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ABSTRACT

We examine the role of structural change in the economic development of Vietnam from 1990 to 2008. Structural change accounted for a third of the growth in aggregate labor productivity during this period, which averaged 5.1 percent per annum. We discuss the role of reforms in agriculture, enterprises, and international integration in this process. In addition to the drastic move of employment away from agriculture toward services and manufacturing, we also document the movement of workers away from household businesses toward firms in the enterprise sector, and the reallocation of workers from state owned firms toward private domestic and foreign owned firms. Manufacturing experienced particularly rapid growth in labor productivity and a large expansion of employment, as it grew from 8 to 14 percent of the workforce. Changes in trade policy, expansion of employment in foreign owned firms, and the declining role of state owned enterprises robustly contributed toward the changing structure of employment within manufacturing.

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1. Introduction

The idea that poor countries need to undergo a process of structural change, where labor reallocates from traditional, low productivity sectors of the economy toward modern, high productivity sectors to achieve high levels of aggregate productivity has a long tradition in development economics (Lewis 1954, Fei and Ranis 1964, Chenery 1979). More recently, McMillan and Rodrik (2011) document significant gaps in labor productivity between agriculture, manufacturing, mining, and services in a large set of developing countries, and substantial heterogeneity in the contribution of structural change to the aggregate economic performance of these economies during the past four decades. Reallocation of labor across sectors enhanced aggregate labor productivity in Asian economies, while decreasing it in Latin American and African countries within their sample. Our paper examines the role of structural change in the economic development of Vietnam in the 1990s and 2000s.[1]

During the last 20 years Vietnam experienced high rates of economic growth. Real GDP increased at an average annual growth rate of 7 percent between 1986 and 2008, GDP per capita in PPP terms tripled, and poverty rates fell sharply.[2] This economic expansion was accompanied by a drastic shift in the composition of Vietnam's GDP, as economic activities shifted away from agriculture toward services and manufacturing. Figure 1 depicts the share of agriculture, manufacturing, mining, and services in GDP from 1986 to 2009. The most drastic changes occur in agriculture and manufacturing. Agriculture accounted for 34 percent of GDP in 1986 and its share decreased continuously to 17 percent in 2009. Manufacturing, on the other hand, experienced significant growth. From 17 percent of GDP in 1986, its share fell sharply in 1989 and 1990 as many state owned enterprises, which dominated manufacturing at the time, closed down (Dodsworth et al. 1996). Manufacturing share of GDP subsequently climbed steadily to 25 percent in 2009, surpassing the share of agriculture in 2003. The service sector accounted for the largest share of GDP, with its contribution increasing from 46 to 54 percent over the period. Mining and quarrying never accounted for more than 6 percent of GDP.

Vietnam also experienced a large expansion of its labor force, as employment increased at an average annual rate of 2.4 percent, accompanied by a drastic change in the structure of employment

[1] Ideally we would examine the role of structural change over a period of time encompassing several decades. There is no publicly available data on employment and GDP by sector prior to 1990 even at a high level of aggregation. Vietnam is also not included in the Groningen Database used by McMillan and Rodrik (2011).

[2] The information on real GDP, real GDP per capita in PPP terms, and poverty is from the General Statistics Office of Vietnam, the Penn World Tables 7.1 (Heston, Summers and Aten 2012), and the World Development Indicators database (henceforth the WDI) respectively.

across economic sectors.[3] Figure 2 displays the share of agricultural, manufacturing, and service employment in total employment from 1990 to 2008. Vietnam started off as a highly agrarian economy. In 1990 over 70 percent of workers were in agriculture, with the remaining workers employed in services (18 percent), manufacturing (8 percent), and mining (1 percent). By 2008 the employment share of agriculture had shrunk drastically from 73 percent to 54 percent, with workers reallocating toward services and manufacturing. The employment share of services grew from 18 to 32 percent and that of manufacturing from 8 to 14 percent. Mining and quarrying never accounted for more than 1 percent of overall employment.

These large shifts in the sectoral composition of Vietnamese GDP and employment motivate our focus on the role of structural change in Vietnam's economic development during the 1990s and 2000s. We begin by quantifying the contribution of structural change to growth in aggregate labor productivity in Section 2. We find that the reallocation of employment away from agriculture toward service industries and manufacturing, all sectors with relatively higher labor productivity, played an important role.

What contributed to Vietnam's economic transformation? To begin to answer this question it is important to highlight the level of development and the structure of Vietnam's economy at the onset of its economic reforms. In 1986 Vietnam's GDP per capita in PPP (2005 international dollars) was around only $800 (Penn World Table 7.1). This positioned Vietnam within the poorest quintile of countries, ahead of Cambodia and Bangladesh, but behind Laos and Kenya. The highly agrarian nature of Vietnam's economy placed it in the top quintile of countries with the largest share of agriculture in GDP and among the top 10 percent of countries with the highest share of workers in agriculture throughout the 1990s (the WDI).

Beginning in 1986 Vietnam initiated a set of reforms collectively known as Doi Moi, or "renovation", to gradually transform the economy from central planning to a regulated market economy. We discuss in Section 3 the role of key reforms in agriculture, the enterprise sector, and integration of Vietnam into the global economy that could have contributed toward the shift of labor out of agriculture.

These reforms had the potential to not only influence the movement of labor away from agriculture toward manufacturing and services, but also the allocation of labor across household

[3] The share of the population age 15 or older who were working declined from 86 percent in 1993 to 75 percent by 2006 (based on authors' estimates using household survey data). By comparison, the WDI database suggests a decline from 77 percent in 1992 to 72 percent in 2009. The same database suggests a slight increase in unemployment, from 1.9 percent in 1996 to 2.4 percent in 2008.

businesses, state owned enterprises, foreign owned firms, and private enterprises within each sector. In Section 4 we document labor reallocation across these types of firms, which differ in their underlying performance, and the potential for such labor reallocation to contribute toward aggregate productivity gains. Section 5 highlights industries that contributed most to the observed expansion of manufacturing employment during the 2000s and the underlying changes in the structure of manufacturing employment. This analysis suggests that manufacturing industries that experienced greater declines in employment in state owned enterprises and greater increases in employment in foreign owned firms expanded their relative employment, contributing more toward the rapid expansion of the manufacturing sector. Section 6 briefly compares Vietnam's growth experience with other countries that started the 1990s at similar levels of economic development. Section 7 concludes.

2. Patterns of structural change

2.1 Nationwide trends

To what extent did the large shifts of labor out of agriculture noted in Figure 2 contribute to aggregate productivity growth? We use the framework from McMillan and Rodrik (2011) to examine the relative importance of structural change and sectoral productivity growth for aggregate growth in Vietnam. The framework decomposes the aggregate change in labor productivity into two components: growth within sectors and growth due to labor reallocation across sectors that differ in their labor productivity, as expressed below:

$$\Delta P_t = \sum_{i=1}^{n} \theta_{i,t-k} \Delta p_{i,t} + \sum_{i=1}^{n} p_{i,t} \Delta \theta_{i,t}$$

where P_t and p_t are aggregate and sectoral labor productivity levels at year t, and $\theta_{i,t}$ refers to sector i's share of total employment. The first term in the decomposition is the "within" component, capturing the part of aggregate growth in productivity due to growth within sectors. The second term in the decomposition is the "structural change" term, measuring how labor reallocation contributes to labor productivity growth. We conduct the above decomposition using data provided by the General Statistical Office (GSO) on output and employment for nine broad sectors, defined in McMillan and Rodrik (2011), from 1990 to 2008. Output is expressed in 1994 Dong. Labor productivity is measured as real output per worker in a sector.[4]

[4] These labor productivity measures capture average productivity rather than marginal productivity. As discussed in McMillan and Rodrik (2011), comparisons of average productivity gaps across sectors can be potentially misleading if the production function is not Cobb-Douglas and if labor shares of value added differ across sectors.

Figure 3 depicts the decomposition results. Aggregate labor productivity grew on average 5.1 percent annually. Improvements in sectoral productivities accounted for the majority (62 percent) of the labor productivity growth during this period. Productivity growth was uneven across the nine sectors. Table 1 reports sectoral labor productivities in 1990, 2000, and 2008. While productivity levels more than doubled in mining, manufacturing, and public utilities, they stayed relatively unchanged for wholesale and retail trade, hotels, and restaurants, and for financial services. Agricultural productivity grew at an average annual rate of 3.5 percent during this period. Although agricultural labor productivity remained low relative to other sectors and grows substantially less than productivity in manufacturing, agricultural productivity growth nonetheless contributed 15.1 percent to aggregate labor productivity growth owing to agriculture's large share in total employment. In comparison, manufacturing productivity grew at an average annual rate of 5.1 percent and contributed 22.1 percent to aggregate labor productivity growth.

Table 1 further suggests that apart from agriculture; wholesale and retail trade, hotels and restaurants; and transport, storage and communications, sectoral productivity grew more slowly in the 2000s than in the 1990s. For example, manufacturing labor productivity grew on average by 7.1 percent per annum during the 1990s and by 2.7 percent per annum during the 2000s. This trend in part accounts for the lower contribution of sectoral productivity growth to aggregate growth in the 2000s than in the 1990s, noted in Figure 3.[5]

Structural change accounts for the remaining 38 percent of growth in aggregate labor productivity. Figure 3 clearly indicates that the structural change component always positively contributes to growth. After playing a relatively small part in the early 1990s, structural change became an increasingly important component of aggregate growth, and eventually surpassed the within-sector component in 2001. The significant contribution of growth-enhancing structural change for Vietnam confirms the trends in McMillan and Rodrik (2011) for other Asian countries during this period. From 1990 to 2005, countries in Asia experienced, on average, 3.9 percent annual labor productivity growth.

McMillan and Rodrik (2011) and Gollin, Lagakos and Waugh (2012) argue that large gaps in average labor productivity between agriculture and manufacturing likely reflect large gaps in marginal productivity. In addition, in imperfectly competitive industries these productivity measures might in part capture differences in market power across industries to the extent that aggregate price deflators do not fully control for this issue.

[5] With the exception of construction, the sectors that experienced a decline in productivity between 2000 and 2008 (mining and quarrying; public utilities; and finance, insurance, real estate and business services) had employment shares below 1 percent. A fall in labor productivity from 2000 to 2008 in these very small sectors may potentially reflect measurement error in employment in either 2000 or 2008. For example, employment share estimates for mining and quarrying and public utilities from the 2009 census differ by about a third from the GSO estimates.

of which 16 percent can be attributed to the structural change component. Vietnam's productivity growth exceeds the average growth for Asian economies (5.1 percent vs. 3.9 percent) and more strongly depends on the structural change component (38 percent vs. 16 percent).

The relatively large contribution of structural change to aggregate productivity in Vietnam in part reflects the predominantly agrarian nature of the Vietnamese economy in 1990, persistent productivity gaps across sectors noted in Table 1, and a drastic move of employment out of agriculture over the two decades. The dominant role of agriculture as the source of initially low aggregate productivity in Vietnam is starkly illustrated in Figure 4, which plots sectoral productivity as a percent of average economy-wide productivity against the sector's share in total employment in 1990. Agriculture, with nearly three quarters of employment, had the lowest labor productivity of all, less than one half of the economy-wide productivity. Labor productivity in manufacturing was substantially higher, but manufacturing only accounted for 8 percent of employment. By 2008 almost 30 percent of workers had moved out of agriculture. Figure 5 displays sectoral productivity as a percentage of average economy-wide productivity against the sector's share in total employment for 2008. Although productivity in agriculture was still significantly lower than in the rest of the economy, agriculture's share of employment had shrunk to 53 percent. By 2008 nearly half of the employed population worked in sectors with relative productivity more than one-fold and less than two-fold the aggregate productivity.

Figure 6 summarizes these shifts in employment across sectors by plotting the initial sectoral productivity against the sectoral employment growth. The size of the bubble reflects the sector's share of total employment in 1990. The positive slope of the scatter plot illustrates the shift of employment away from low toward higher productivity sectors. A decrease of more than 20 percentage points in agriculture's share of employment was accompanied with about an 8 percentage point expansion in the share of employment in wholesale and retail trade, hotels and restaurants, a 6 percentage point expansion in manufacturing's share of employment, and about a 3 percentage point expansion in construction's share of employment.

Growth in sectoral productivities accounted for the majority of Vietnam's growth in aggregate labor productivity in the 1990s, but Figure 3 shows that structural change became the dominant driver of productivity growth in the 2000s. What accounts for the substantially larger contribution of the structural change component to aggregate growth in the 2000s as compared to in the 1990s? While more detailed research is required to understand the accelerated pace of structural change, we discuss a few possible explanations.

The large contribution of sectoral productivity growth to aggregate growth in Vietnam in the 1990s might be related to the low initial levels of economic development in Vietnam and the implementation of drastic domestic reforms at the end of 1980s. Poor economic conditions in the 1980s induced policy makers to implement wide-ranging reforms in agriculture, the enterprise sector, and international integration. As we discuss in detail in Section 3, these reforms likely contributed toward increased agricultural productivity and toward increased productivity in manufacturing and services during the 1990s, as noted in Table 1. These initial improvements in sectoral productivity could also contribute to subsequent reallocation of workers from agriculture to manufacturing and services. For example, increased agricultural productivity means that fewer workers are required to maintain food production and leads to increased agricultural incomes which, combined with non-homothetic preferences, generates increased demand for non-agricultural goods. Both of these factors would enable subsequent release of agricultural labor. Likewise, productivity gains in non-agricultural sectors during the 1990s and increased demand for Vietnamese nonagricultural goods on the world markets could have subsequently pulled agricultural labor to non-agricultural activities. In both cases, structural change would follow sectoral productivity improvements. We discuss these reforms and their implications in detail in Section 3.

Earlier discussion suggests that structural change is strongly related to the movement of workers out of agriculture and into other sectors. The results in Figure 2, based on national accounts data, and separate census estimates both point to acceleration in the movement of labor out of agriculture in the 2000s. The increased importance of structural change during the 2000s could in part reflect demographic changes, which might have accelerated the decline in the relative share of agricultural employment by increasing the employment share of younger cohorts that entered the workforce directly into high-productivity sectors such as manufacturing and by exiting of older cohorts out of the labor force directly from agriculture. Shifts in the sectoral composition of the workforce owing to demographics are arguably subject to smaller mobility costs than shifts across sectors among cohorts in the workforce. Although Vietnam's workforce grew significantly between 2000 and 2008, from an estimated 36.7 to 44.9 million workers, the movement of workers out of agriculture was not predominantly driven by the changing demographics of the workforce. Table 2 reports the share of workers in agriculture by 5-year cohorts for 1989, 1999, and 2009 from the censuses in the top panel. Over time younger generations of workers have become less likely to work in agriculture, particularly in 2009 relative to 1989 and 1999. However, the panel also demonstrates that workers within cohorts left agriculture. For example, 68.2 percent of workers age 20 to 24 worked in agriculture in 1999, but the

share within this cohort (30 to 34 year olds) fell to 47.2 percent in 2009. Thus, the reduction in employment in agriculture is not simply due to the entry and exit of cohorts from the workforce. In the lower panel we report the results from decomposing the aggregate reduction into within and between cohort effects.[6] Focusing on the period between 1999 and 2009, when most of the movement out of agriculture occurred, over 80 percent of the reduction in the share of agricultural employment reflects the changes within cohorts rather than the changes across cohorts described above. Demographics can therefore account for a small part of the accelerated pace of structural change during the 2000s.

