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The Impact of the Global Commodity and Financial Crises on Poverty in Vietnam

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Abstract

Economic growth in Vietnam was resilient to the global commodity and financial crises, but it is unclear why. Impacts on employment and poverty are also disputed. We develop a dynamic computable general equilibrium model to decompose growth and distributional outcomes. Results indicate that the 2008 commodity crisis raised employment and reduced poverty by favoring labor-intensive exports. The 2009 financial crisis reversed these gains and pushed a million workers into unemployment and 3 million people below the poverty line. Overall, the crises and government stimulus package left growth and poverty in Vietnam virtually changed from a baseline (no crises) path.

KEYWORDS: economic crisis, growth, poverty, Vietnam

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1. Introduction

Vietnam's economy grew rapidly over the last two decades, and poverty declined without a significant deterioration in inequality (Glewwe et al., 2002; GSO, 2007). Agriculture played a key role in this process. Large parts of the sector were transformed from subsistence to export-orientation and Vietnam became a major exporter of grains and other foods. During the 2008 commodity crisis, world prices for Vietnam's major exports rose rapidly, but during the 2009 financial crisis and subsequent global recession there was a sharp decline in world prices, export demand, and foreign investment. Economic growth in Vietnam slowed in early 2009, but the economy continued to expand and there were clear signs of recovery during the second half of the year. This suggests that, from a macroeconomic perspective, Vietnam weathered the two crises fairly well.

It is uncertain, however, what the effect of the crises has been on workers and households and what the lasting welfare implications will be. Industrial workers were laid off in early 2009, possibly resulting in migration back to rural areas (Van, 2009), but it is unclear to what extent agriculture and the rural non-farm economy cushioned the incomes of displaced workers and their households. Moreover, Vietnam's government responded to the financial crisis by introducing a stimulus package aimed at stabilizing capital markets, encouraging domestic investment, and extending social security. The extent to which these measures might offset growth and welfare losses is the subject of debate.

Given the uncertainty surrounding household-level outcomes, we estimate the impact of the commodity and financial crises on growth, employment, and poverty. We also assess the government's stimulus package. Section 2 describes Vietnam's economy and its growth performance during the crises. Section 3 considers the impact channels through which economic growth may have been affected. To translate macro-level impacts into household incomes and poverty, we develop a dynamic computable general equilibrium (DCGE) model described in Section 4. Section 5 discusses the simulations and results; the final section concludes.

2. Vietnam's economic performance during the crises

2.1 Structure of the Vietnamese economy

Total gross domestic product (GDP) was US$61.3 billion in 2007, equivalent to US$743 per capita for Vietnam's 82.5 million people.[1] Industry generates two-

[1] Adjusting for purchasing power, per capita GDP in 2006 was US$2363 (World Bank, 2009a).

fifths of total GDP and one-fifth of employment, two-thirds of which is in manufacturing (Table 1). Industrial goods also generate a major share of Vietnam's export earnings due to large contributions from textile and clothing (25.8%), agro-processing (12.5%), and metals and machinery (11.9%). Oil has also contributed significantly (19.0%). Vietnam is equally dependent on industrial imports, particularly metals and machinery (38.5%), fuel and chemicals (22.5%), and textiles (15.3%).

Table 1: Structure of the Vietnamese economy, 2007

	Share of total (%)				Export intensity	Import intensity
	GDP	Employ-ment	Exports	Imports		
Total GDP	100.0	100.0	100.0	100.0	32.4	39.1
Agriculture	22.1	53.9	7.6	2.0	21.3	8.4
Crops	13.4	36.6	4.6	1.4	23.3	10.3
Livestock	2.7	8.5	0.4	0.0	7.4	1.6
Forestry/fishing	5.9	8.8	2.6	0.6	23.4	8.2
Industry	41.7	19.9	76.1	85.4	38.5	48.7
Mining	10.9	0.9	19.0	0.6	82.9	14.9
Manufacturing	20.1	13.3	57.1	84.9	40.7	57.8
Agro-processing	5.8	4.1	12.5	4.3	33.5	20.3
Textiles/clothing	3.7	2.2	25.8	15.3	68.6	62.2
Wood/paper	1.4	0.8	2.9	3.0	34.9	44.2
Fuel/chemicals	2.8	2.3	3.2	22.5	21.8	74.7
Metals/machinery	4.4	3.0	11.9	38.5	36.8	70.4
Other	2.8	1.4	1.4	2.7	8.1	17.6
Other	10.7	5.7	0.0	0.0	0.0	0.0
Services	36.2	26.1	16.3	12.6	22.0	20.5

Source: Authors' calculations using the 2007 social accounting matrix (Arndt et al., 2009).
Note: "GDP" is gross domestic product; "export intensity" is the share of exports in gross domestic output; "import intensity" is the share of imports in total demand.

Agriculture is another key sector, generating one-fifth of total GDP and employing half the country's workforce. Crops dominate, with paddy rice alone accounting for 6.8% of total GDP. Seafood and traditional crops, such as rubber and coffee, have strong downstream linkages to manufacturing, where raw agricultural products are processed and often exported. Agriculture in Vietnam is more export-oriented than in most developing countries, with agriculture and agro-processing together generating one-fifth of all export earnings. Moreover, 10% of agricultural investment is FDI (GSO, 2009a). Agriculture in Vietnam thus has relatively strong ties to global market conditions.

