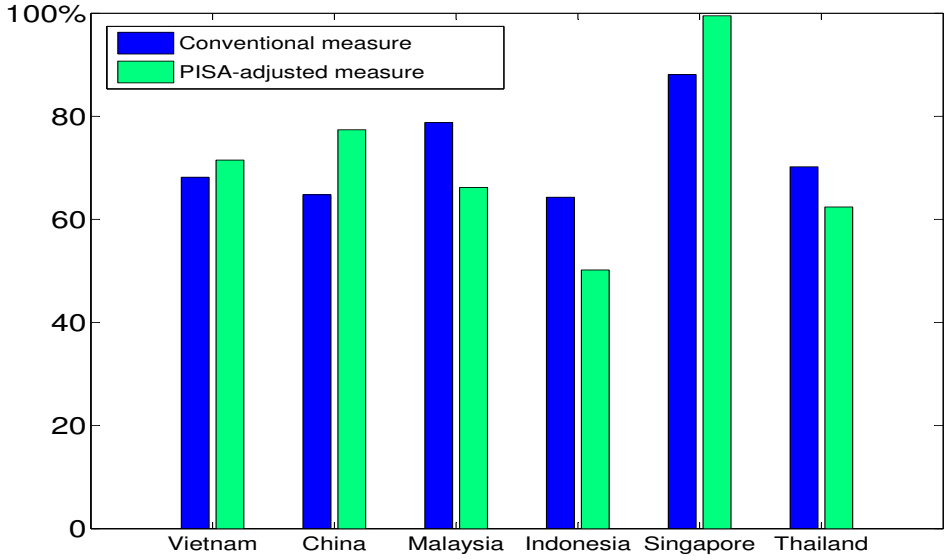

Figure A1: Human capital relative to the U.S. in 2012 (%)

related discussions at: `http://www.economist.com/blogs/banyan/2013/12/education-vietnam`

Appendix B Reduced Distortions in Agriculture

Prior to 1987, agricultural production in Vietnam was conducted on a collective basis. Multiple farms were merged and run by the state as a joint-enterprise. Crops were sold at pre-agreed price levels to the state, well below their true market value. Faced with implicit subsidies and poor incentives, agrarian output stagnated, with thousands of farmers even leaving the country. In 1988, reform transformed agricultural production into a private economic activity. Price controls were eliminated, with farmers being exposed for the first time to markets and competition (Dollar and Litvack, 1998). Agricultural land in Vietnam was decollectivized in 1988, and land-use rights were granted to households. The subsequent land law of 1993, by issuing land-use certificates (or land titles), gave households the right to inherit, transfer, exchange, lease, and mortgage their land-use rights.[50] Do and Iyer (2008) report that close to 11 million land titles had been issued by 2000, which makes Vietnam's land titling program one of the largest in the developing world. These changes put in place an incentive structure which stimulated agrarian production. However, although at the national level these changes have allowed a market for rural land to emerge, Saint-Macary (2012) notes that in some isolated provinces the impact has been subdued. For example, in the northwest region of Vietnam, land transactions remain anecdotal due to a lack of knowledge about law changes and uncertainty regarding the extension of land use rights at the end of long-term leases.

Further reform in agriculture took place in the early 1990s, this time focussed on liberalising both internal and external trade of output and production inputs such as fertilisers. The most influential changes were those made to the rice market. Although seventy percent of farmers produced rice, restrictive export quotas and suppressed internal trade meant that Vietnam was a net importer of rice throughout the 1980s. However, by 1997, *Doi Moi* had propelled Vietnam to be the second largest exporter of rice in the world. With agricultural output being stimulated, this produced a 'labor push' phenomenon, or the migration of labour to the non-agricultural sector (McCaig and Pavcnik, 2013). Improved productivity allowed for less manpower to produce the subsistence level of agrarian output. The aforementioned turnaround in rice production suggests that this transition was swift, providing some explanation for the pace of deagriculturalization which Vietnam experienced since *Doi Moi* in the late 1980s.