The acceleration in structural change during the 2000s also coincided with increased internal migration, which appears to be driven by economic reasons (United Nation Population Fund 2007, Fukase 2013). This has led to a rapid shift in the distribution of employment across regions within Vietnam. In particular, the workforce in South East Vietnam grew from 15.7 to 19.0 percent of the national workforce between 1999 and 2009, according to our estimates using census data. In Section 2.2 we discuss in detail the differences in economic structure across Vietnam's eight major regions, but for the current discussion it is worth noting that the South East is the region with the lowest share of workers in agriculture and the highest share of workers in manufacturing. Thus, accelerated inter-regional migration may have facilitated the increased rate of structural change during the 2000s.

2.2 Regional trends

Movements of labor out of agriculture toward sectors such as manufacturing were uneven across major regions of Vietnam. Vietnam is composed of eight major geographical regions: the Red River Delta, the North East, the North West, the North Central Coast, the South Central Coast, the Central Highlands, the South East, and the Mekong River Delta. These regions differ along important physical and economic dimensions. For example, the Red River Delta and the South East contain Vietnam's two most important economic centers, Ha Noi and Ho Chi Minh City, respectively. As another example, the North East, North West, and Central Highlands are mountainous and populated by many ethnic minorities.

[6] The decomposition is based on the formula $\Delta S_t = \sum_c \Delta s_{c,t} E_c + \sum_c \Delta E_{c,t} s_c$ where s_{ct} is the share of workers in cohort c working in agriculture at time t, E_{ct} is the share of cohort c's employment in total employment at time t, $s_c = 0.5(s_{ct} + s_{ct-1})$, and $E_c = 0.5(E_{ct} + E_{ct-1})$. The "within" effect is the first summation term, which captures changes within cohorts holding the relative size of cohorts constant and the "between" effect is the second summation term which captures changes in the relative sizes of cohorts holding the prevalence of agriculture employment within the cohort constant. For cohorts that are entering the workforce, we assign a size of 0 prior to entering and for cohorts that are exiting the workforce we assign a size of 0 after exit.

All regions experienced declines in the share of workers in agriculture, but these declines were unevenly distributed across regions. Table 3 documents the share of workers within a region working in agriculture and manufacturing in 1989 and 2009 using information from the Population Censuses. Agricultural employment initially varied widely across regions, ranging from 45 percent in the South East to 85 percent in the North West in 1989. There is significant heterogeneity across Vietnam in terms of structural change as major economic centers, such as in the South East centered around Ho Chi Minh City, have significantly shifted employment out of agriculture into manufacturing and services, while other regions, such as the North West, continue to feature almost complete employment of workers in agriculture. For example, the region with the lowest share of agricultural workers in 1989, the South East at 45 percent, experienced one of the largest reductions in agricultural employment, 19 percentage points, so that by 2009 only about a quarter of its workers were in agriculture. By comparison, the North West, which had the highest share of agricultural workers in 1989 at 85 percent, saw the smallest reduction, 3.4 percentage points, so that over 80 percent of its workers continue to work in agriculture, the sector with lowest labor productivity.

The regions also faced uneven changes in the prevalence of manufacturing jobs. Table 3 reports the share of workers within a region working in manufacturing. The South East and South Central Coast areas started off with the largest manufacturing employment base in 1989 with 24 and 14 percent of workers in manufacturing, respectively. Over the two decades, the manufacturing base expanded relative to total employment in only 3 regions and these increases were especially pronounced in the South East and the Red River Delta. By 2009, the share of manufacturing employment was noticeably higher than the 14 percent national average in the South East (29 percent), the Red River Delta (16.6 percent), and around the national average in the South Central Coast (12 percent). These same regions also feature the highest share of workers engaged in service industries.

Regional disparities in the movement of labor out of agriculture toward manufacturing are stark. The regions that originally relied less on agriculture and more on manufacturing and that are closer to the major seaports experienced larger movements of labor out of agriculture toward manufacturing (and services). Among other factors, the existence of major seaports and the early establishment of industrial zones (see next section) in these regions likely contributed to these diverging trends. The benefits of Vietnam's economic growth were nonetheless distributed throughout the country, as demonstrated by the fall in poverty in all regions. For example, despite the slow movement of workers out of agriculture and the extremely small manufacturing employment base in North West, the poverty rate dropped from 81 percent in 1993 to 46 percent in 2008 (Vietnamese Academy of Social Sciences

2011). This may in part reflect productivity improvements within agriculture noted above and a growth in crop output, as discussed in Benjamin et al. (2009).

3. Major economic reforms: agriculture, enterprises, and international integration

What contributed to structural change in Vietnam? We discuss the role of major reforms in key areas: agriculture, enterprises (including state, foreign owned, and domestic private), and international integration. The reforms began in the late 1980s with a package of policies, collectively known as Doi Moi or "renovation," aimed at gradually transforming the economy from central planning toward economic decisions based on markets. Dollar and Litvack (1998) and the World Bank (2011) argue that the Communist Party implemented the reforms in response to extremely poor economic conditions in Vietnam during the 1980s. Not only was Vietnam a very poor and highly agrarian country at the onset of reforms, but also it faced low economic growth, famine, large budget deficits, hyperinflation, a trade embargo from the United States, and drastic cuts in Soviet aid.

3.1 Agricultural reforms

The agricultural sector was, and continues to be, the largest employer in Vietnam, employing 53 percent of the workforce in 2009. Agriculture contributed to aggregate labor productivity growth through improvements in agricultural productivity and through the release of labor to more productive sectors. Agricultural reforms likely influenced both of these components.

Agriculture was one of the first sectors to experience substantial reform. Prior to Doi Moi agriculture in Vietnam was organized through collectives. The reforms in 1987 and 1988 legalized private economic activity and exposed farms to markets and competition by eliminating price controls and the state procurement system (Dollar and Litvack 1998, Glewwe 2004). The elimination of price controls had dramatic impacts on producer prices. For example, the official procurement price of rice was approximately one-tenth of the market price in 1988 (Dollar and Litvack 1998).

The reforms replaced farming based on collectives with household farms as the main units of production. The land was divided amongst the member households (Decree No. 10 in April 1988), who received a 15-year lease for their plots and could sell agricultural output produced on the plot for market prices (Glewwe 2004). The 1993 Land Law (Decree No. 5 of 1993) strengthened household land property rights by increasing tenure to 20 years for annual land (50 years for perennial land), and by giving households the right to exchange, transfer, lease, inherit, and mortgage their land use rights

(Glewwe 2004). Vietnam also started the process of land titling, so that by 1997 half of all land had been titled (Benjamin and Brandt 2004).

Agricultural reforms further relaxed restrictions on external and internal trade of agricultural goods and inputs, such as fertilizers, during the 1990s. Rice market liberalization played a particularly influential role due to the dominance of rice in agricultural production at the onset of reforms. Seventy percent of Vietnamese households produced rice (Minot and Goletti 2000) and 77 percent of cultivated land was devoted to rice paddies in 1992 (Wiens 1998). At the time, a rice export quota limited exports of rice and farmers and private traders could not freely trade rice within Vietnam. These policies depressed the domestic price of rice, especially in the South, and weakened the incentives of farmers to produce rice.

Between 1992 and 1997 Vietnam increased the quota on rice exports from 1 to 4.5 million metric tons of rice and removed restrictions on internal trade in rice (Benjamin and Brandt 2004), leading to a 30 percent increase in the price of rice relative to the consumer price index between 1992 and 1998. Moreover, the government lifted some restrictions on imports of fertilizers, which reduced their price and increased their use, potentially improving labor productivity in agriculture (Benjamin and Brandt 2004).

The mix of the abovementioned domestic and external reforms contributed toward the takeoff in agricultural labor productivity growth during the 1990s noted in the previous section. Rice production increased drastically, growing at an average annual rate of 4.6 percent between 1985 and 1995 (Minot and Golleti 2000) as yields increased from 3.33 to 4.90 tons per hectare between 1992 and 2006 (Benjamin et al. 2009). Benjamin and Brandt (2004) find that the associated improvements in rural incomes were uneven across regions (benefiting the South and the Red River Delta, where most of the rice is grown, relatively more than the North). Nonetheless, all regions of Vietnam experienced an increase in agricultural output. Benjamin et al. (2009) report that crop output grew by between 2.5 and 16.0 percent per annum between 1992 and 2006 across Vietnam's major regions. Indeed, the fastest growth was in the Central Highlands, North East and North West, regions that are not very specialized in rice. Instead, these regions experienced faster growth in crops such as vegetables and beans (particularly in the Central Highlands), perennials such as tea and coffee, and fruit (particularly in the North East). The widespread gains from agricultural growth might reflect initially fairly equitable allocation of land across households during the Land Law reforms (Ravallion and van de Valle 2008) and the increased opportunity for regions to specialize along lines of comparative advantage.

We are aware of no study that formally examines the impact of agricultural productivity growth on the "labor push" explanation for the observed movement of labor out of agriculture in Vietnam. One explanation for a labor push driven structural change is that people in low-productivity agriculture remain in agriculture to produce a sufficient amount of food for subsistence. Labor can be released from agriculture to more productive activities once agricultural productivity increases above the subsistence threshold. The drastic expansion of rice production subsequent to the reforms in the late 1980s and 1990s suggests that Vietnam's agricultural productivity reached a sufficiently high level for agriculture to exceed the subsistence level and release labor to more productive activities, as suggested in the structural transformation model by Gollin, Parente and Rogerson (2007). In fact, following the implementation of the abovementioned reforms, Vietnam shifted from subsistence agriculture and importation of rice during the 1980s to being the second largest exporter of rice on world markets by 1997 (Dollar and Litvack 1998, Minot and Goletti 2000).

At the same time, Vietnam also experienced several reforms in the enterprise sector that have likely contributed toward observed increases in nonagricultural productivity and thus provide the "labor pull" explanation for structural change. We turn to a discussion of these reforms next.

3.2 Enterprise reforms

Prior to Doi Moi, state owned enterprises (SOEs) were the dominant means of production outside of agriculture. Dodsworth et al. (1996) report that in 1989 SOEs produced about 29 percent of overall output and about half of output in industry and services while employing 16 percent of the Vietnamese labor force. SOEs employed about half of the Vietnamese non-agricultural labor force.

As in agriculture, the Doi Moi reforms decentralized decision making and provided enterprises autonomy over production, pricing and trading. The government implemented policies that further introduced competition and private enterprise activities, including the entry of foreign owned firms. The Foreign Investment Law of 1987 opened all sectors of the economy other than defense to foreign investors, allowed for 100 percent foreign ownership of firms and offered foreign firms generous tax concessions and duty exemptions (Dodsworth et al. 1996). Foreign investment was further encouraged through the formation of economic zones, such as export processing zones and industrial parks (see Decree No. 332/HDBT in October 1991). The first export processing zone was established near Ho Chi Minh City in November 1991. These zones often offered firms reduced tax rates and exemptions on import and export duties (see Articles 51 and 52 of Decree No. 332-HDBT and Article 15 of Decree No. 192-CP issued in 1994, for example). More generally, various reforms such as uniform rules of taxation,

the freedom for enterprises to form their own trading relationships, and exposure to foreign competition (discussed in detail in Section 3.3) aimed to level the playing field between SOEs, foreign enterprises, and private enterprises (World Bank 2011).

Another set of reforms implemented in 1988-89 directly targeted SOEs. As discussed in Dodsworth et al. (1996), the SOEs received autonomy over the production process and price setting, and were allowed to lay off workers. Importantly, SOEs had to begin operating subject to hard budget constraints and could no longer rely on export subsidies.

The combination of these early reforms immediately changed the production incentives within the SOEs, increased their exposure to market forces, and led to a drastic consolidation of the sector. Excluding oil production, SOE value added declined by 7 percent between 1989 and 1991 (Dodsworth et al. 1996). Between 1989 and 1992 about 800,000 SOE employees (approximately one third) were laid off (Glewwe 2004). The number of SOEs declined dramatically from 12,000 in 1988 to about 6500 in the mid-1990s (Dodsworth et al. 1996). The consolidation was accomplished mainly through closure (which disproportionately affected the local government SOEs as opposed to central government SOEs) and mergers, while privatization was rare (Dodsworth et al. 1996). The consolidation of the SOE sector slowed down during the rest of the 1990s and much of it was achieved through selling of equity in the SOEs (World Bank 2002). By 2000, about 5700 SOEs were present and by 2010, only 3364 SOEs remained in operation (World Bank 2011), less than a fourth of the SOEs that operated in 1989. Despite the drastic reform of the sector during the 1990s, the World Bank (2002, 2011) indicates that the process of SOE restructuring has slowed down during the second part of the 2000s. SOEs now employ less than 10 percent of the workforce, but they remain an important sector in terms of production, accounting for about 35 percent of GDP in 2009 and 19 percent of manufacturing output. Likewise, Dinh Hien Minh, Trinh Quang Long, Dinh Thu Hang, and Pham Thien Hoang (2010) report that state ownership contributed 36.8 percent of GDP over the 1991-95 period and this actually increased slightly for the period 1996 to 2005, before returning to 36.1 percent over the period 2006-09.

The liberalization of foreign direct investment (FDI) led to a large inflow of FDI in the 1990s and 2000s. Foreign direct investment as a percentage of GDP increased from 2.8 percent in 1990 to 11.9 percent in 1994 and then fluctuated between 3.5 and 10.5 percent between 1995 and 2010.[7] This was accompanied by a significant change in the relative share of output produced by the FDI sector, mainly at the expense of the private non-state domestic sector. The share of output from the FDI sector grew

[7] The estimates of FDI as a percentage of GDP are from the World Development Indicators database.

from 6.4 percent over 1994 and 1995 to 18.0 percent over the 2006 to 2009 period with an accompanied fall in the share of GDP produced by the non-state domestic sector (Minh et al. 2010).

Another important reform for the private sector has been the 2000 Enterprise Law, which made it easier for private enterprises to register and operate across most industries (World Bank 2002). In Vietnam, firms either operate as a household business (or a farm) or an officially registered enterprise. The Enterprise Law reduced the time required to register an enterprise, leading to 50,000 new registered enterprises between January 2000 and October 2002, about three quarters of the total number of enterprises then registered. Most of the newly registered enterprises were fully privately owned and very small in size. World Bank (2002) reports that those registered in 2002 had an average registered capital of only 90,000 USD. Malesky and Taussig (2009) report that the 2000 Enterprise Law contributed to the growth in private enterprise firms through firms being more likely to start operations in the enterprise sector, as opposed to in the household business sector, and firms transitioning more quickly from the household business sector to the enterprise sector.