Agriculture's importance extends beyond its contribution to GDP, employment, and export earnings. Three quarters of Vietnam's population live in

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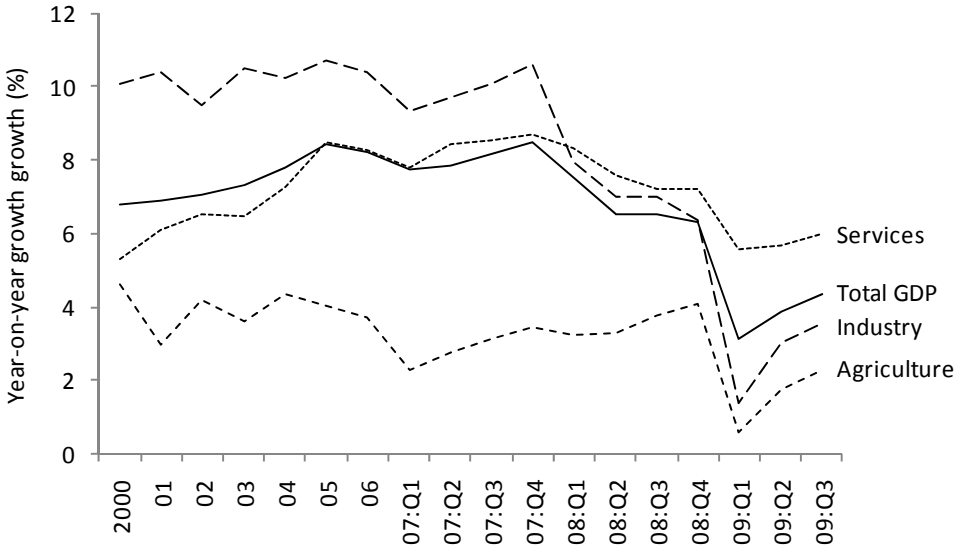
rural areas, where most derive some farm income. Poverty is also much higher in rural areas. According to the 2006 Vietnam Household Living Standard Survey (VHLSS), 47% of Vietnam's population lives below the US$2-a-day poverty line (GSO, 2007). Yet equivalent rural and urban poverty rates are 59% and 15% respectively, implying that about 90% of the poor population is in rural areas. Moreover, poorer urban households spend half of their incomes on food. Agriculture therefore plays a crucial role in households' livelihoods, especially for the poor.

2.2 Economic growth during the crises

Vietnam's real economy expanded at an average 7.5% per year during 2000-2007 (Figure 1). Growth in total GDP decelerated slightly during the 2008 commodity crisis, driven by a small slowdown in services and a larger decline in industry. Falling industrial growth was due to construction, whose annualized growth rate dropped from 12% to 0%. Agricultural growth, by contrast, rose from 3% to 4% due to expanded crop and aquaculture production (GSO, 2009b). Vietnam's overall performance during the 2008 commodity crisis was thus characterized by stronger agricultural growth and continued industrial growth outside of construction.

Figure 1: Annualized economic growth by major sectors, 2000-2009



Source: Authors' calculations using General Statistical Office (GSO, 2009a and 2009b).

Economic growth slowed sharply in the first quarter of 2009, which marks the height of the financial crisis and the onset of the global recession. Industry's deceleration was almost exclusively due to manufacturing, with firms temporarily closing factories and dismissing workers (Van, 2009). The financial crisis also marked a reversal for agriculture. Crop production growth slowed from 5.7% during the first half of 2008 to 0.7% in 2009 (GSO, 2009b). The decline was even more pronounced for aquaculture, whose annualized growth rate fell from 30% to 2%. Although rice and seafood were affected by lower export demand, at least some of their poor performance in early 2009 was due to adverse weather conditions. The slight slowdown in services resulted from weakened foreign tourism.[2] Ultimately, only transport and construction grew robustly during the 2009 financial crisis with all other sectors either stagnating or contracting. However, during the second half of 2009, agriculture and industry showed signs of recovery, suggesting that the negative growth-effects of the financial crisis may have been fairly short-lived.

3. Growth and poverty impact channels

This section examines the apparent resilience of national GDP growth to the two crises, considering various impact channels, including the financial sector; foreign direct investment; world prices and trade; and the government's stimulus package. We also identify various channels linking the macro-level impacts of the crises to household incomes and poverty.

3.1 Financial sector and monetary policy

Vietnam's financial sector has been fairly insulated from the financial crisis. Andersen et al. (2008) identify three sources of potential financial instability in developing countries resulting from the financial crisis: (i) exposure to illiquid/downgraded assets in developed countries; (ii) presence of foreign-owned domestic banks; and (iii) liquidity constraints from a shortage of short-term capital in international money markets. None of these were present in Vietnam.

First, the country had limited direct exposure to the "toxic assets" that undermined many Western financial institutions. Vietnam's banks are generally well capitalized with limited reliance on credit lines to Western banks (i.e., low balance sheet exposure). Nevertheless, asset prices, and in particular stocks, are

[2] The number of tourists visiting Vietnam fell by 20% in 2009 from 2 million in 2008 (GSO, 2009b).

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highly sensitive to market sentiment and the external environment. The stock market therefore plummeted in late 2008 and early 2009.

Second, despite the rising market shares of joint-stock commercial banks, most banking assets remain on the balance sheets of five state-owned banks. This limited exposure to troubled foreign-owned banks. In addition, while central banks worldwide exert direct control over short-term interest rates, long term rates are typically not as easily controlled. State ownership of the banking system in this case provided the government with a mechanism for controlling both long and short-term credit rates, which proved to be key instruments in its stimulus package. The state-supported Vietnam Bank for Social Policy (VBSP) also provided a means of disbursing government-subsidized loans to rural communities.

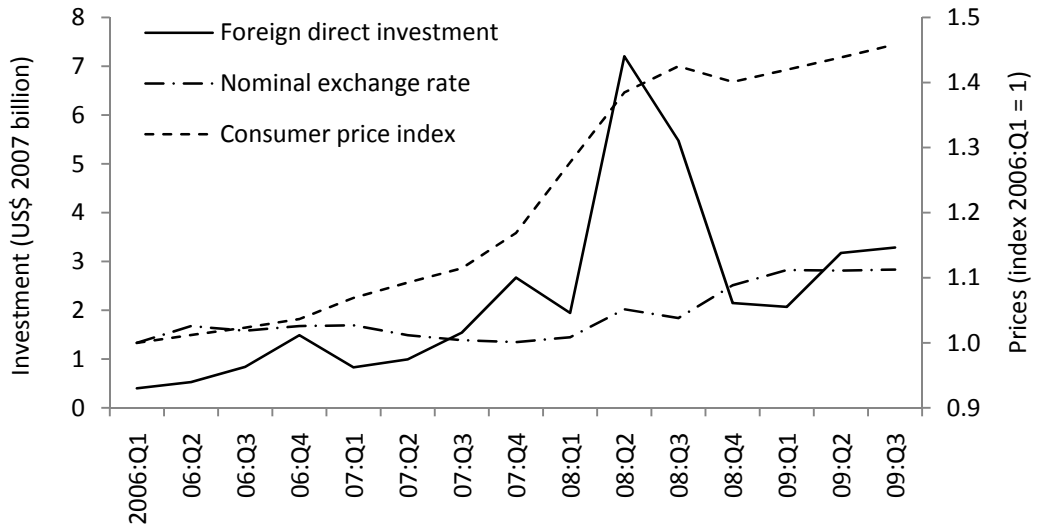
Finally, the tightening of monetary policy in mid 2008 to cool the economy was reversed in late 2008 due to the financial crisis. Monetary policy remained loose, with government interest-rate subsidies expanding credit and money supply during 2009. Overall, total liquidity (measured by M2) rose by 35% in the first half of 2009. The supply of short-term capital was therefore expanded and the impact of the crisis on the financial sector has remained small.