A reduction in agricultural distortions was a central factor causing productivity in the sector to rise, thus allowing for the reallocation of labour to the more productive non-agricultural sector. The World Bank's research project "Distortions to Agricultural Incentives" looks at the causes and effects of distortions present in the agricultural markets of 82 countries over the past 50 years. The project includes a variable called the relative rate of assistance (RRA). This captures government policy induced distortions to relative agricultural prices, and is defined as:

$$RRA = 100 * \Big[\frac{100 + NRA_t^{ag}}{100 + NRA_t^{nonag}} - 1\Big],$$

[50] Vietnam has clearly been influenced by China's Household Responsibility System (HRS). The HRS gradually replaced the commune system in China since the end of 1978, transferring the collective agricultural production system to individual farms by contracting land-use rights to individual rural households. In what follows, price and marketing reforms improved the peasants' work incentives in rural China.

where NRA_t^{ag} is the nominal rate of assistance to producers of tradables in the agricultural sector, and NRA_t^{nonag} is the nominal rate of assistance to producers of tradables in the non-agricultural sector. The NRA of a sector is the degree to which government imposed distortions created a gap between domestic producer prices and what they would be under free markets. If the RRA is below (above) zero, a country's policy regime has an anti-(pro-) agricultural bias. If both sectors are equally assisted the RRA is zero (Anderson, 2009; Anderson et al., 2010).

Panel (a) in Figure A2 plots the estimated distortions in Vietnam between 1986 and 2005.[51] In addition to the RRAs, we also plot the NRAs for agricultural tradables and non-agricultural tradables. The policy regime was characterized by a significant bias against agriculture between 1986 and 1993. The RRA averaged 21% during 1986-1989 and 22% during 1990-1993. These RRA values suggest that farmers received, on average, less than 80% of the prices they would have received had markets for both farm and non-farm goods been free between 1986 and 1993. The direct negative assistance to agriculture (as measured by the NRAs for agriculture) underpinned the high degree of distortion in agricultural incentives. The estimated RRA declined in absolute value to -8% in 1994. The RRAs averaged -4% between 1997 and 2001. An agricultural bias remained in the post-Asian crisis, but it is small relative to the corresponding bias that prevailed between 1986 and 1994. Vietnam's agriculture has become much less distorted since then. Farmers in Vietnam received slightly positive assistance, with an average RRA of 1.2% between 2002 and 2005 (see also Athukorala et al., 2009). Panel (b) in Figure A2 plots the estimated distortions in China between 1986 and 2010. There have been dramatic changes in the incentive environment in the agricultural sector for China. The declines in both negative protection for agriculture and the positive protection for non-agricultural tradables since the 1990s changed the distortions in agricultural incentives in China. Instead of facing an RRA of 50% in 1989, farmers in China received an average RRA of 4.2% between 2003 and 2010 (see Huang et al., 2009).

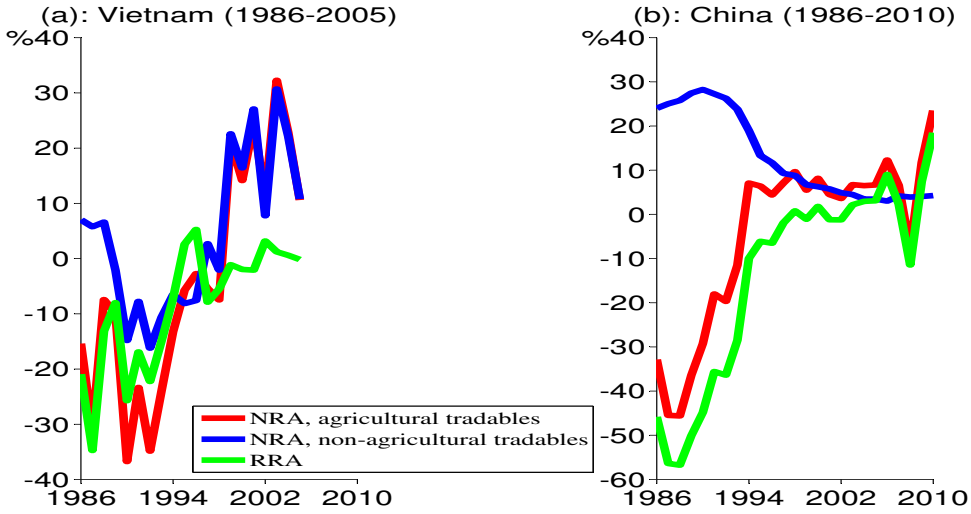

Figure A2: NRAs for agricultural and non-agricultural tradables and the RRA

[51] Data in Figure A2 are from Anderson and Nelgen (2013).