The enterprise sector reforms have dramatically changed the business environment in Vietnam. According to Doing Business 2013 (World Bank 2013), Vietnam was ranked 99 out of 185 countries on the ease of doing business. This ranks it only slightly behind China, ranked 91st, and ahead of countries such as Indonesia and Bangladesh. The current ranking reflects significant improvements over time in some business environment characteristics tied directly to enterprise sector reforms. For example, the number of days needed to start a business fell from 59 to 38 and the percentage of income per capita required to start a business has decreased from 31.9 to 12.1 percent between 2003 and 2010 (World Bank 2004, 2013).

Overall, the associated restructuring of SOEs, expansion of private enterprises, inflows of new investment and technology, and better incentive structures for production decisions all contributed toward the observed increases in sectoral labor productivity in non-agricultural sectors noted in Section 2. These sectoral productivity gains not only directly impacted the gains in aggregate productivity, but could have in principle also induced labor to move out of agriculture. Agriculture started off with lower labor productivity in 1990 and experienced lower subsequent productivity growth than non-agricultural sectors such as manufacturing. An increase in non-agricultural productivity is predicted to induce rising wages in the non-agricultural sector, particularly within enterprises, thus inducing workers to move out of agriculture. The magnitude of the contribution of these “pull” factors relative to the “push” factors for moving workers out of agriculture discussed in the previous subsection remains an open empirical question.

3.3. International integration

Strongly connected to the reforms in agriculture and enterprises was Vietnam's gradual integration with the global economy. To appreciate the vastness of the reforms undertaken as part of this integration one must appreciate how controlled and closed, in many respects, Vietnam was at the beginning of the Doi Moi period in comparison to its current openness.

Prior to the reforms foreign trade in Vietnam was subject to central decisions and could only be carried out by a small number of state trading monopolies. Exports were discouraged through the overvaluation of the exchange rate and the use of export duties, imports had to proceed through an extensive system of quotas and licenses, and exports had to fulfill partner obligations within the Council for Mutual Economic Assistance before they could be sold to the convertible currency area (Dodsworth et al. 1996). Additionally, Vietnam faced a trade embargo with the United States that was only lifted in 1994. These restrictions made Vietnam a relatively closed economy.

The list of reforms early in Doi Moi is extensive. These include the unification and devaluation of the exchange rate in 1989, relaxations on import and export quotas in 1989, eliminating all budget subsidies for exports in 1989, simplification of licensing procedures for import and export shipments, delisting items from export duties and reducing the rates for remaining products in 1989, allowing private enterprises to engage directly in international trade in 1991, and removal of import permit requirements for most remaining items in 1995 (Dodsworth et al. 1996).

Domestic reforms related to international trade were quickly followed by international trade agreements and partnerships. In 1992 Vietnam signed a preferential trade agreement with the European Economic Community (Glewwe 2004). In 1995 Vietnam became a member of ASEAN and its associated ASEAN Free Trade Area, which bound Vietnam to reduce tariffs on imports from ASEAN members to 5 percent or less by 2006 for the vast majority of goods (Athukorala 2006). In 1995 Vietnam also initiated the application process to join the World Trade Organization. In December 2001 the U.S.-Vietnam Bilateral Trade Agreement came into effect, leading to a huge increase in Vietnamese exports to the U.S., predominantly in light manufactured products such as clothing, textiles, and footwear (McCaig 2011). The culminating act was membership in the World Trade Organization in 2007 (World Bank 2011).

The vast array of trade reforms significantly increased the ability of firms to export and import. According to Doing Business 2013 (World Bank 2013) Vietnam ranks better on trading across borders than for overall ease of doing business. It ranks 74 in 2012, just behind China at 68th position. In Vietnam fewer documents are needed to export, but more to import than in China and container costs are very

similar. The trading across borders rankings put Vietnam well ahead of other Asian countries such as Cambodia (118th), Bangladesh (119th), and India (127th).

These policy changes contributed to a dramatic increase in both aggregate exports and imports as a percentage of GDP. Figure 7 shows the dramatic rise in imports and exports as a percentage of GDP between 1986 and 2011. In the mid-1980s imports and exports averaged about 15 and 5 percent of GDP respectively. Starting in the late 1980s and early 1990s imports and exports both began a rapid and continuous increase, reaching 88 and 78 percent of GDP by 2010. Between 1990 and 2010 exports and imports grew in value by an average of 18.5 and 18.7 percent per annum (based on data from the GSO).

The trade reforms not only increased the aggregate value of trade and its importance to the economy, but also affected the composition of trade in two important dimensions: the types of goods being traded and the ownership of the firms involved in trading. As shown in Figure 8, Vietnam's exports shifted significantly away from agricultural and aquaculture products, such as rice and fish, and crude petroleum (within mineral fuels, lubricants and related materials) to manufactured exports such as clothing and footwear (within miscellaneous manufactured products) and office machinery (within machinery and transport equipment). Primary products exports constituted over 60 percent of exports in 1995, but they had fallen to about 30 percent by 2010. Two major export commodities, rice and crude petroleum, account for a large share of the decline in the relative importance of primary exports.[8] Data constraints prevent us from constructing a consistent series stretching further back in time, but Chu Thi Trung Hau and Dickie (2006) report that manufactured exports accounted for only 6 percent of exports in 1992. As displayed in Figure 9, the major compositional shift in imports was away from miscellaneous manufactured goods, primarily due to a fall in the share of clothing and footwear imports, towards manufactured goods classified chiefly by materials, such as iron and steel and non-ferrous metals.

The above reforms and changes in the composition of traded products likely contributed to the reallocation of labor from agriculture (including aquaculture) to manufacturing, as agricultural exports became relatively less important over time. Vietnam dramatically expanded exports of unskilled labor-intensive manufactured goods such as clothing, footwear, and office machinery, which grew at average annual rates of 16.8, 13.9 and 67.5 percent respectively from 1997 to 2000.[9] At the same time, the share of light manufactured goods in imports declined. This expansion of net exports and the changes in the composition of manufacturing trade likely contributed to increased demand for labor within

[8] Data from the UN Comtrade database suggest that rice (SITC 42) dropped from 9.5 percent of exports in 1997 to 4.5 percent of exports in 2010. Crude petroleum exports (SITC 333) declined from 15.6 to 6.9 of total exports during the same period.

[9] Authors' own calculation based on data from UN Comtrade.

manufacturing, where employment expanded at an average annual rate of 7.5 percent during this period and at the same time affected the structure of employment across manufacturing industries. We more closely examine changes in composition of manufacturing industries in Section 5.

Additionally, the liberalization of foreign investment and SOE reforms noted in Section 3.2 interacted in important ways with trade reforms and affected the composition of ownership of firms involved in international trade. Foreign-invested firms became responsible for over half of all exports by 2010, as compared to only about a quarter of exports in 1995 while imports by foreign firms rose from 18 to 44 percent of total imports between 1995 and 2010.[10] Thus, Vietnam's trade reforms likely influenced the structure of the workforce across firms of different ownership type. We discuss the importance of changes in the allocation of labor across firms that might have been differentially affected by trade and other reforms in the next section.

4. Labor allocation across firm types within sectors

Movements of labor away from agriculture toward services and manufacturing contributed significantly toward Vietnam's economic growth during the past two decades. A large literature emphasizes allocation of labor across heterogeneous firms within sectors as an important source of aggregate productivity (see, for example, Hsieh and Klenow 2009, Melitz 2003, Melitz and Redding forthcoming, Pavcnik 2002, Restuccia and Rogerson 2008). The sectoral labor productivity improvements noted in Table 1 could in part stem from such reallocation of labor from less to more productive firms within each sector. In this section, we document the extent to which labor reallocated across firms types and discuss the potential contribution of this channel to aggregate productivity growth in Vietnam from 1990 to 2008. The discussion focuses on two dimensions of labor allocation: the allocation of workers between household businesses and firms in the formal enterprise sector, and the allocation of labor across SOEs and firms in the private domestic and foreign sector.

4.1 Moving out of household businesses toward firms in the registered enterprise sector

A large share of workers in low-income countries work for informal household businesses or farms. The informal sector is usually associated with lower productivity (McMillan and Rodrik 2011, La Porta and Shleifer 2008, McCaig and Pavcnik 2013) and workers employed in the informal sector tend to earn lower wages than observationally similar workers in the formal sector (Goldberg and Pavcnik 2003,

[10] The data series are "Exports of goods by kind of economic sector and by commodity group" and "Imports of goods by kind of economic sector and by commodity group" from the GSO's website.

2007). If firms in the formal sector are more productive than firms in the informal sector, a reallocation of labor toward formal firms could in principle contribute toward growth in aggregate productivity.

The Vietnamese household surveys conducted between 2002 and 2008 allow for a consistent definition of informal employment based on the ownership sector in which the individual worked. The surveys identify whether the individual is self-employed on a household farm or business, working for another household's farm or business, or working in the state, collective, private, or foreign sector. Our definition of household business employment encompasses workers that are either self-employed or working for another household's farm or business.[11] Firms in the state, collective, private, and foreign sector are registered as an enterprise with the government. Household farms and businesses (henceforth household businesses) are not officially registered with the government as an enterprise. As such, they are subject to looser regulations on employment conditions for workers. Our focus on household businesses thus conforms to an important distinction across different types of businesses in Vietnam as per national legislation.

As in many less developed economies, a large share of Vietnam's labor force works for household businesses or farms. Table 4 reports household business employment shares in aggregate and in broad sectors of the economy as defined in McMillan and Rodrik (2011) for 2002 and 2008. Despite Vietnam's rapid growth during the 1990s, the vast majority of workers, 86.3 percent, continued to work for a household business as of 2002. Sectors differ in the prevalence of household business employment. Almost all workers in agriculture, hunting, forestry, and fishing work for household businesses. While rates are lower in other sectors, household business employment exceeds 80 percent in sectors such as wholesale and retail trade, hotels, and restaurants, and in construction and it accounts for 66.7 percent of manufacturing employment in 2002. Vietnam observed a sharp decline of 5.6 percentage points in the aggregate share of household business employment by 2008. These declines were uneven across sectors. Virtually all sectors observed large drops in the share of household business employment, but the declines were largest in manufacturing (from 66.7 to 54.4 percent) and mining and quarrying (from 57.9 to 45 percent). Transport, storage, and communication and utilities also experienced large drops, while the prevalence of household business employment in agriculture and in finance, insurance, real estate and business services was unaffected.

Declining household business employment in part reflects the structural change in Vietnam's workforce discussed in Section 2. Between 2002 and 2008, workers tended to move away from sectors

[11] The censuses cannot be used in a similar manner because the required definitions were not consistently applied over time.

with a high incidence of household business employment such as agriculture toward sectors with lower prevalence such as manufacturing. This relationship is strongly influenced by the agriculture, hunting, forestry, and fishing sector which contracted sharply as a share of total employment and features a high prevalence of employment in household businesses. McCaig and Pavcnik (2013) find that about 50 percent of the decline in the aggregate share of employment in household businesses in the first half of the 2000s is driven by movements of labor between industries, notably away from agriculture and aquaculture toward other industries. Their findings are based on a decomposition of the aggregate decline in household business employment into between- and within-industry shifts across 60 distinct industries. The remaining half of the decline is driven by the reallocation of workers from household business to firms in the enterprise sector within an industry. This latter mechanism could have contributed toward the sectoral productivity increases in sectors such as manufacturing, as noted in Table 1, because household businesses tend to have substantially lower labor productivity than firms in the enterprise sector (McCaig and Pavcnik 2013). The difference in productivity between household businesses and enterprises persists even when state and foreign enterprises are excluded. For example, estimates from the 2006 VHLSS suggest that private enterprises report average revenue per worker of 46.3 million dong, while household businesses report average revenue per worker of 17.7 million dong across all industries and 78.9 and 18.0 million dong respectively within manufacturing.

Vietnam's increased access to export markets contributed toward the observed declines in household business employment within industries. Recent trade theory based on Melitz (2003) highlights the reallocation of labor toward more productive firms within an industry in response to declines in trade costs. More generally, if trade increases the opportunity cost of working in a household business by increasing the relative profitability of firms in the formal enterprise sector, workers are expected to reallocate away from household businesses toward larger, more formal employers and these effects are expected to be more pronounced in industries that face increased export opportunities. McCaig and Pavcnik (2013) find that increased access of Vietnamese exports to the U.S. markets after the 2001 U.S.-Vietnam Bilateral Trade Agreement reduced the probability of household business employment. The probability of working for a household business declined the most in Vietnamese industries that experienced the largest U.S. tariff cuts. These declines in household business employment were more pronounced for workers in younger cohorts and for workers in provinces closer to major seaports. Their findings imply that industry tariff cuts on exports in manufacturing can account for up to 40 percent of the decline in household business employment in manufacturing between 2001 and 2003. Increased access to export markets, which disproportionately benefits larger, more

productive firms in the enterprise sector, contributed toward the observed increases in manufacturing productivity during the 2000s.

4.2 Moving out of SOEs toward the private sector

The enterprise reforms discussed in Section 3 exposed SOEs to market competition and eased the entry and growth of private domestic and foreign owned enterprises, setting the stage for potential reallocation of resources such as labor away from SOEs toward firms in the private sector.

The Vietnamese census data on employment by broad sectors and ownership type presented in Table 5 shed further light on the process of labor allocation between SOEs and private domestic and foreign firms over the two decades. At the onset of reforms in 1989, apart from community and government services (where virtually all employment was in state jobs), employment in SOEs was the most prevalent form of employment in services such as finance, insurance, real estate and other business services (88 percent), and construction (68 percent), and was also significant in transport, storage and communication (48 percent) and manufacturing (37.5 percent). The reforms reduced the number of workers working for SOEs in absolute number from 4.4 million in 1989 to 3.8 million in 1999. The decline in the absolute number of workers in SOEs occurred in all sectors, with the exception of community, social, personal and government services and finance, insurance, real estate and other business services. Overall, the share of the Vietnamese labor force working for SOEs declined from 15.7 to 10.7 percent. While all industries observed a shrinking share of SOE employment, the most notable declines occurred in construction; transport, storage, and communication; and in wholesale and retail trade, hotels and restaurants.

Labor was clearly being reallocated from the SOE sector toward the growing private sector in the decade following the initial reforms. Some of the expansion of the employment in private sector owes to foreign direct investment. Table 5 documents that while Vietnam attracted employment in foreign owned firms during the 1990s, the expanding foreign owned sector employed less than 200,000 workers by 1999 and accounted for less than one percent of the economy-wide workforce. These aggregate numbers mask differences in exposure to FDI across broad industrial sectors, as 87 percent of the workers in the FDI sector were employed in manufacturing. Manufacturing was the only sector in 1999 where employment in foreign owned firms exceeded 5 percent.