3.2 Foreign direct investment

One motivation for tightening monetary policy in 2008 was the high levels of inflation caused in part by large surges in FDI (Figure 2). The financial crisis caused a sharp contraction in global capital markets in late 2008, including foreign capital inflows to Vietnam. By early 2009, FDI had fallen below 2007 levels. This slowdown in investment helped stabilize consumer prices, with inflation returning to pre-2007 trends. Thus, a positive outcome of the financial crisis was that it cooled the overheating Vietnamese economy.

To isolate the effects of the financial crisis on FDI, we compare flows in late 2008 with those in late 2007, treating the spike in FDI in 2008 as independent of the two crises. This comparison suggests that almost all of the reduction in FDI caused by the financial crisis occurred in the industrial sectors, with manufacturing being the worst affected (GSO, 2009b). FDI in agriculture and downstream agro-processing also declined, although these were among the least affected sectors. By contrast, FDI in the transport sector rose during the crisis, possibly explaining its continued growth while other sectors declined (Section 2). Using 2007 trends as a baseline and excluding the transport sector, FDI inflows to Vietnam were more than 20% below what they would have been had the financial crisis not occurred. The decline in FDI has implications for growth in both contemporaneous and future periods.

Figure 2: Foreign investment, consumer prices and exchange rate, 2000-2009



Source: Authors' calculations using General Statistical Office (GSO, 2009a and 2009b).
Note: "Foreign direct investment" is implemented and not registered investment.

3.3 World commodity prices and foreign trade

World commodity prices rose rapidly in late 2007 and peaked in mid 2008 (Figure 3). Food and energy prices rose especially rapidly, with the largest increases recorded for rice and crude oil. Both of these commodities are major exports for Vietnam, generating a quarter of export earnings. Smaller price increases were recorded for major imports, such as metals and machinery. Overall, the 2008 commodity crisis improved Vietnam's terms of trade. However, rising prices generated worldwide concern for food security and prompted Vietnam to ban incremental rice exports during the first half of 2008. In other words, planned exports were permitted to continue (and to reap the terms of trade gain). However, agents were prevented from increasing export levels, thus preventing reallocation of domestic supplies to exports in response to higher world prices.

The financial crisis and subsequent global recession caused world prices to fall rapidly to levels similar to those of 2007. Crude oil prices initially declined below 2007 levels, thus having a detrimental effect on Vietnam's terms of trade, but prices had returned to 2007 levels by late 2009. Moreover, food prices remained similar to or even above 2007 levels throughout the financial crisis. By contrast, metals and minerals prices fell below 2007 levels and their rebound by

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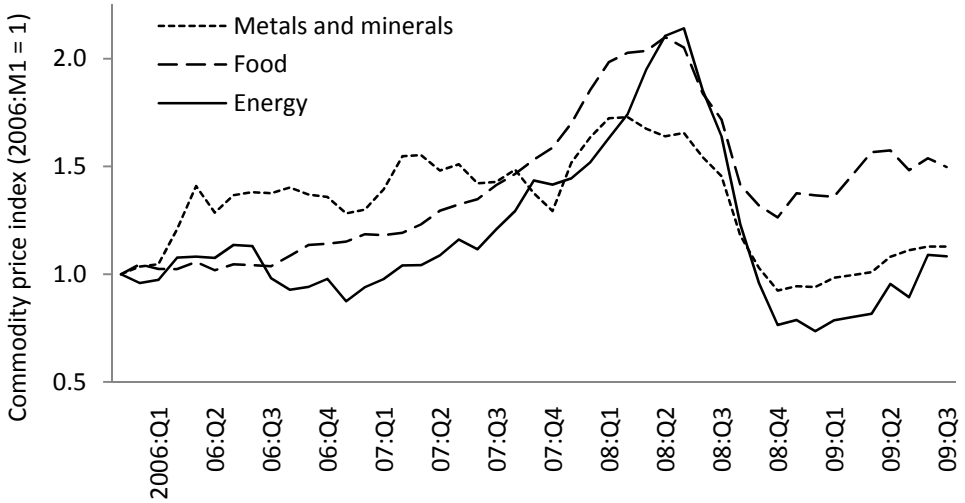
late 2009 remained fairly modest. Vietnam's import prices therefore fell by more than export prices during the financial crisis.[3]

Figure 3: World commodity prices, 2006-2009



Source: Authors' calculations using World Bank (2009b).

Changes in world prices reflect shifts in global demand and supply. Vietnam is a very open economy and, as such, is vulnerable to falling export demand. Merchandise exports fell during the first quarter of 2009 relative to the quarterly average for 2008. Most of this decline was driven by agriculture, food, and textiles, where exports fell by about 40%. Crude oil exports remained relatively stable, albeit below peak 2008 values. Moreover, some export sectors expanded during the crisis, most notably high-value minerals. Ultimately, while the value of most export products declined during the financial crisis, by mid 2009, they had again surpassed 2007 levels. This may reflect price-inelastic demand for many of Vietnam's exported products, such as grains and low-value clothing.