While the number of workers in the state sector increased by 1.7 million between 1999 and 2009, the state sector was, in aggregate, neither expanding nor contracting as a share of total employment during the 2000s, accounting for about 10 percent of overall employment. This mainly

reflects the growth of state employment in community, social, personal and government services during 2000s. Outside of this sector, the share of SOE employment dropped by 30 percent between 1989 and 1999, and by 16 percent between 1999 and 2009. The declines in SOE employment were particularly pronounced in manufacturing (from 30 to 9 percent), construction (23 to 6 percent), and in finance, insurance, real estate, and other business services (from 74 to 36 percent) between 1999 and 2009.[12] SOE employment actually dropped in absolute number in manufacturing; construction; and wholesale and retail trade, hotels and restaurants.

In the private sector, FDI employment played an increasingly important role in the 2000s. Further expansion of private investment and jobs might have been spurred by implementation of several additional reforms such as the Domestic Investment and Promotion Law in 1998 and Common Investment Law in 2006. Table 5 suggests that the number of workers in foreign owned firm increased by almost 1.5 million during this period, although the share of individuals employed by foreign firms continues to be low economy-wide (about 3.4 percent in the 2009 census). FDI's impact was mainly felt within manufacturing, where foreign owned firms employed 22 percent of workers, and in finance, insurance, real estate and business services, where foreign firms employed 6.4 percent of workers by 2009. No other sector saw its share of workers in foreign-invested firms grow by more than a few percentage points.

The observed drastic shift of workers away from SOEs toward private firms, including foreign owned ones, could have contributed toward aggregate productivity improvements. Firms in the state sector tend to be less productive than private establishments (World Bank 2011). In addition, most of the closed or merged SOEs were smaller, less productive, and non-profitable (Tuan et al. 1996). As a result, reallocation of labor away from SOEs toward private or foreign owned firms might have contributed toward the growth in sectoral productivity noted in Table 1 in sectors such as manufacturing; wholesale and retail trade, hotels, and restaurants; and construction, as workers moved from lower to higher productivity firms.

However, a recent report by the World Bank (2011) indicates that the process of SOE restructuring has slowed down between 2005 and 2009. SOEs now employ less than 10 percent of the workforce, but they remain an important sector in terms of production, accounting for about 35 percent of GDP in 2009. The state sector still has a virtual monopoly on production in sectors such as fertilizer,

[12] Some of the reductions in state employment might reflect the formation of joint ventures with foreign firms, in which case the firm would become classified as a foreign-invested firm. Thus, the reduction in state employment may not translate one to one into job losses. Nonetheless, these reductions show the declining importance of state firms.

coal, electricity and gas, telecommunications, water supply, and insurance (World Bank 2011). The state sector also tends to have better access to capital and land markets, receiving about 27 percent of domestic credit in 2009, and capital accumulation among the SOEs has accelerated during the 2000s (World Bank 2011). Capital accumulation has not translated into disproportionately greater labor productivity, so the labor productivity of SOE firms lags relative to private enterprises. These observations suggest that Vietnam could further increase aggregate productivity by either further implementation of reforms in the SOE sector or reallocation of resources, especially capital, from SOEs to the private sector.

5. Digging deeper in the manufacturing sector during the 2000s

The manufacturing sector observed a large expansion of employment and output during the past two decades. What manufacturing industries contributed toward the expansion of manufacturing employment from 8 to 14 percent of the Vietnamese workforce between 1990 and 2008 noted in Figure 2? Information on employment patterns across 23 manufacturing industries from the 1999 and 2009 Vietnamese census data provides further insights on this process during the 2000s. Data constraints preclude this analysis for the 1990s.

Table 6 reports the estimated number of workers across 23 manufacturing industries for 1999 and 2009. Four industries employed 61 percent of manufacturing workers in Vietnam in 1999. Clothing accounted for 25 percent of manufacturing employment, followed by food products and beverages (16 percent), furniture (12 percent), and footwear (8 percent).[13]

During this decade manufacturing employment grew at an average annual rate of 7.5 percent, absorbing about 3.3 million workers. The differences in employment growth rates across industries noted in Table 6 have somewhat influenced the composition of employment within manufacturing, but the vast majority of manufacturing jobs were added in the initially largest industries. The four largest industries expanded the most in terms of number of employees and continued to dominate manufacturing employment. These are all industries in which Vietnam, as a relatively less-skilled labor abundant country, has a comparative advantage, and indeed Vietnam exports significant quantities of

[13] Employment in the furniture industry also includes manufacturing n.e.c. (industry 36 in ISIC revision 3) Employment in furniture accounts for 81 percent of total employment in the industry based on estimates from the 1999 census and thus for brevity we simply refer to this industry as furniture. Similarly, employment in footwear also includes employment in tanning and dressing of leather and manufacturing luggage, handbags, saddlery, and harnesses (industry 19 in ISIC revision 3) but employment in footwear is the dominant component at 88 of total employment in the industry according to estimates from the 1999 census. We thus we simply refer to this industry as footwear.

clothing, footwear, and furniture. For example, almost 600,000 new workers joined the clothing industry, accounting for 18 percent of the total growth in manufacturing employment. Vietnam also appears to be transitioning into industries that traditionally did not account for much of its manufacturing labor force. Some initially very small industries experienced very rapid growth in employment. These include motor vehicles, trailers and semi-trailers; other transport equipment; and radio, television and communication equipment and apparatus. Employment in office, accounting and computing machinery grew at an astounding average annual rate of 33.7 percent, although the industry still accounts for a relatively small share of total manufacturing employment at just 0.3 percent in 2009.

Much of this employment expansion occurred in the officially registered enterprises that tend to be substantially larger and have higher labor productivity than non-registered household businesses (McCaig and Pavcnik 2013). The right side of Table 6 provides estimates of the number of employees, at year end for 2000 and 2008, using the enterprise surveys, which only cover employment in officially registered enterprises.[14] Registered manufacturing sector employment added 2.3 million workers, representing an average annual growth of 12 percent. The registered sector observes similar patterns in employment expansion as the overall manufacturing sector, highlighting the dominant role of larger firms in manufacturing expansion. The initially largest industries, such as clothing, experienced the largest increases in the number of workers, but some initially smaller industries, such as office, accounting and computing machinery, experienced faster growth rates. Clothing was a very important industry for employment growth as it added about 525,000 workers during this period, accounting for over one fifth of total employment growth in the formal manufacturing sector. Other industries that experienced large expansions in absolute terms include footwear, furniture, and food products and beverages, as they all added over 200,000 employees over these eight years. In terms of growth rates, the fastest growth was observed in office, accounting and computing machinery and furniture, which both experienced average annual growth rates above 20 percent.[15]

The observed changes in the structure of employment across manufacturing industries relate to changes in the relative importance of SOE employment and FDI employment within an industry during the 2000s. Industries that observed the biggest declines in the share of state sector employment and

[14] The household surveys used in Section 4.1 also collect information on whether the individual worked for an enterprise. These unreported estimates are very similar to those from the enterprise data. For example, the employment shares are highly correlated: 0.971 using the 2001 enterprise data and the 2002 household survey data and 0.963 using the 2005 enterprise data and the 2006 household survey data. Thus, both data sources depict broadly similar employment patterns among officially registered firms.

[15] Recycling also grew at an average annual rate above 20 percent, but it started from an extremely small base, just a few hundred workers.

biggest increases in the share of FDI employment expanded relative to other manufacturing industries between 1999 and 2009. These patterns in relative employment changes are documented in Figure 10, which plots the change in an industry's share of manufacturing employment against the prevalence of SOE jobs and Figure 11, which plots the change in an industry's share of manufacturing employment against the change in the prevalence of FDI jobs. The correlation between 1999 and 2009 in the change in the share of workers within an industry working for a state firm and the change in the industry's share of manufacturing employment is -0.26. Between 1999 and 2009 the correlation between the change in an industry's share of manufacturing employment and the change in the share of workers in FDI firms within an industry is 0.18. These relationships suggest that either foreign investors have selectively targeted sectors with the greatest employment growth potential or that these sectors grew because they attracted foreign capital.

6. Vietnam's structural change in international perspective

Structural change contributed positively toward aggregate productivity improvements in Vietnam. Domestic reforms in agriculture, the enterprise sector, and international integration likely played an important role in this process. How does Vietnam's experience compare to other less developed economies during the last two decades? McMillan and Rodrik (2011) noted heterogeneity in the impact of labor reallocation across sectors on aggregate growth: structural change increased aggregate productivity in Asian countries but decreased it in Latin American and African countries within their sample. Reallocation of labor across sectors tended to enhance aggregate productivity in countries with a comparative disadvantage in natural resources, an undervalued exchange rate, and a more flexible labor market.

We briefly compare Vietnam's growth experience to other countries of similar initial economic development in 1990 and discuss the potential role of the factors identified by McMillan and Rodrik (2011) in enhancing Vietnam's ability to expand its manufacturing and service sector relative to other low-income countries. Figure 12 plots GDP per capita in 1990 and 2010 for countries with GDP per capita within $300 of Vietnam's GDP per capita of $900 (in 2005 PPP prices) in 1990. This grouping predominately includes countries in Africa (such as Zambia (ZMB), Lesotho (LSO), Kenya (KEN)) and Asia (such as Cambodia (KHM), China (CHN), Laos (LAO)). The figure illustrates Vietnam's remarkable economic growth between 1990 and 2010. Within this country grouping, Vietnam (VNM) moved from the middle of the pack to the fourth richest country, trailing only Bosnia and Herzegovina (BIH), China (CHN) and Equatorial Guinea (GNQ).

As discussed in Section 2, slightly more than a third of Vietnam's growth can be attributed to structural change induced by movements of labor from low productivity agriculture toward more productive manufacturing and services. The relatively large contribution of structural change in Vietnam may in part owe to Vietnam's high initial concentration of workers in low productivity agricultural activities. Figure 13 plots the percentage of employment in agriculture against GDP per capita for the same set of countries as in Figure 12. Even among this group of low-income countries, Vietnam's workforce is more agrarian than would be predicted based on its initial level of income. However, the 20 percentage point drop in the share of agricultural employment in Vietnam between 1990 and 2008 is not solely due to the initially highly agrarian nature of Vietnam's economy. Many other highly agrarian countries in the sample experienced a much slower reallocation of workers out of agriculture and slower overall economic growth. For example, the share of workers in agriculture dropped by only 4 percentage points between 1994 and 2005 in Burkina Faso (BFA) and by only 8 percentage points between 1991 and 2006 in Tanzania (TZA). Both countries also experienced notably slower growth than Vietnam between 1990 and 2010 (Figure 12). Thus not all initially agrarian economies necessarily experience the fast movement of workers out of agriculture experienced in Vietnam.

The discussion in previous sections suggests that in Vietnam workers leaving agriculture and less productive employers are fairly quickly absorbed into more productive sectors and firms in manufacturing and services. The expansion of manufacturing employment owes to Vietnam's comparative advantage in labor-intensive manufacturing industries rather than in natural resource sectors, which tend to be more capital intensive and appear to deter growth-enhancing structural change (McMillan and Rodrik 2011). As noted in Sections 3.3, 4 and 5, labor-intensive manufacturing industries accounted for an increasing share of Vietnam's exports during the 1990s and 2000s, were important recipients of foreign direct investment during the 2000s, and accounted for a large share of Vietnam's employment expansion during the 2000s. Vietnam's export performance also benefited from relatively lower administrative barriers to trade (for example measured by the number of documents needed to export, lowest domestic costs of exporting) than comparison countries such as Zambia, Laos, and Lesotho (World Bank 2013).

Vietnam's traded sector also benefited from the undervalued exchange rate, which tends to be positively associated with structural change (McMillan and Rodrik 2011). Figure 14 plots a measure of exchange rate undervaluation from Rodrik (2008) against initial GDP per capita. Vietnam's exchange rate is significantly undervalued (a positive value indicates undervaluation) and well above the trend line,

suggesting that Vietnam was ranked high in terms of its competitiveness relative to the comparison countries.[16]

Vietnam also appears to have more flexible labor markets than most other countries in the comparison group. Figure 15 displays the relationship between labor market rigidity (a higher index number corresponds to higher rigidity) and initial GDP per capita. Vietnam has relatively more flexible labor markets among this group of low-income countries, similar to China (CHN), and more flexible than Zambia (ZMB). Based on data from the World Development Indicators database, Vietnam has a relatively more educated labor force (90 percent literacy rate) versus around 70 percent literacy rates in Laos (LAO), Madagascar (MDG), and Zambia (ZMB) and this might further contribute toward a more rapid transition of labor toward more productive sectors and employers.

Although this analysis is purely descriptive, it seems that relative to other initially low-income countries Vietnam possesses characteristics that tend to be associated with a positive contribution of structural change to aggregate productivity growth (McMillan and Rodrik 2011): comparative advantage in labor-intensive manufacturing, low trade costs, significantly undervalued currency, and flexible labor markets. This brief discussion suggests that these factors might help to account for a relatively fast transition of labor toward more productive sectors and employers and subsequent aggregate growth in Vietnam relative to other initially low-income countries.

7. Conclusion

Vietnam, like most less developed countries studied in McMillan and Rodrik (2011), is characterized by large productivity gaps across sectors, especially between agriculture and manufacturing and some services. During the 1990s and 2000s Vietnamese workers moved out of low-productivity agriculture toward higher-productivity manufacturing and services. These movements of workers from less to more productive sectors accounted for more than a third of the average annual 5.1 percent aggregate productivity growth during this period. An analysis that focused solely on the manufacturing sector would miss this important role of economy-wide worker reallocation when assessing the sources of aggregate labor productivity growth in Vietnam. Our discussion suggests that reforms in agriculture, the enterprise sector, and international integration all likely contributed to the movement of labor out of agriculture toward manufacturing and services.

[16] Bems and Johnson (2012) show that Vietnam's real effective exchange rate that takes into account its position in global production chains is less undervalued that the conventional exchange rate measure.

Vietnam's aggregate labor productivity growth also owes to improved sectoral productivities. Resource reallocation from less to more productive firms within sectors in part contributed toward these sectoral labor productivity improvements, as workers reallocated from less productive household businesses toward more productive registered firms in the enterprise sector, and from SOEs toward more productive private domestic and foreign owned firms.

Manufacturing stands out as a sector that experienced a large increase in productivity during this period, averaging an annual growth rate in labor productivity of 5.1 percent, and a large expansion of its employment base at an annual growth rate of 7 percent. Manufacturing observed a large expansion of exports and a growing presence of foreign owned enterprises during the 2000s. In general, relative employment tended to expand in manufacturing industries with greater declines in the share of employment in SOEs and a greater inflow of employment to foreign firms.

Despite Vietnam's substantial economic reforms and subsequent labor reallocation across and within sectors, large productivity gaps remain both between and within sectors. Reports point to lagging productivity performance of the SOE sector, accompanied by preferential access of SOEs to credit and capital markets (The McKinsey Global Institute 2012, World Bank 2011). Our own research emphasizes the potential importance of further reallocation of resources from the household business sector to the enterprise sector. Although employment in household businesses dropped substantially during the 2000s, it continues to account for 80 percent of economy-wide jobs and 54 percent of manufacturing employment in 2008. Estimates from the 2006 VHLSS suggest substantially lower labor productivity in household businesses than in private enterprises. The movement of workers out of household businesses into firms in the enterprise sector could either be accomplished through workers leaving household businesses to join firms operating in the enterprise sector or by household businesses registering as enterprises. Existing evidence in McCaig and Pavcnik (2013a, 2013b) suggests that growth of firms in the enterprise sector, as opposed to new registration of existing household businesses, is more likely to lead to the reallocation of labor away from low to high productivity firms.