There were also substantial declines in Vietnamese import demand, which almost halved during the first quarter of 2009. This was driven by falling FDI, which is highly import-intensive and accounted for about 40% of merchandise imports in 2008 (GSO, 2009a). Lower inflation and some depreciation of the nominal exchange rate also helped reduce import demand (Figure 2). Ultimately, imports declined by more than exports pushing the trade balance into surplus in

[3] Vietnam's terms-of-trade index (2000=100) improved from 91.7 in 2007 to 94.6 in 2008 (World Bank, 2009a).

the first three months of 2009. This raised national GDP and offset declining foreign investment. Overall, the strong links between FDI and imports reduces the risks typically associated with current account deficits. While the decline in FDI clearly translated into reduced investment and hence reduced future growth, it also eliminated the current account deficit, thus obviating the frequently experienced need to restructure the economy to produce more tradables and fewer nontradables when a principal source of foreign exchange disappears. This automatic stabilization mechanism explains some of the resilience of Vietnam's economic performance during the financial crisis.

Table 2: Foreign merchandise trade, 2006-2009

	Quarterly average value (constant 2007 US$ million)					
	2006	2007	2008	2009 Q1	2009 Q2	2009 Q3
Trade balance	-789	-3,082	-1,357	4,341	-408	-897
Imports	10,943	15,191	18,472	10,643	16,104	16,648
Exports	10,155	12,110	17,116	14,984	15,696	15,751
Agric/food	2,134	2,121	2,843	1,585	2,093	1,627
Crude oil	2,575	3,153	4,041	3,358	3,991	4,178
Textiles/clothing	2,080	2,468	3,499	2,220	4,122	3,262
Other	3,366	4,367	6,732	7,820	5,491	6,685

Source: Authors' calculations using General Statistical Office (GSO, 2009a and 2009b).

3.4 Government stimulus package

As in many countries, Vietnam's government put in place a stimulus package in early 2009 to bolster investment and private consumption during the financial crisis. The International Monetary Fund estimated that Vietnam's proposed stimulus package was worth US$4 billion, although the official budget was US$8.6 billion (Table 3). A large component of the stimulus package was a 4% interest rate subsidy, which is estimated to have generated US$24.1 billion in additional lending. About 68% of these subsidies went to private businesses and 17% to households. The intended impact of the stimulus package was to offset some of the declines in foreign investment, and may explain the strong growth in construction from mid 2009 onward.

The largest component of the stimulus package was "advanced capital," which brought forward planned investments from future budgets. The government announced that half of the funds would be devoted to transport infrastructure and the rest would be divided evenly between agriculture and small businesses. It is unclear how much of these funds were actually disbursed, but the government announced in late 2009 that it would implement a US$3.3 billion stimulus package targeting agriculture and rural development. Most of these funds have

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been allocated to infrastructure, including irrigation, grain storage, and farm machinery. Finally, in its original stimulus package, the government directly targeted households via tax relief and social transfers.

Table 3: Vietnam's proposed stimulus package (January 2009)

	US$ billion
Total proposed cost	8.6
Interest support	1.0
Delayed payback for construction capital in 2009	0.2
Advanced capital investment (from 2009/10)	2.2
Transfer planned investment capital (2008 to 2009)	1.8
Additional government bonds	1.2
Tax reduction	1.6
Other expenditures (including social safety)	0.6

Source: Government of Vietnam (2009).
Note: Figures converted at the exchange rate US$1=VND17,000.

3.5 Household consumption

To date, no firm quantitative evidence exists which can gauge the effects of the crises on private consumption. However, there are a range of impact channels that should be considered. The first channel is via *domestic prices*. The effect of world price changes depends on the degree of price transmission and the composition of households' incomes and expenditures. Some empirical studies indicate that international-to-domestic price transmission is high (Rapsomanikis and Sarris, 2007). This is potentially important for food products, which comprise 47% and 33% of rural and urban households' consumption baskets respectively (Arndt et al., 2009). Food is also a larger consumption item for low-income consumers, implying that changes in world food prices could have significant implications for poverty.

At the same time, households, especially the poor in rural areas, often produce their own food. Home production accounts for about a third of total consumption in Vietnam. World price impacts will be substantially smaller for those households that produce a large share of their own consumer goods; the degree of price transmission remains subject to debate (Abbott et. al, 2009). Two studies conducted soon after the onset of the food price crisis predicted that poverty in Vietnam should fall, given the net-seller position of the country and of many of its poorer rural households (see, for example, Vu and Glewwe, 2009; Ivanic and Martin, 2008). This is in contrast to most other developing countries, whose net-buyer position meant that poverty should have risen (see, for example, Arndt et al., 2008). However, as shown later in the paper, the rice export ban in Vietnam limited some of the benefits for domestic farmers.

The second channel is via *employment and wages*. Although national GDP did not fall in 2008-2009, there were larger adjustments at the firm level. Vietnam's government estimates that 80,000 jobs were lost in the early stages of the financial crisis and that the total job losses may be as high as 400,000 (cited in Van, 2008). Many factories ceased production in early 2009 causing unemployment rates to rise. Moreover, the government suggests that a million workers were "affected" by the crisis, meaning that workers who retained their jobs earned lower wages. Thus, the impact of the crisis on employment and wages depends on shifts in firms' profitability and labor demand.

The final impact channel is *taxes and transfers*. Vietnamese households received US$3.5 billion in foreign transfers in 2007. This was US$44 per capita or 7.3% of total household income. Projections indicate that remittances fell by 8% in 2009 (World Bank, 2009c). This may not directly affect poverty, however, since higher-income households receive most remittances. For instance, transfers from abroad generated 15% of incomes for households in the top income quintile in 2007, but less than 2% of incomes for the bottom three quintiles (Arndt et al., 2009). Moreover, some households benefited from new social transfers in the government's stimulus package. Existing social transfers averaged US$27 per capita in 2007 and were biased toward urban households in the middle of the income distribution.

This section has suggested why national GDP growth in Vietnam did not collapse during the two crises. The 2008 commodity crisis improved terms of trade, especially for agriculture, prior to policy intervention. Evidence also indicates that falling FDI during the 2009 financial crisis was associated with a dramatic decline in imports and was further offset by the government's stimulus package. Throughout the crisis, the financial sector remained insulated from disruptions in developed countries' financial systems. However, there is so far little quantitative evidence on the distributional impacts on private consumption or welfare effects on different population groups.

4. Economy-wide modeling framework

In order to better understand the implications of the food and financial crises for Vietnam, we develop a detailed dynamic computable general equilibrium (DCGE) model. This section provides details on a parsimonious specification of the model.[4]

[4] GAMS code and underlying data for the model are available from the authors upon request.