Appendix A: Data Description

1. Employment and GDP data by broad sectors

The analysis in Section 2 uses data on employment, gross domestic product (in constant 1994 prices), and labor productivity (also in constant 1994 prices) disaggregated into economic sectors. Our source of data is from the General Statistics Office of Vietnam (GSO), available at http://www.gso.gov.vn/. The GSO provides data on employment and gross domestic products in current Vietnamese Dong and 1994 Dong disaggregated into nineteen economic activities. We categorize these nineteen activities into the sectors used by McMillian and Rodrik (2011), as shown in Table A.1.

The employment series shows a break in trend between 2002 and 2003. For example, the percentage of workers employed in agriculture fell by 5.9 percentage points as compared to by 1.1 and 1.5 percentage points between 2001 and 2002 and 2003 and 2004 respectively. We thus omit the decomposition between 2002 and 2003 in decomposition of productivity growth in Figure 3. Despite the apparent change in estimation procedure used in the GSO employment data between 2002 and 2003, the overall employment trends are very consistent with those estimated using census data.

2. Population censuses

Samples of the 1989, 1999, and 2009 population censuses are publicly available through IPUMS-International. Each census asked individuals some basic questions related to their working status. The 1989 census provides the industry of affiliation at a relatively aggregate level whereas the 1999 and 2009 census industry codes are adaptations based on three-digit ISIC revision 3 and ISIC revision 4. Thus, while we can use the 1999 and 2009 censuses to look at the growth of employment within various manufacturing industries we cannot use the 1989 census for this purpose. However, the 1989 census can be used for verifying the aggregate trends described in Section 2. Additionally, the censuses contain information on the type of ownership (e.g., self-employed, working for the state, etc.) for each employee, which we use for looking at the changing role of state owned and foreign-invested enterprises.

3. Household surveys

We use four nationally representative household surveys conducted in 2002, 2004, 2006, and 2008. The GSO conducted these surveys with technical advice from the World Bank. Each survey contained modules on education, health, income and production activities, expenditures and

employment. The employment modules collected information on the industry of affiliation, wage payments if applicable, and the type of ownership for the individual's primary job during the past 12 months. Although the surveys also collected information on additional jobs, we restrict our focus to the individual's primary job. Like the censuses, the surveys use industry codes based on adaptations of ISIC revisions 3 and 4 and are available at the two digit level. The ownership variable includes information on whether the individual was self-employed, working for another household, working in the formal private sector, working in a collective, working in the state sector, or working in the foreign-invested sector. In our analysis on informality we make use of the ownership sector to define informal employment as being either self-employed or working for another household. One caveat to this definition is that the 2002 household survey did not distinguish between self-employment in a household business versus in a private enterprise whereas the latter three surveys did. Thus, our estimate of informality is a slight overestimate since we include all self-employment as informal, even those self-employed in a private enterprise. The subsequent surveys demonstrate that this leads to only a slight overestimate. For example, in 2004 we estimate that 83.1 percent of workers were working informally. Removing workers that are self-employed in private enterprises reduces this to 82.7 percent. Thus including self-employed workers in private enterprises will not significantly alter our results and allows us to use a consistent definition across all of the household surveys and thus have a longer period to study.

4. Enterprise surveys

Beginning in 2000 the GSO has been conducting annual surveys of all formally registered enterprises in the country. Basic information, such as industry and employment, is collected for all enterprises regardless of the size or the sector. We use information on the industry of the firm (we rely on the primary industry of the firm for multi-industry firms) and the number of employees. The industry codes are based on an adaptation of ISIC revision 3 and thus are easily matched with information from the household surveys and the latter two censuses. This allows us to cross check our results for consistency across various sources.

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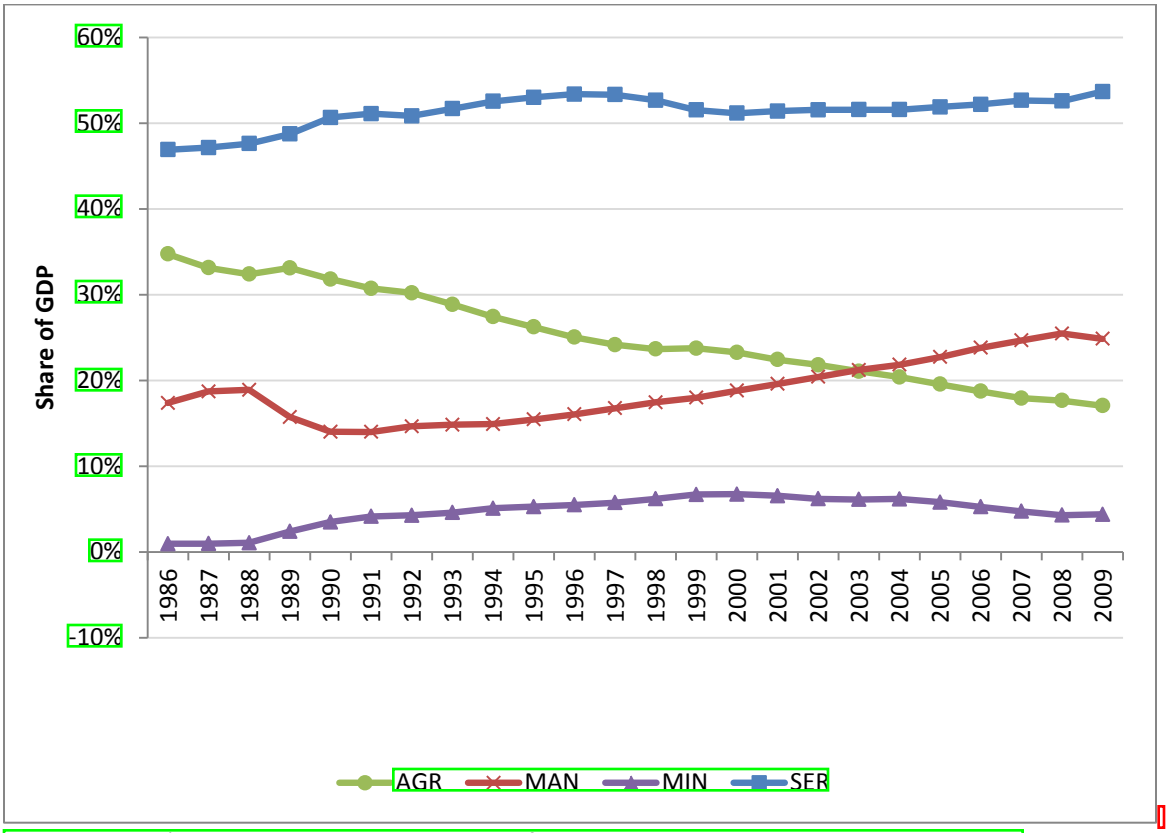
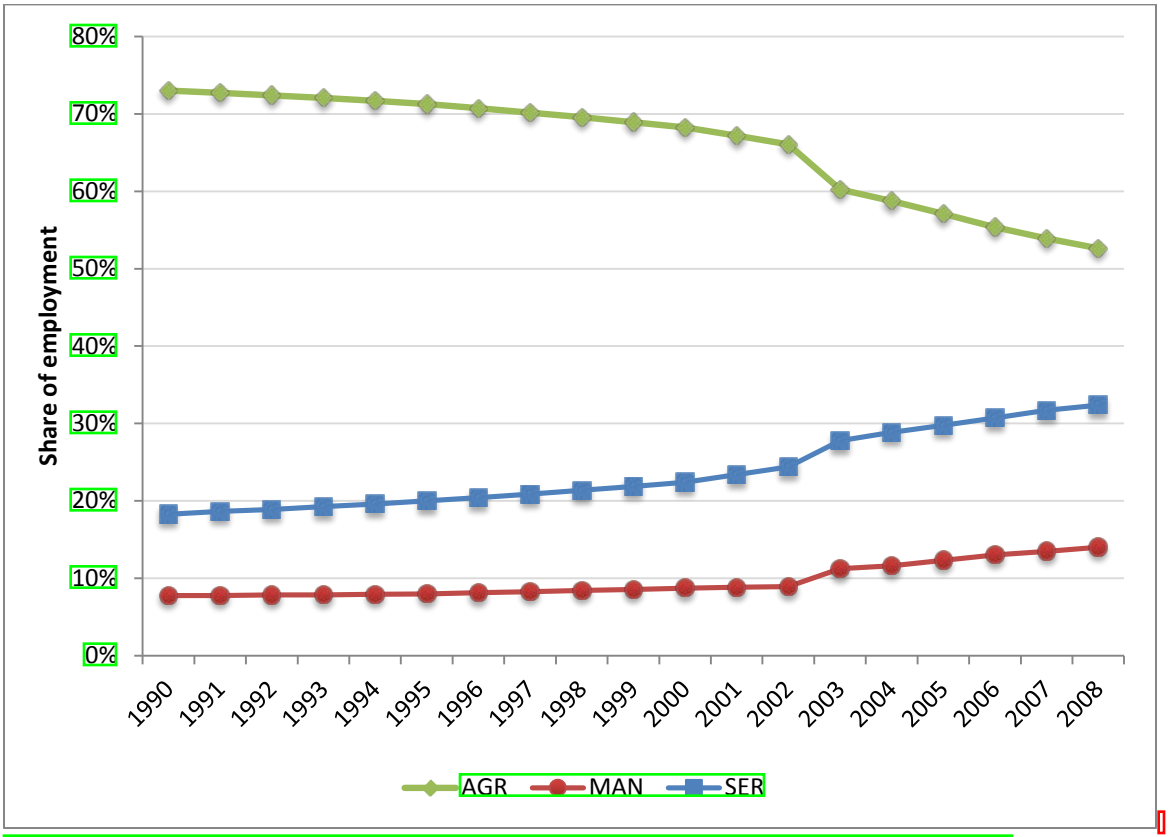
Figure 1: Shares of GDP by Broad Sectors, 1986-2009



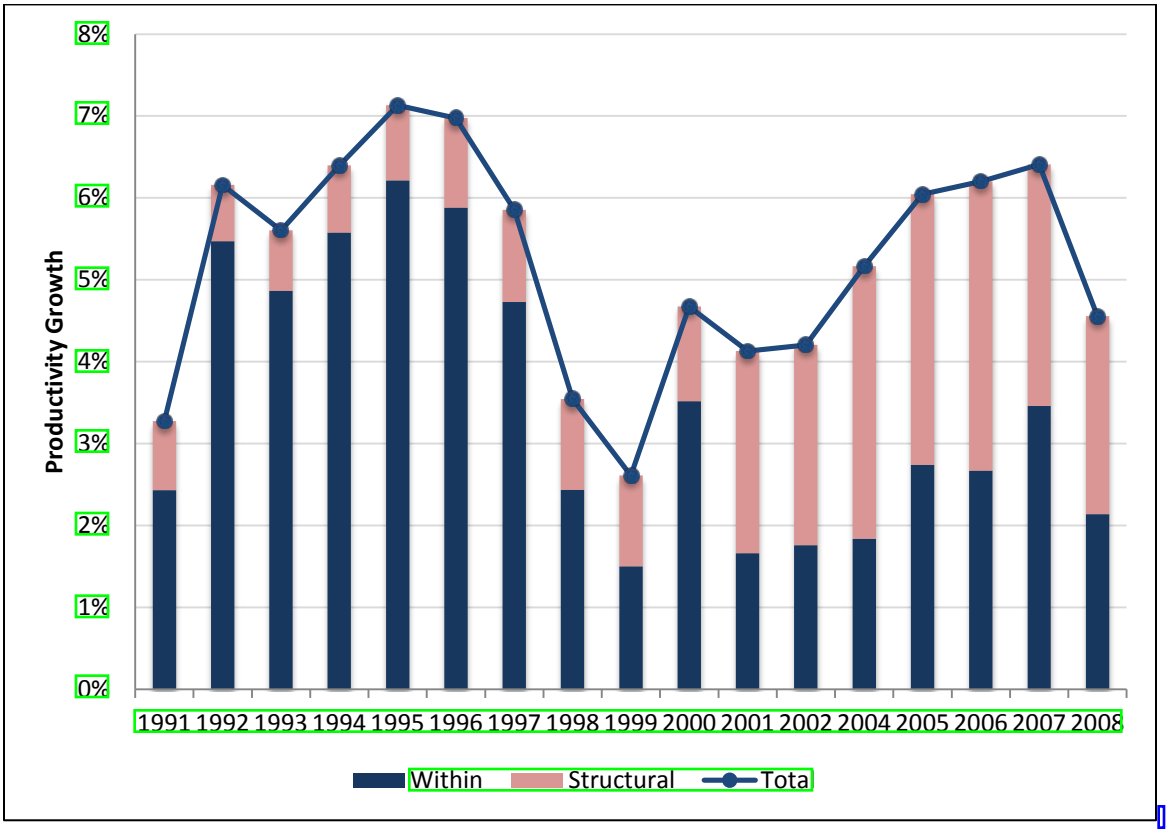
Notes: Authors' own calculations based on data from the GSO. AGR denotes agriculture, MAN manufacturing, MIN mining, and SER services.