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4.1 Consumer and producer behavior

Representative consumers and producers in the DCGE model are treated as individual economic agents. Under a Stone-Geary function, consumers maximize utility subject to a budget constraint:

$$\underset{i}{\text{Max}}\, U_h = \prod\nolimits_i (QH_{ih} - \gamma_{ih})^{\beta_{ih}}$$
$$\text{subject to} \quad \sum\nolimits_i (PQ_i \cdot QH_{ih}) = (1 - s_h - th_h) \cdot YH_h$$

where *QH* is the level of consumption of good *i* by household *h*, γ is a minimum subsistence level, and *β* is the marginal budget share. In the budget constraint, *PQ* is the market price of each good, *YH* is total household income, and *s* and *th* are savings and tax rates, respectively. Maximizing this utility function generates the Linear Expenditure System of demand functions:

$$PQ_i \cdot QH_{ih} = PQ_i \cdot \gamma_{ih} + \beta_{ih} \cdot \left((1 - sh_h - th_h) \cdot YH_h - \sum\nolimits_{i\prime} PQ_{i\prime} \cdot \gamma_{i\prime h} \right) \quad (1)$$

Similarly, representative producers maximize profits subject to given input and output prices. Assuming constant returns to scale, a constant elasticity of substitution (CES) function determines production:

$$QA_i = A_i \cdot \left(\delta_i^p \cdot L_i^{-\rho_i^p} + \left(1 - \delta_i^p\right) \cdot K_i^{-\rho_i^p} \right)^{-1/\rho_i^p} \quad (2)$$

where *QA* is output quantity of sector *i*, *A* is a shift parameter reflecting total factor productivity, *L* and *K* are labor and capital demand, and δ is a share parameter.[5] The elasticity of factor substitution is a transformation of *ρ* (i.e., σ=1/(1+ρ)). Maximizing profits subject to Equation 2 and rearranging the resulting first order condition provides a system of factor demand equations:

$$\frac{L_i}{K_i} = \left(\frac{r \cdot D_i}{W} \cdot \frac{1 - \delta_i^p}{\delta_i^p} \right)^{1/\left(1+\rho_i^p\right)} \quad (3)$$

[5] We maintain the option to account for factor supplies in effective units inside the production function. A 10% increase in effective units for all factors is equivalent to a 10% gain in TFP. Accounting in effective units allows for the possibility of introducing biased technical change.

where W is the labor wage, r is a fixed capital rental rate, and D is a sector-specific distortion term. For ease of exposition, we ignore intermediate demand. The producer price PA in sector i is thus the sum of factor payments per unit of output:

$$PA_i \cdot QA_i = W \cdot L_i + r \cdot D_i \cdot K_i \tag{4}$$

4.2 Behavior governing international trade

To accommodate two-way trade for similar goods, we assume imperfect substitution between domestic goods and goods supplied to and from foreign markets (see Armington, 1969). A constant elasticity of transformation function determines the quantity of goods produced for domestic and foreign markets:

$$QA_i = \alpha_i^t \cdot \left(\delta_i^t \cdot QE_i^{\rho_i^t} + (1 - \delta_i^t) \cdot QD_i^{\rho_i^t}\right)^{1/\rho_i^t} \tag{5}$$

$$PA_i \cdot QA_i = PD_i \cdot QD_i + PE_i \cdot QE_i \tag{6}$$

$$PE_i = pwe_i \cdot X \tag{7}$$

where QD and QE are domestically supplied and exported quantities, and PD is the price of the domestic good QD. Under a small country assumption, export price PE is determined by fixed world imports prices pwe multiplied by a nominal exchange rate X that coverts foreign currency into local currency units.

Similarly, a CES function defines the relationship between domestically produced and imported goods:

$$QQ_i = \alpha_i^q \cdot \left(\delta_i^q \cdot QM_i^{-\rho_i^q} + \left(1 - \delta_i^q\right) \cdot QD_i^{-\rho_i^q}\right)^{-1/\rho_i^q} \tag{8}$$

$$PQ_i \cdot (1 - tq_i) \cdot QQ_i = PD_i \cdot QD_i + PM_i \cdot QM_i \tag{9}$$

$$PM_i = pwm_i \cdot (1 + tm_i) \cdot X \tag{10}$$

where tq is a sales tax, QQ is the composite good consumed domestically, QM is the import quantity, pwm is the fixed world import price, and tm are import tariff rates.

Maximizing $PQ_iQQ_i - PD_iQD_i - PM_iQM_i$ subject to Equation 8 and rearranging the resulting first order condition gives the following equation defining the ratio of QD and QM:

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$$\frac{QM_i}{QD_i} = \left(\frac{PD_i}{PM_i} \cdot \frac{1-\delta_i^q}{\delta_i^q}\right)^{1/\left(1+\rho_i^q\right)} \tag{11}$$

Similarly, minimizing $PA_iQA_i - PD_iQD_i - PE_iQE_i$ subject to Equation 5 gives the ratio of *QD* and *QE*:

$$\frac{QE_i}{QD_i} = \left(\frac{PE_i}{PD_i} \cdot \frac{1-\delta_i^t}{\delta_i^t}\right)^{1/\left(\rho_i^t-1\right)} \tag{12}$$

4.3 Government and investment demand

Assuming all factors are owned by households, total income *YH* is

$$YH_h = \sum_i (\theta_h \cdot W \cdot L_i + \pi_h \cdot r \cdot D_i \cdot K_i) + gh_h + wh_h \cdot X \tag{13}$$

where θ and π are coefficient matrices determining how factor earnings are distributed to households, *gh* are transfer payments from the government (e.g., social grants), and *wh* are foreign remittance incomes.

The government is a separate agent with income and expenditures, but without any behavioral functions. Total domestic revenues *YG* is the summation of individual taxes:

$$YG = \sum_h th_h \cdot YH_h + \sum_i (tm_i \cdot pwm_i \cdot QM_i \cdot X + tq_i \cdot PQ_i \cdot QQ_{it}) \tag{14}$$

The government uses its revenues to purchase goods and services (i.e., recurrent consumption spending) and to save (i.e., finance public capital investment):

$$YG = \sum_i PQ_i \cdot qg_i + \sum_h gh_h + FB \tag{15}$$

Our macroeconomic closure rule for the government account assumes that recurrent consumption spending is fixed at *qg* and the fiscal balance *FB* adjusts to ensure total revenues equal total expenditures in equilibrium.