Figure 2: Shares of Employment by Broad Sectors, 1990-2008



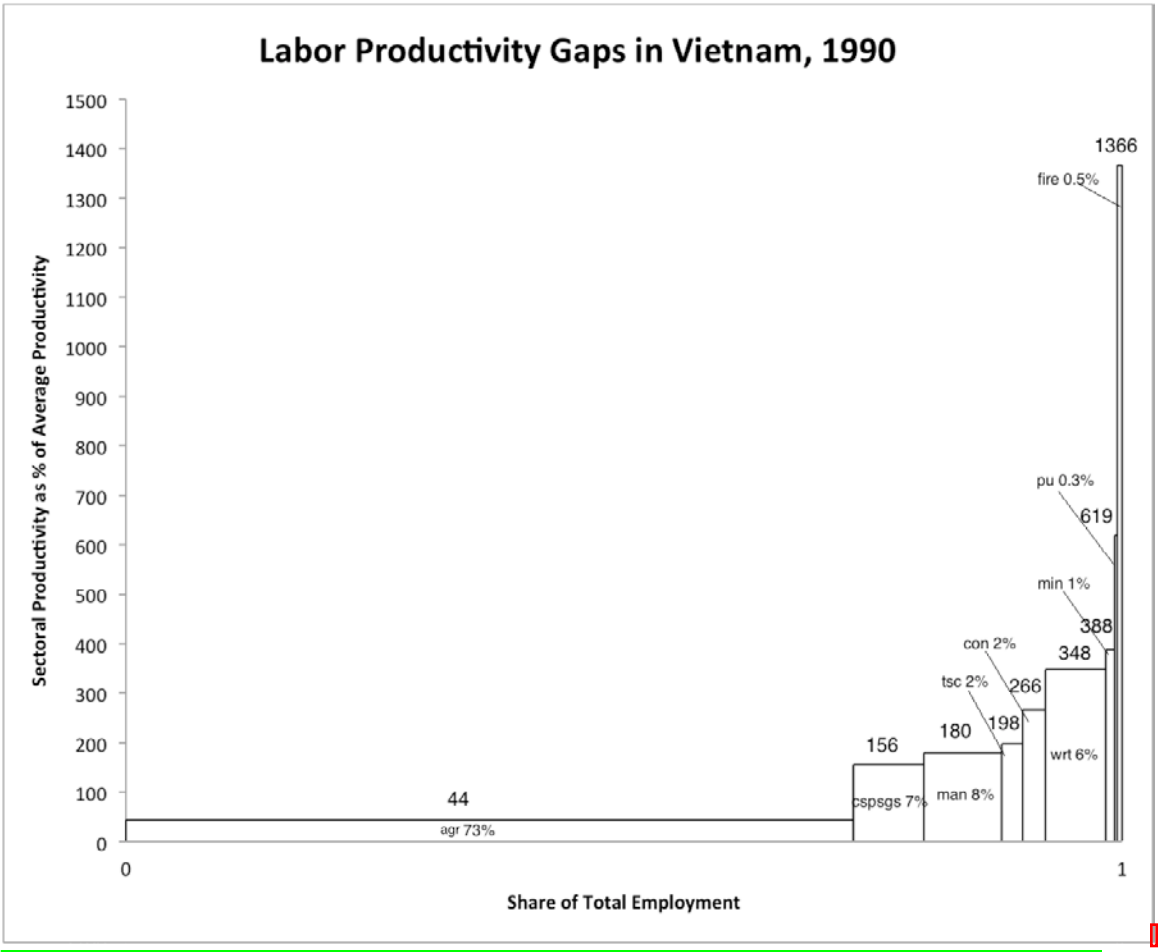
Note: Authors' own calculations based on data from the GSO. AGR denotes agriculture, MAN manufacturing, and SER services. Mining is not depicted because it accounts for less than 1 percent of total employment. The 1989, 1999, and 2009 employment shares match well with census estimates.

Figure 3: Components of Labor Productivity Growth



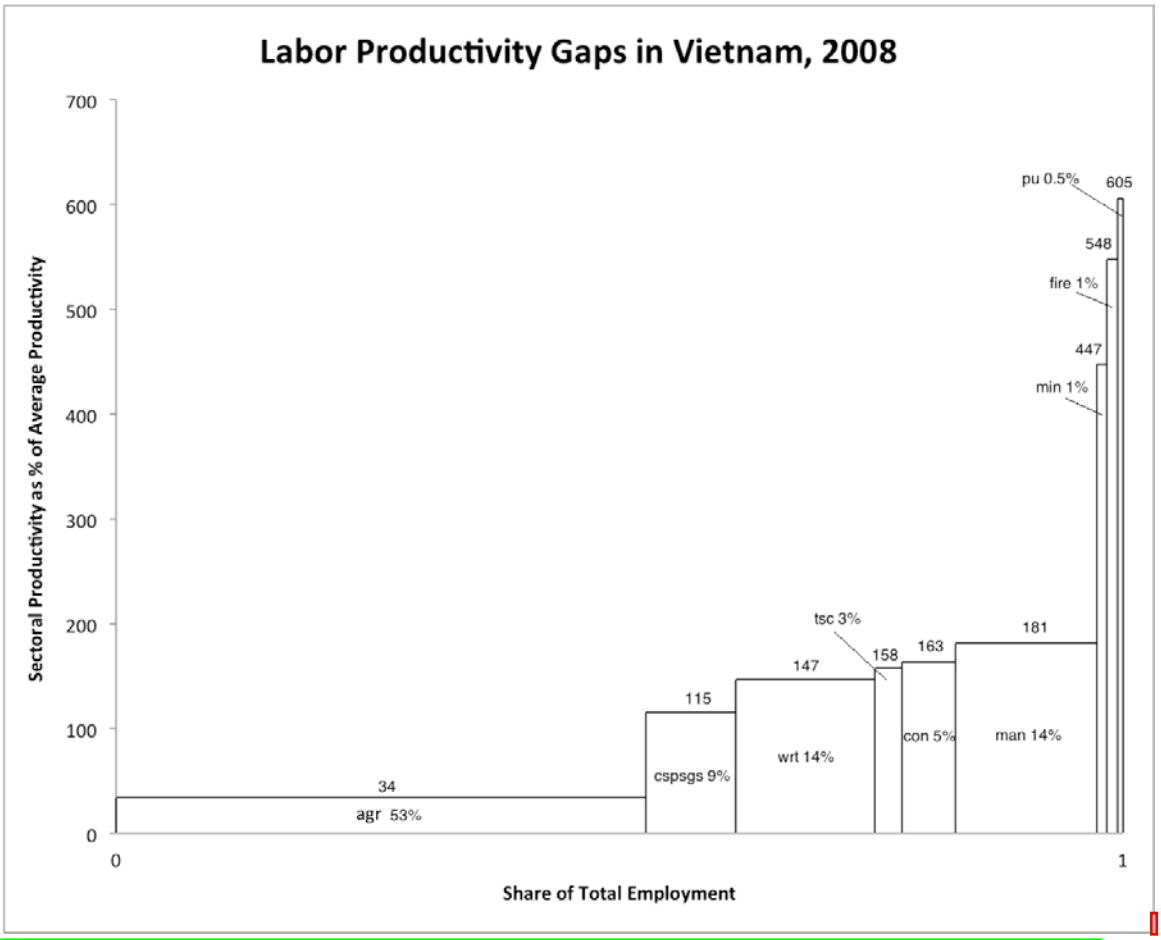
Notes: Authors' calculations based on data from the GSO and decomposition described in the text.

Figure 4: Productivity Gaps in Vietnam in 1990



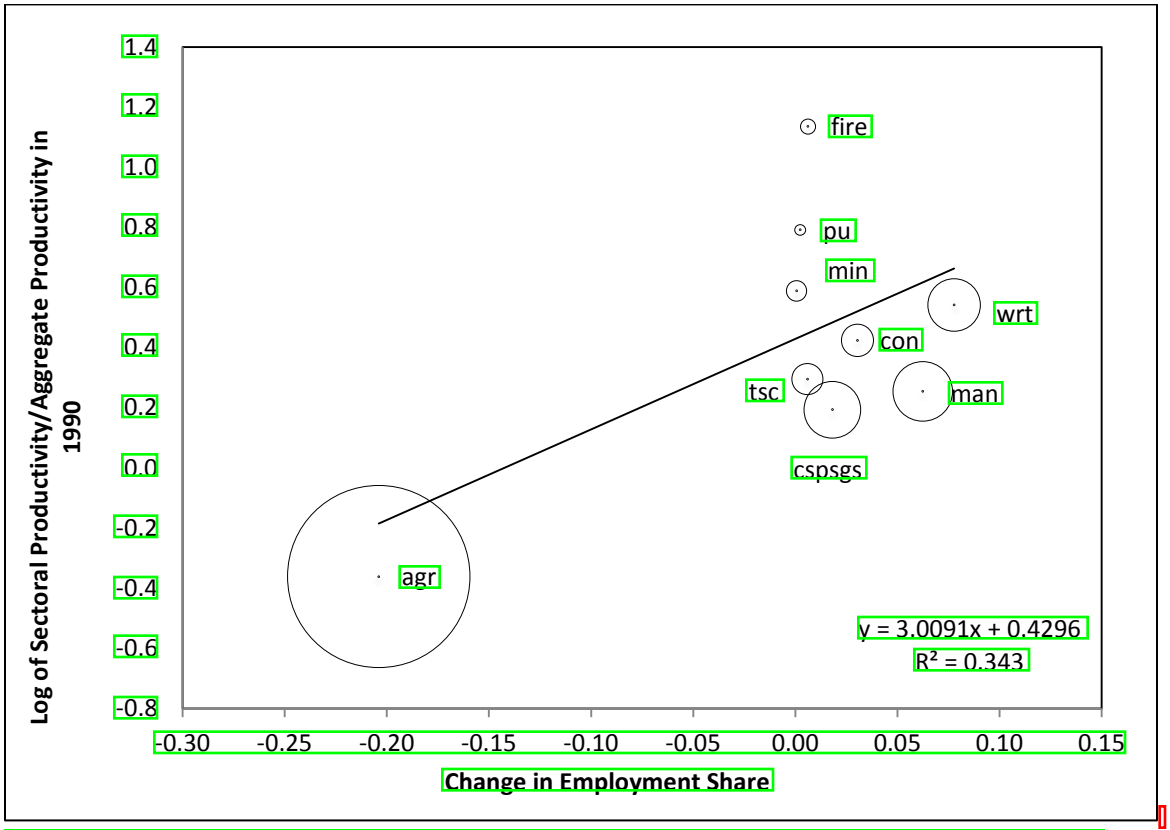
Notes: Authors' calculations based on data from the GSO. For sector abbreviations refer to Table A.1. Numbers above the line denote the relative sectoral productivity. Numbers below the line denote the sectoral share in total employment.

Figure 5: Productivity Gaps in Vietnam in 2008



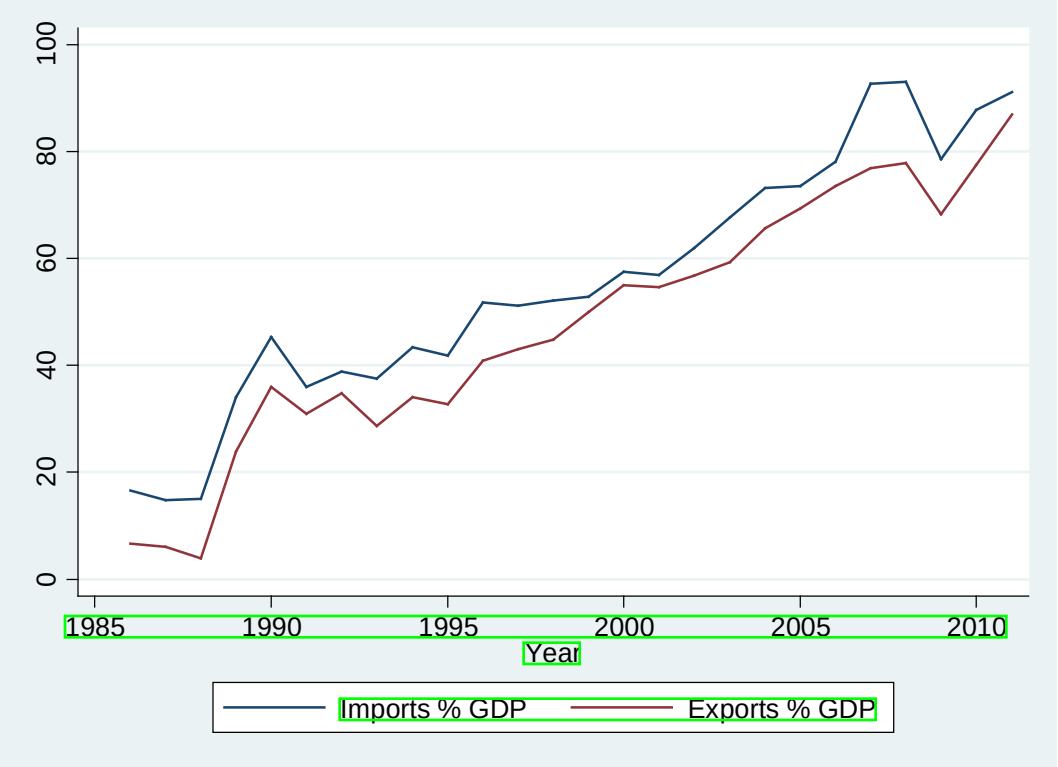
Notes: Authors' calculations based on data from the GSO. For sector abbreviations refer to Table A.1. Numbers above the line denote the relative sectoral productivity. Numbers below the line denote the sectoral share in total employment.

Figure 6: Initial Sectoral Productivity and the Change in Employment Share, 1990-2008



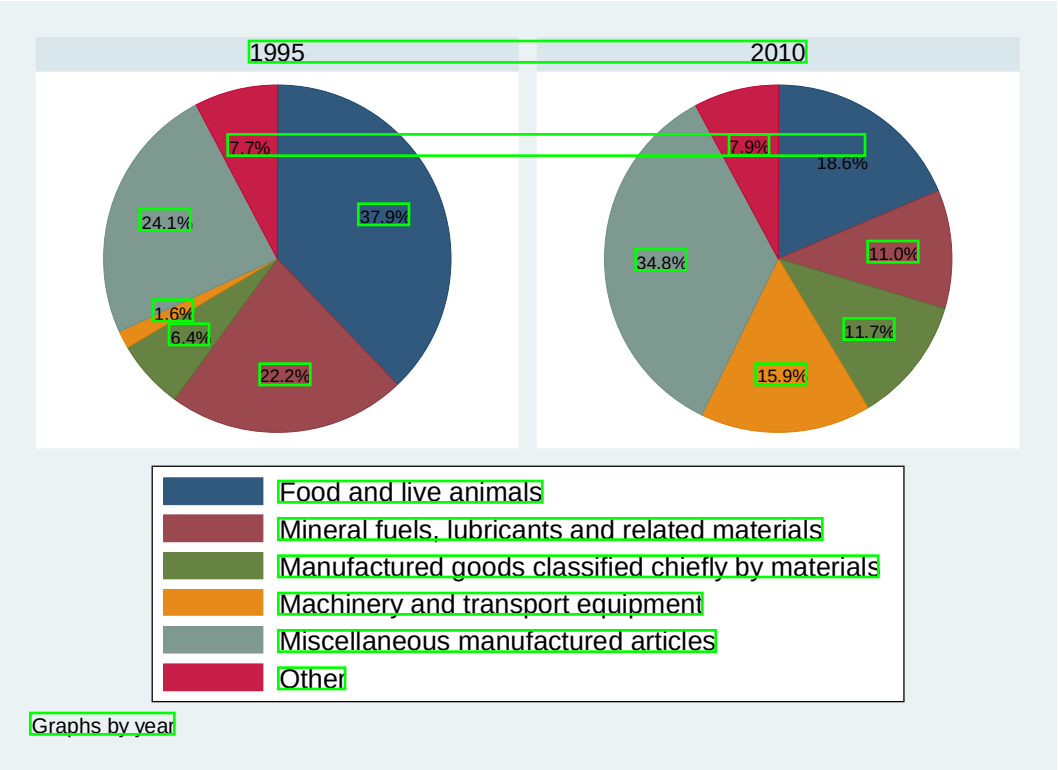
Notes: Authors' calculations based on data from the GSO. The bubble sizes indicate the share of total employment in 1990. For sector abbreviations refer to Table A.1.

Figure 7: Imports and Exports as a Percentage of GDP, 1986 to 2011



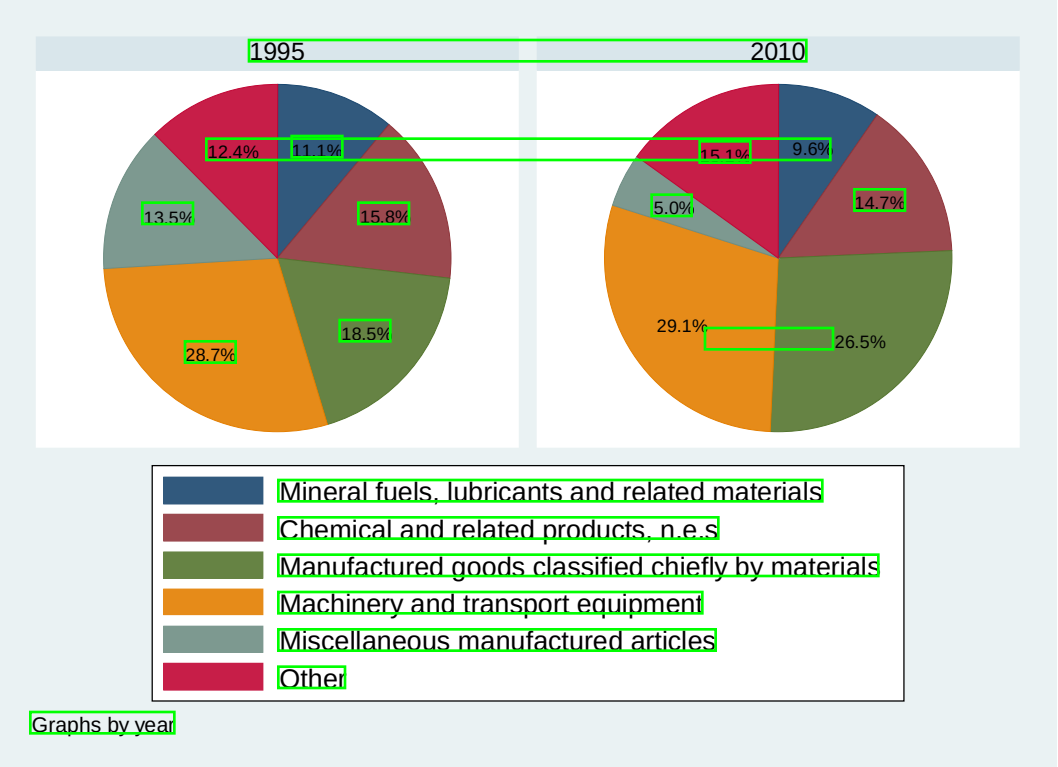
Note: Data is from the World Development Indicators database.

Figure 8: Share of Exports by Commodity Group, 1995 and 2010



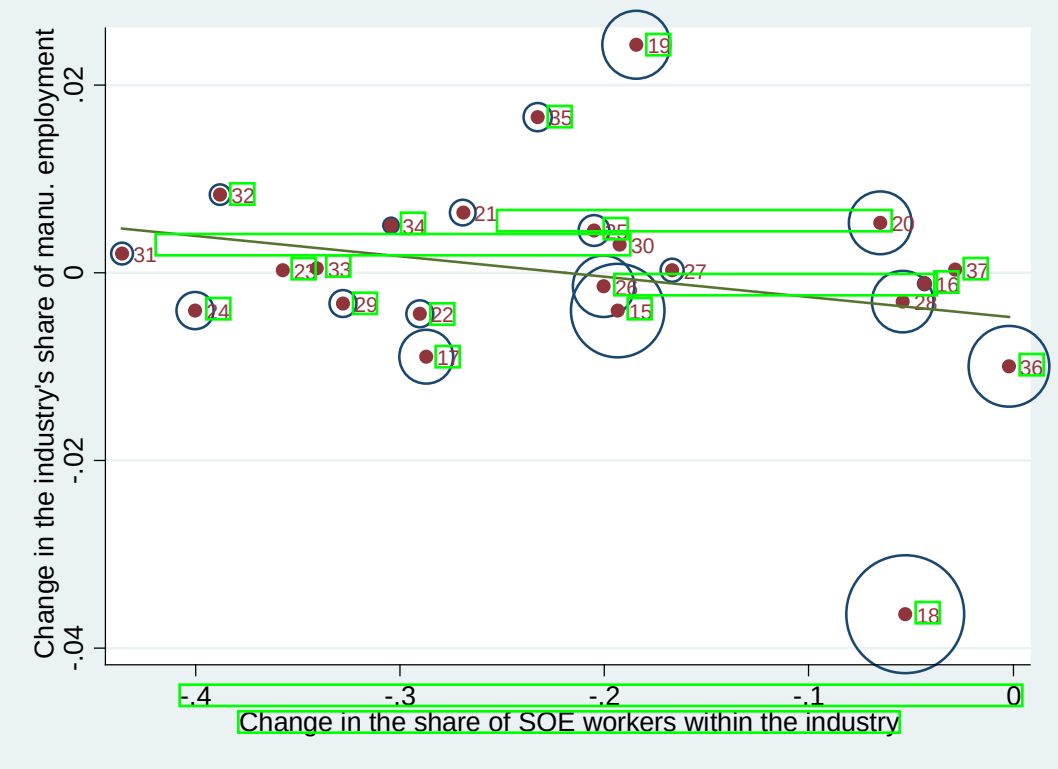
Note: Data is based on the GSO.

Figure 9: Share of Imports by Commodity Group, 1995 and 2010



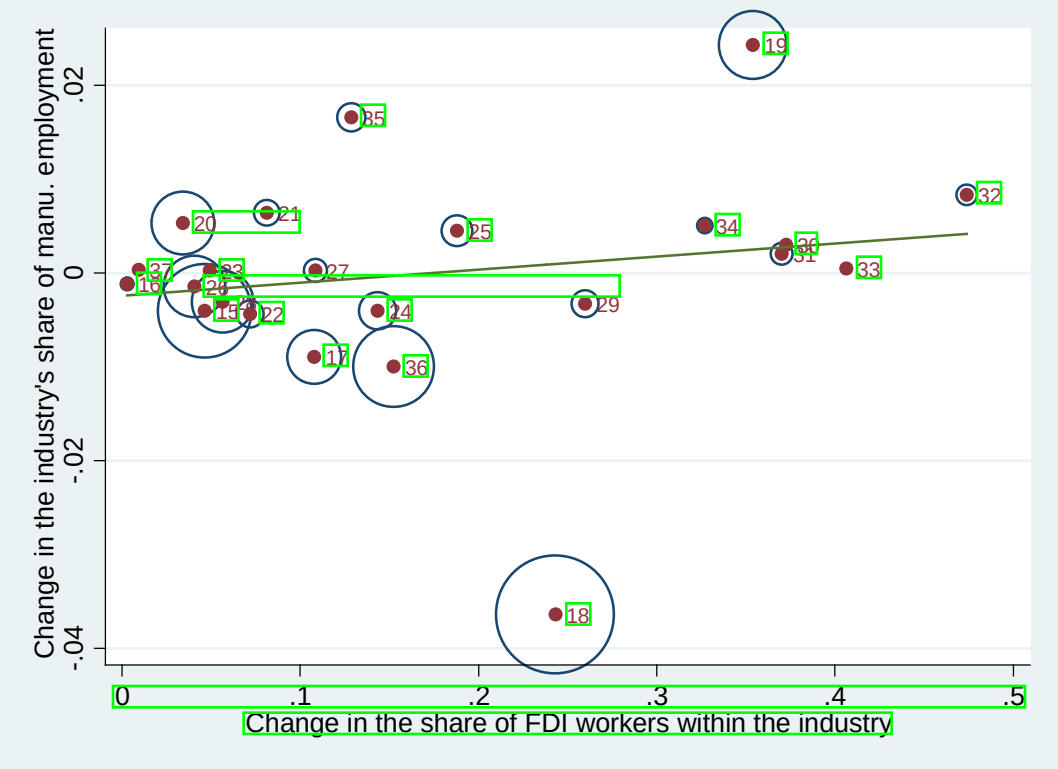
Note: Data is based on the GSO.

Figure 10: Changes in Relative Industry Size and the Share of SOE Workers, Manufacturing Industries 1999 to 2009



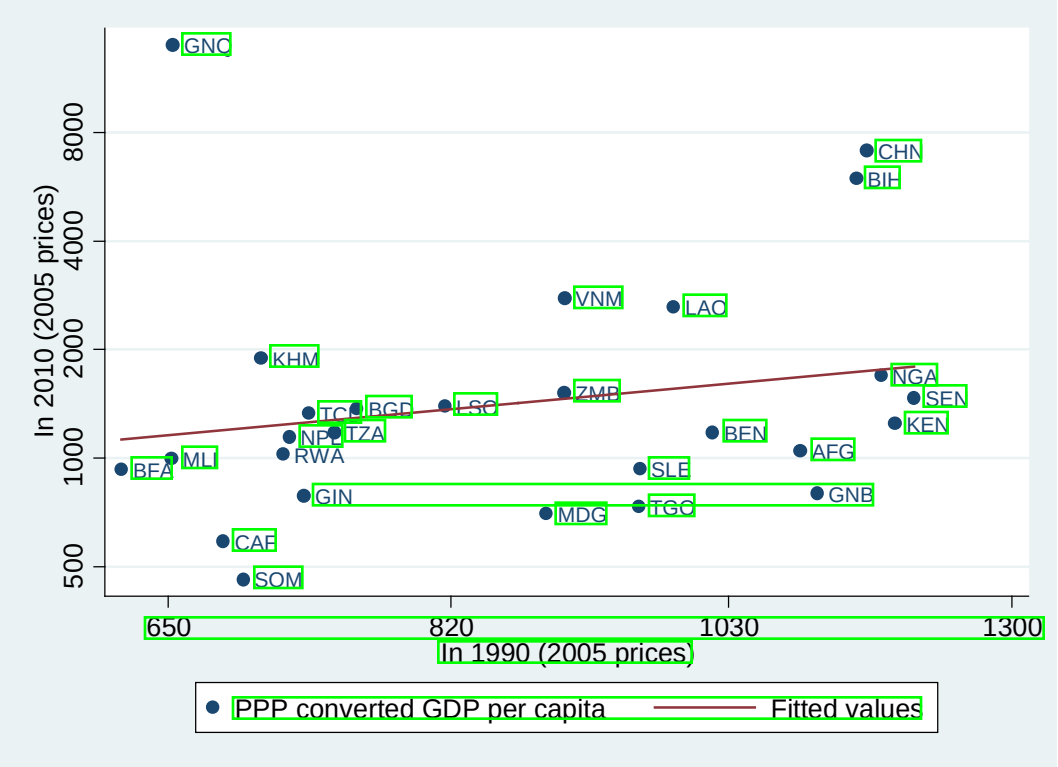
Notes: The bubble sizes indicate the share of manufacturing employment in 1999. Industry codes are ISIC revision 3. Authors' calculations based on the 1999 and 2009 Population Censuses. The y-axis measures the change in the share of industry employment in total manufacturing employment.

Figure 11: Changes in Relative Industry Size and the Share of FDI Workers, Manufacturing Industries 1999 to 2009



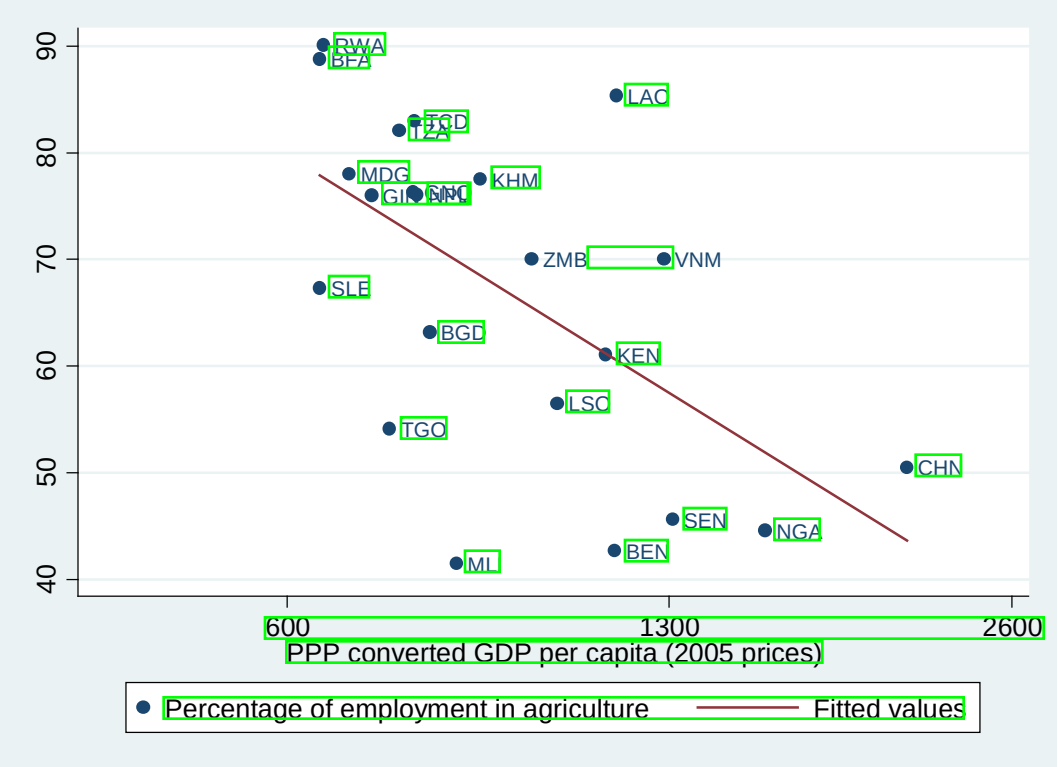
Notes: The bubble sizes indicate the share of manufacturing employment in 1999. Industry codes are ISIC revision 3. Authors' calculations based on the 1999 and 2009 Population Censuses. The y-axis measures the change in the share of industry employment in total manufacturing employment.