There is also no behavioral function determining investment demand for each commodity. We assume that investment is savings-driven, i.e., it adjusts to match the level of savings in the economy. As shown below, savings are combined in a national pool from which investment is financed:

$$\sum_h s_h \cdot YH_h + FB + cab \cdot X = \sum_i PQ_i \cdot I \cdot qi_i \quad (16)$$

where *cab* is foreign capital inflows fixed in foreign currency (i.e., the current account balance) and *qi* is fixed base-year quantities of investment demand multiplied by an endogenous adjustment factor *I*.

Fixing foreign capital inflows *cab* is our closure for the external account. We assume that a nominal exchange rate adjusts so that total foreign currency earnings equal total payments in equilibrium.

$$\sum_i pwm_i \cdot QM_i = \sum_i pwe_i \cdot QE_i + \sum_h wh_h + cab \quad (17)$$

4.4 Factor and product market equilibrium

Rather than assuming full employment for all factors, we allow upward-sloping labor supply curves that depend on prevailing wage rates relative to base-year wages. As shown below, in equilibrium, total labor supply must equal the sum of all sector labor demands:

$$LS \cdot \left(\frac{W/CPI}{w^0}\right)^{\varepsilon} = \sum_i L_i \quad (18)$$

where *LS* is total labor supply, *W* is the market wage, *CPI* is the consumer price index, w^0 is the base year wage rate, and ε is the elasticity of labor supply with respect to the wage differential. The aggregate labor supply response moderates changes in wages as increases (decreases) in labor demand will be met with a combination of supply and wage increases (decreases). Unlike labor, which is mobile across sectors, capital is assumed to be sector-specific. Under this assumption, factor demand *K* in each sector and the economy-wide rental rate *r* are both fixed (see Equation 3). A rental rate distortion term *D* adjusts so that the sector-specific profit rate equates capital demand and supply in each sector. [6]

Finally, commodity market equilibrium requires that the composite supply of each good *QQ* equals total household, government, and investment demand:

[6] Modern solvers permit the specification of mixed complementarity problems (Rutherford, 1995). For example, it is possible, within Equation 3, to specify a minimum rate of return to sector specific capital. Once that minimum is attained, adjustment proceeds through shutdown of some of the available sector specific capital stock.

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$$QQ_i = \sum_h QH_{ih} + qg_i + I \cdot qi_i \tag{19}$$

Market prices *PQ* adjust to ensure equilibrium is achieved. Together, the above 19 equations simultaneously solve for the values of 19 endogenous variables (i.e., *L*, *QA*, *PA*, *D*, *W*, *QE*, *PE*, *QD*, *PD*, *QQ*, *PQ*, *QM*, *PM*, *YH*, *QH*, *YG*, *FB*, *X,* and *I*). We select the consumer price index as a numéraire.

4.5 Recursive dynamics

The model is recursive dynamic; i.e., the model consists of distinct within- and between-period components. The above equations specify the within-period component. Between-periods, certain exogenous variables are updated based on either externally determined trends or previous period results.

Although not shown in Equations 1-19, each variable has a time subscript associated with it. The two most important external trends imposed on the model are changes in labor supplies and total factor productivity (i.e., *LS* in Equation 18 and *A* in Equation 2). With respect to labor supply, there is a secular growth trend in labor supply that is independent of the wage. Total factor productivity increases at an exogenously imposed rate across time periods. We also increase public consumption spending *qg* and recurrent transfers *gh* (see Equation 15).

Sector-level capital accumulation rates are determined endogenously based on investment levels from the previous period. As shown below, the quantity of new capital *QN* is based on the total value of investment and a fixed capital price *pk*. This is allocated to sectors after applying a national depreciation rate υ and according to a capital allocation factor *SK* (0<*SK*<1).

$$QN_t \cdot pk = \sum_{i\prime} (PQ_{i\prime t} \cdot I_t \cdot qi_{i\prime})$$

$$KS_{it+1} = KS_{it} \cdot (1 - \upsilon) + SK_{it} \cdot QN_t$$

The allocation parameter *SK* specifies how much investment is directed toward each sector and so sums to one. Following Dervis et al. (1982), *SK* is defined as follows

$$SK_{it} = SP_{it} + \varphi \cdot SP_{it} \left(\frac{SR_{it} - AR_t}{AR_t} \right)$$

where *SP* is a sector's current share in aggregate profits, *SR* is a sector's profit rate (i.e., $r \cdot D_i$), and *AR* is the economy-wide average profit rate. New capital is

allocated in proportion to each sector's share in aggregate capital income, adjusted by its profit rate relative to the average profit rate. Sectors with above-average profit rates receive a greater share of investable funds than their share in aggregate profits. The term φ is an investment mobility parameter. This allocation procedure is known as a "putty-clay" specification, since new capital is mobile, but once invested it becomes sector-specific. Note that when the term φ is zero, it is assumed that there is no inter-sectoral mobility in investment funds.

4.6 Model calibration

The model's variables and parameters are calibrated to empirical data from a social accounting matrix that captures the initial structure of Vietnam's economy in 2007 (see Arndt et al., 2009). As described above, the parameters are adjusted to reflect demographic and economic trends and the model is re-solved for a new equilibrium each half-year during 2007-2011. The above model is extended to include fixed coefficient intermediate demand, transaction costs in product markets, and agriculture-specific factors.

The model identifies 66 sectors (14 agriculture, 40 industry, and 12 services). Based on VHLSS 2006, labor markets are segmented across rural/urban areas and four education groups: (i) below primary schooling; (ii) completed primary; (iii) completed secondary; and (iv) tertiary. Agriculture-specific factors include crop land, livestock, and fisheries stocks. All workers have upward-sloping labor supply curves.[7] Agricultural factors are fully employed (i.e., ε in Equation 18 is zero for these factors). As described above, capital is immobile under a "putty-clay" specification. When profit rates on fixed capital fall by 20%, we impose a mixed complementarity formulation such that declines in capital utilization become the adjustment variable. Unused capital continues to depreciate but is reactivated once profit rates improve. This specification of underutilization permits temporary shutdown of a share of the capital stock during the crises, while retaining producers' capacity to expand production under better market conditions.

Production and trade elasticities are based on global estimates from Dimaranan (2006).[8] Household income elasticities were econometrically estimated using VHLSS and the approach presented in King and Byerlee (1978).[9] Finally, the analysis includes a separate micro-simulation module in which each household in the VHLSS is linked to itscorresponding representative household group in the DCGE model. Changes in commodity prices and households'

[7] Wage elasticities are set at 0.30 for lower-educated labor groups and 0.15 for higher-educated labor. This reflects greater underemployment in rural areas where education levels are lower.
[8] All elasticities are reported in the appendix.
[9] The authors are grateful to Bingxin Yu at IFPRI for estimating the income elasticities.

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consumption spending are passed down from the DCGE model to the micro-simulation module. Total per capita consumption and poverty measures are then recalculated, assuming Leontief preferences by individual households.

5. Model simulations and results

5.1 Baseline scenario

The DCGE model is initially calibrated to track observed trends in key demographic and macroeconomic indicators. Annual labor force growth of about 2.5% is targeted during 2007-2011 (World Bank, 2009a). Higher-educated labor grows faster than other labor types, reflecting improvements in human capital stocks. For example, based on recent surveys, the supply of workers with tertiary schooling expands at 6.5% per year, while the supply of workers with only primary schooling grows at 2.3% (GSO, 2009b). By manipulating effective labor units, technical change is biased toward higher-educated labor.

Total GDP growth of about 7.5% per year in the Baseline scenario is driven by industry and services, which grow at about 8.5% during 2007-2011. Agriculture grows at a slower 3% per year. The national US$2-a-day poverty headcount rate declines from 47.3% in 2007 to 42.2% by 2011. Although poverty declines in both rural and urban areas, slower agricultural growth results in slightly smaller reductions for rural households. A comparison with observed trends for 2005-2007 suggests that this baseline adequately captures Vietnam's growth path prior to the commodity and financial crises. The Baseline scenario thus provides a reasonable counterfactual against which we can measure the impacts of the crises.

5.2 Simulating the commodity and financial crises

Section 3 identified impact channels linking the crises to economic growth. Here, we describe the shocks imposed on the DCGE model. In the first simulation, we estimate the impact of the 2008 commodity crisis. Detailed world prices were taken from World Bank (2009b). The real price changes imposed on the model are shown in Table 4 for Vietnam's main traded commodities. In the commodity crisis scenario, we only impose the price changes that took place during 2008 (i.e., the first two columns), so this is referred to as the "Food/fuel" simulation.

Table 4: Shocks to the model

		Change from baseline during half-year period (%)			
		2008:S1 (Jan-Jun)	2008:S2 (Jul-Dec)	2009:S1 (Jan-Jun)	2009:S2 (Jul-Dec)
World prices *(for selected products)*	Rice	30.0	10.0	-15.0	-5.0
	Coffee	7.0	0.0	-15.0	-3.0
	Coal	30.0	10.0	-30.0	0.0
	Oil and fuel	10.0	0.0	-20.0	-15.0
	Textiles and clothing	5.0	0.0	-10.0	7.0
	Fertilizer	30.0	20.0	-30.0	-15.0
	Machinery	5.0	-5.0	-10.0	0.0
Foreign direct investment inflows		-	-	-15.0	-15.0
Foreign transfers to households		-	-	-5.0	-5.0
Stimulus package	Capital inflows	-	-	15.0	15.0
	Recurrent spending	-	-	3.0	3.0
	Land productivity	-	-	3.0	3.0
	Social transfers	-	-	8.0	8.0
	Direct tax rates	-	-	-6.0	-6.0

Source: Authors' calculations using world prices from World Bank (2009b).

In assessing the 2009 financial crisis, we take the results from the "Food/fuel" simulation as our starting point (i.e., the end 2008). We then incrementally include the changes in world prices, foreign investment, and foreign remittances. In addition, rates of productivity growth are changed in order to track the GDP and trade changes described in Table 2. Changes in world prices during 2009 are shown in the final two columns of Table 4. These are imposed on the model in the "2009 prices" simulation. In the "FDI outflows" simulation we include both declining world prices and FDI flows. FDI falls by 15% in the first and second halves of 2009, which is a cumulative decline of about 25% for the year. Finally, in the "Remittances" simulation we reduce foreign transfers to households by about 10% based on projections from World Bank (2009c). Absolute declines in transfers are distributed proportionally across rural/urban households according to remittance receipts reported in VHLSS. The "Remittances" scenario captures all three impact channels from Section 3 and thus reflects the overall impact of the 2009 financial crisis.

Finally, we simulate the government's stimulus package. First, interest support and advanced capital offset declining FDI by injecting capital into the private sector. These are modeled as a US$1.45 billion increase in investment funds transferred to the real economy.[10] Second, we simulate a 3%, or US$300

[10] This is modeled as an increase in *cab* in Equation 17 in Section 4.

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million, increase in recurrent government spending which raises agriculture's productivity by 6%.[11] Third, we proportionally reduce direct tax rates on enterprises and households by about 12% (not percentage points) and extend social transfers by US$10 per capita. The costs of the latter two interventions are US$900 million and US$850 million, respectively. Finally, the stimulus is assumed to eliminate about a quarter of the productivity growth losses incurred during the financial crisis. The overall stimulus package simulated in the DCGE model costs US$3.5 billion or 5% of GDP in 2008. The "Stimulus" simulation captures key elements of the proposed 2009 stimulus package and is of similar magnitude.

5.3 Impact of the 2008 food and fuel price crisis

Table 5 presents the results for the Food/fuel scenario, which captures the changes in commodity prices during 2008. Although price changes are modeled on a semester basis (half yearly), the table reports total impacts for 2008. As such, since the ban on additional rice exports was only imposed during the first half of 2008, the table reflects post-ban outcomes when world price changes had been transmitted to the domestic economy. The export ban is modeled by preventing exports from increasing in response to higher world export prices. No additional export tax revenues are generated by the government.