Figure 12: GDP Per Capita in 1990 and 2010 for Initially Low-Income Countries



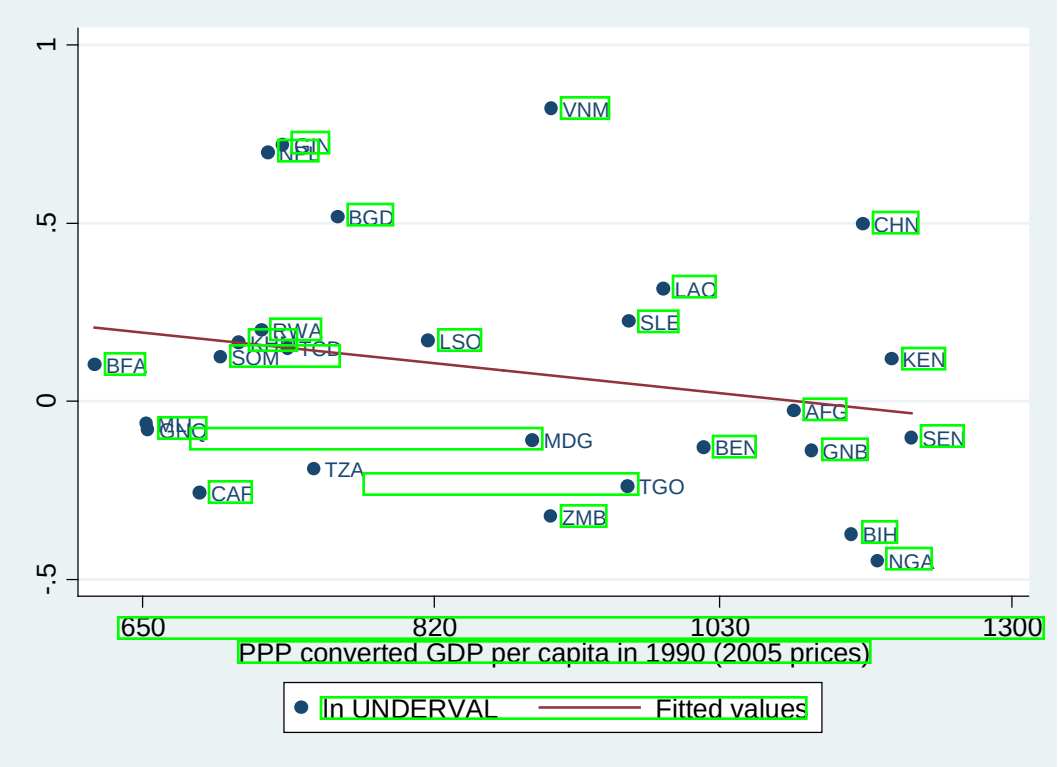
Note: Data is based on Penn World Tables 7.1. GDP per capita is expressed in 2005 PPP prices. Country code for Vietnam is VNM. The sample includes all countries with GDP per capita within $300 of Vietnam's 1990 GDP per capita.

Figure 13: Agricultural Employment and Initial GDP Per Capita



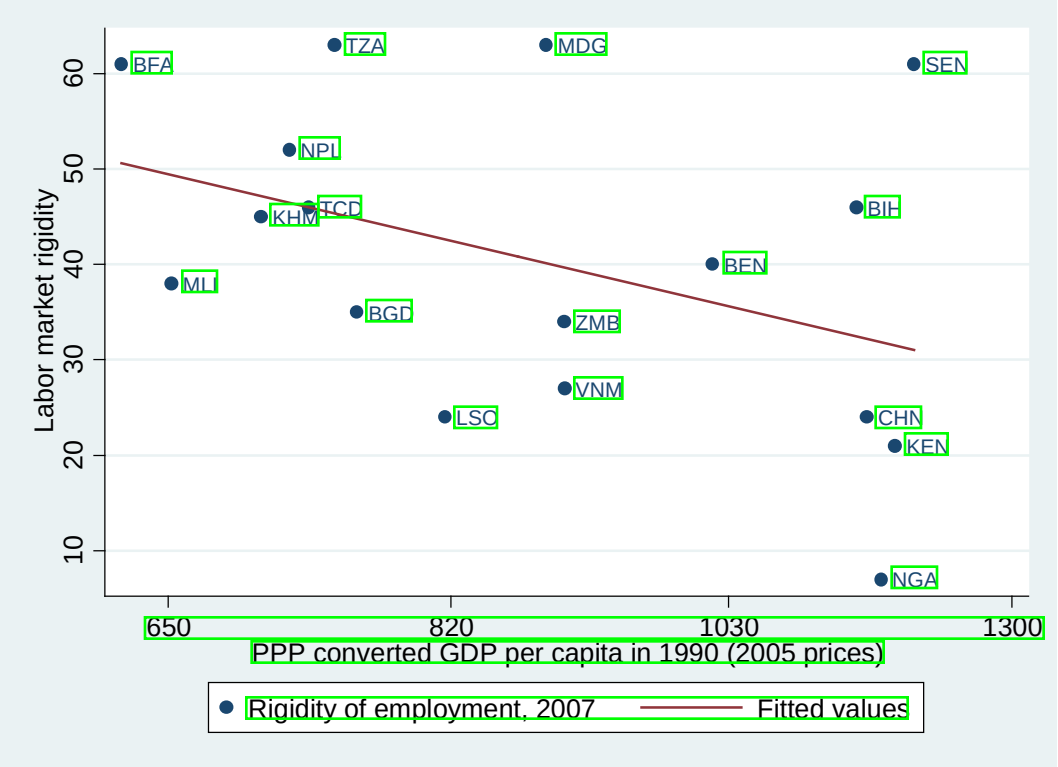
Notes: The percentage of employment in agriculture is from the World Development Indicators database. For Vietnam this variable is first reported for 1996. For each country we plot the closest observation by year to 1996 for which the employment information is available. PPP converted GDP per capita is plotted for the same year as employment in agriculture and is from the Penn World Tables 7.1. VNM is country code for Vietnam.

Figure 14: Undervaluation of the Exchange Rate and Initial GDP Per Capita



Notes: The data for undervaluation of exchange rate is from Rodrik (2008). We plot the average of this measure for 1990 to 2004. GDP per capita is 1990 value from Penn World Tables 7.1.

Figure 15: Labor Market Rigidity and Initial GDP Per Capita



Source: The data for labor market rigidity is from the World Bank Doing Business as reported in the World Economic Forum's Global Competitiveness Report 2008-09. The data on GDP per capita is 1990 value from Penn World Tables 7.1.

Table 1: Labor productivity by broad sectors, 1990, 2000 and 2008

	Productivity (mils dong/person employed)		
Sector	**1990**	**2000**	**2008**
Agriculture, Hunting, Forestry, and Fishing	1.96	2.54	3.66
Mining and Quarrying	17.41	84.04	48.85
Manufacturing	8.07	16.05	19.81
Public Utilities (Electricity, Gas, and Water)	27.79	79.71	66.08
Construction	11.92	22.00	17.84
Wholesale and Retail Trade, Hotels, and Restaurants	15.63	15.77	16
Transport, Storage, and Communications	8.87	11.55	17.21
Finance, Insurance, Real Estate and Business Services	61.3	91.71	59.79
Community, Social, Personal, and Government Services	7.01	10.96	12.56
Economy-wide	**4.49**	**7.46**	**10.92**

Notes: Authors' calculations based on GSO data. The sectors are defined as in McMillan and Rodrik (2011).

Table 2: The role of demography in movement out of agriculture

Panel A: Share of agricultural employment, by cohort

Cohort	1989	1999	2009
Age 15 to 19	0.830	0.790	0.645
Age 20 to 24	0.719	0.682	0.475
Age 25 to 29	0.668	0.657	0.432
Age 30 to 34	0.633	0.672	0.472
Age 35 to 39	0.630	0.669	0.502
Age 40 to 44	0.638	0.658	0.544
Age 45 to 49	0.706	0.671	0.563
Age 50 to 54	0.761	0.718	0.599
Age 55 to 59	0.802	0.784	0.682
Age 60 to 64	0.825	0.848	0.764
Total	**0.705**	**0.691**	**0.530**

Panel B: Decomposition of decline in agricultural employment into within and between cohort component

Period	Within	Between	Total
1989 to 2009	-0.079	-0.096	-0.175
1989 to 1999	-0.016	0.001	-0.014
1999 to 2009	-0.132	-0.028	-0.161

Note: Panel A reports the share of agriculture in total employment by cohort and census. Panel B decomposes the change in the share of agricultural employment into within and between cohort components.

Table 3: Share of workers in agriculture and manufacturing by region, 1989 and 2009

	Agriculture			Manufacturing		
Region	**1989**	**2009**	**Change**	**1989**	**2009**	**Change**
Red River Delta	0.719	0.486	-0.233	0.119	0.166	0.047
North East	0.779	0.682	-0.097	0.091	0.082	-0.009
North West	0.847	0.813	-0.034	0.029	0.025	-0.004
North Central Coast	0.743	0.668	-0.075	0.122	0.071	-0.051
South Central Coast	0.671	0.541	-0.131	0.142	0.122	-0.020
Central Highlands	0.830	0.762	-0.068	0.050	0.037	-0.013
South East	0.451	0.261	-0.190	0.243	0.289	0.046
Mekong River Delta	0.776	0.582	-0.194	0.075	0.104	0.029

Notes: Authors' calculations based on Census data.

Table 4: Share of workers in household businesses

	2002	2008	Change
Agriculture, Hunting, Forestry and Fishing	0.985	0.987	0.001
Mining and Quarrying	0.579	0.450	-0.129
Manufacturing	0.667	0.544	-0.123
Public Utilities (Electricity, Gas, and Water)	0.125	0.059	-0.066
Construction	0.827	0.805	-0.021
Wholesale and Retail Trade, Hotels, and Restaurants	0.934	0.896	-0.038
Transport, Storage and Communication	0.751	0.677	-0.073
Finance, Insurance, Real Estate and Business Service	0.276	0.285	0.009
Community, Social, Personal, and Government Services	0.263	0.238	-0.025
Total	**0.863**	**0.807**	**-0.056**

Notes: Authors' calculations based on VHLSS data. The reported numbers are the share of workers in household businesses in a sector. The sample is restricted to workers age 15 and older. The estimates are population estimates based on using sampling weights. The sectors are defined as in McMillan and Rodrik (2011).

Table 5: Employment in state and foreign-owned firms by sector, 1989, 1999 and 2009 censuses

	1989		1999			2009		
Sector	**Total**	**State**	**Total**	**State**	**Foreign**	**Total**	**State**	**Foreign**
Panel A: Number of workers (000s)								
Agriculture, Hunting, Forestry, and Fishing	19,809	407	24,854	252	4	25,710	183	12
Mining and Quarrying	0	0	184	84	1	294	112	3
Manufacturing*	3,391	1,273	3,179	969	165	6,545	583	1,465
Public Utilities (Electricity, Gas, and Water)	0	0	82	73	0	167	132	1
Construction	585	398	929	213	3	2,620	154	20
Wholesale and Retail Trade, Hotels, and Restaurants	2,102	628	3,265	221	8	6,444	152	62
Transport, Storage, and Communications	587	282	947	210	1	1,510	269	13
Finance, Insurance, Real Estate and Business Services	132	117	207	154	4	671	243	43
Community, Social, Personal, and Government Services	1,380	1,278	2,134	1,668	3	3,661	2,740	22
Total	**27,986**	**4,383**	**35,782**	**3,843**	**190**	**47,622**	**4,569**	**1,642**
Panel B: Share of workers within the sector								
Agriculture, Hunting, Forestry, and Fishing		0.021		0.010	0.000		0.007	0.000
Mining and Quarrying				0.456	0.003		0.381	0.012
Manufacturing*		0.375		0.305	0.052		0.089	0.224
Public Utilities (Electricity, Gas, and Water)				0.890	0.006		0.793	0.008
Construction		0.681		0.229	0.004		0.059	0.007
Wholesale and Retail Trade, Hotels, and Restaurants		0.299		0.068	0.003		0.024	0.010
Transport, Storage, and Communications		0.480		0.222	0.001		0.178	0.009
Finance, Insurance, Real Estate and Business Services		0.880		0.741	0.018		0.362	0.064
Community, Social, Personal, and Government Services		0.926		0.782	0.002		0.749	0.006
Total		**0.157**		**0.107**	**0.005**		**0.096**	**0.034**

Notes: Authors' calculations based on census data. The 1989 census did not separately identify mining and quarrying and public utilities from manufacturing and thus manufacturing includes all three sectors in 1989. The 1989 did not separately identify employment in foreign-owned firms.

Table 6: Employment in manufacturing industries

Industry	Total number of workers (000s)				Number of workers in enterprises (000s)			
	1999	2009	Change	Annual growth (%)	2000	2008	Change	Annual growth (%)
Food products and beverages	496	993	497	7.2	268	501	233	8.1
Tobacco products	10	13	3	2.7	12	14	2	1.7
Textiles	169	289	120	5.5	126	179	53	4.5
Clothing	790	1,387	597	5.8	233	758	525	15.9
Footwear	268	709	441	10.2	297	632	336	9.9
Wood and products of wood and cork, except furniture; articles of straw and plaiting materials	226	498	273	8.2	60	130	70	10.2
Paper and paper products	37	117	81	12.3	37	81	44	10.4
Publishing, printing and reproduction of recorded media	51	80	29	4.5	23	58	35	12.4
Coke, refined petroleum products and nuclear fuel	4	9	6	10.0	1	1	0	2.3
Chemicals and chemical products	80	139	59	5.6	66	112	46	6.8
Rubber and plastic products	55	142	87	10.0	51	162	111	15.5
Other non-metallic mineral products	216	435	219	7.2	128	252	124	8.8
Basic metals	32	68	36	7.7	29	60	31	9.6
Fabricated metal products, except machinery and equipment	213	418	205	7.0	51	191	141	18.0
Machinery and equipment n.e.c.	40	68	28	5.6	31	68	37	10.2
Office, accounting and computing machinery	1	22	21	33.7	3	25	22	29.7
Electrical machinery and apparatus n.e.c.	26	68	41	9.9	38	109	72	14.3
Radio, television and communication equipment and	23	101	78	16.1	18	66	48	17.3
Medical, precision and optical instruments, watches and clocks	6	16	10	9.8	7	17	10	12.2
Motor vehicles, trailers and semi-trailers	12	58	46	16.7	14	44	31	15.9
Other transport equipment	44	199	155	16.2	41	127	86	15.1
Furniture	376	708	332	6.5	65	352	287	23.5
Recycling	3	8	5	10.9	0	2	2	27.7
Total	**3,179**	**6,545**	**3,366**	**7.5**	**1,598**	**3,943**	**2,345**	**11.9**

Notes: The numbers for 1999 and 2009 are population estimates calculated from the 1999 and 2009 censuses. The sample is restricted to workers age 15 and older. The numbers of workers in enterprises are based on the 2000 and 2008 enterprise surveys.

Table A.1: Mapping between GSO sectors and McMillan and Rodrik (2011) sectors

McMillan and Rodrik sector	Abbreviation	GSO sectors
Agriculture, Hunting, Forestry and Fishing	agr	Agriculture and forestry Fishing
Mining and Quarrying	min	Mining and quarrying
Manufacturing	man	Manufacturing
Public Utilities (Electricity, Gas, and Water)	pu	Electricity, gas and water supply
Construction	con	Construction
Wholesale and Retail Trade, Hotels, and Restaurants	wrt	Wholesale and retail trade; repair of motor vehicles, Hotels and restaurants
Transport, Storage and Communications	tsc	Transport, storage and communications
Finance, Insurance, Real Estate and Business Services	fire	Financial intermedation Scientific activities and technology Real estate, renting and business activities
Community, Social, Personal and Government Services	cspsgs	Public administration and defence; compulsory social security Education and training Health and social work Recreational, cultural and sporting activities Activities of party and of membership organisations Community, social and personal service activities Private households with employed persons