As indicated earlier, Vietnam's terms of trade improved in 2008, because weighted export prices rose by more than import prices. This was primarily due to rice and crude oil, which are major export commodities, the prices of which rose significantly (see Table 4). Recall that the export ban applied only to incremental exports of rice. Existing rice exports benefited from higher prices even when the ban was in place. In addition, the ban was not in place in the second half of 2008. The improvement in the terms of trade generates an appreciation of the real exchange rate, reflected in a reduced price of tradeable to nontradeable commodities. The Vietnamese economy responds by reducing total exports, which fall by 1% in volume terms below the baseline. Even though world import prices are rising, this is more than offset by the real appreciation and there is a slight increase in import volumes.

[11] This implies a spending-to-productivity-growth elasticity of 0.05 since natural resource value-added is half of agricultural GDP and 5% of the state budget is allocated to agriculture (i.e., 0.03 / 0.05 / 0.5 x 0.05 = 0.06). This elasticity is below the econometrically estimated returns to irrigation (0.11), rural roads (0.07), and agricultural research and extension (0.06) (Fan et al., 2004), but reflects possible delays in the returns to investments.

Table 5: Model results for the 2008 food-and-fuel crisis

	Baseline scenario		Food/fuel (1)
	Initial, 2007	Change, 2008 (%)	Deviation from baseline, 2008 (%-point)
Real GDP	100.0	7.0	-0.2
Absorption (C+I+G)	113.3	7.3	1.1
Consumption (C)	57.6	5.3	1.5
Investment (I)	41.6	9.9	0.8
Government (G)	14.1	8.2	0.0
Exports (E)	76.5	7.3	-1.0
Imports (M)	89.8	7.7	0.7
Real exchange rate	100.0	1.5	-2.1
Terms of trade	100.0	0.0	2.3
Exports	100.0	0.0	7.7
Imports	100.0	0.0	5.3
Consumer price index	100.0	0.5	-1.4
GDP at factor cost	100.0	7.0	-0.2
Agriculture	22.1	3.5	0.5
Crops	13.4	3.4	1.9
Livestock	2.7	4.5	-0.2
Other	5.9	3.0	-2.2
Industry	41.7	8.1	-0.2
Mining	10.9	6.2	0.5
Manufacturing	20.1	8.1	-1.0
Other	10.7	10.2	0.7
Services	36.2	8.0	-0.6
Employment (mil.)	39.1	2.7	0.9
Urban	11.2	4.0	-0.3
Rural	27.9	2.3	1.4
National poverty (%)	47.3	-1.4	-3.6
Urban	15.2	-1.8	0.2
Rural	59.0	-1.2	-5.0

Source: Results from the Vietnam DCGE and micro-simulation model.
Notes: The first column of numbers provides, from the top, baseline shares of GDP, initial price index levels, baseline shares of GDP at factor, employment in millions, and the poverty rate. The poverty rate is based on a US$2 per day poverty line calculated using 2006 VHLSS (GSO, 2007).

The rapid onset of the 2008 commodity crisis constrained producers' abilities to respond to new external market conditions. This is captured in the model by fixing capital stock and land allocations and limiting labor substitution possibilities. There is still, however, a shift in resources toward commodities whose export profitability rises the most. Crop production, for example, expands

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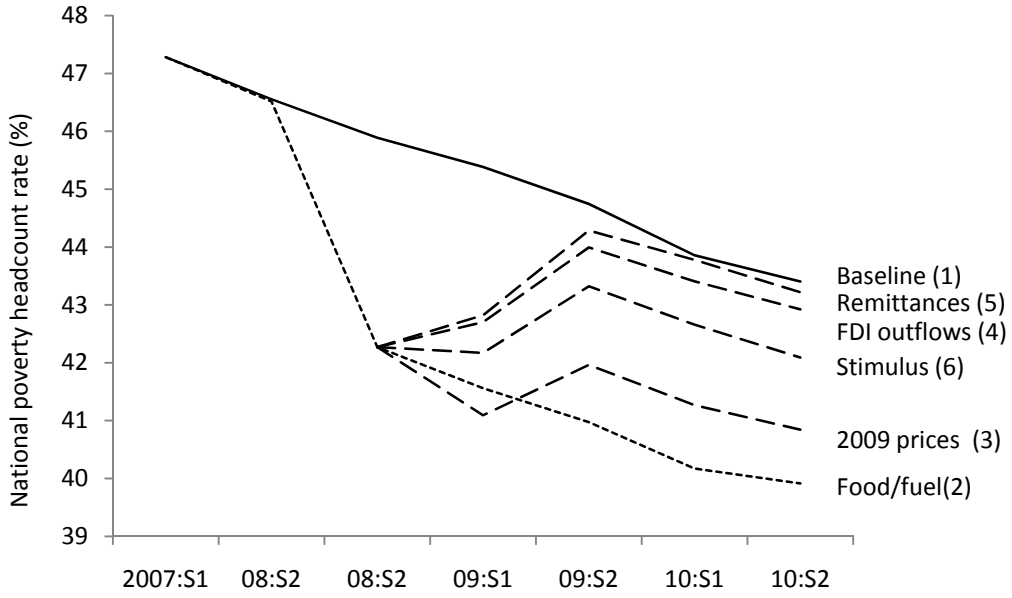
by an additional 1.9% as rice farmers eventually take advantage of higher export prices. This increases rural employment, mainly for lower-skilled farm workers. Conversely, manufacturing and services production falls, because the large real appreciation reduces their export competitiveness. Urban employment also declines as a result. Overall, the shift out of non-agriculture into lower productivity crop production causes real GDP to decline slightly by 0.2%. These results are consistent with the observed rise in agricultural GDP and decline in the growth of services GDP during 2008.

Although economic growth declines slightly, there is still an increase in total absorption due to the terms of trade improvement. However, not all components of absorption are affected equally. Since recurrent government spending is constant in the model, tax revenues from oil exports are used to expand public investment. Overall, total investment demand rises by 0.8% relative to the baseline. The increase in investment also benefits from cheaper imported machinery and accounts for the expansion of construction (included in "Industry, other"). Falling consumer prices, caused by cheaper imported goods and higher food production, also causes real private consumption to expand by 1.5%. Since absorption is an aggregate measure of welfare in the economy, the results suggest that the global commodity crisis had a positive effect on welfare in Vietnam.

The net employment effects of the 2008 commodity crisis were also positive. At the national level, employment increased by 0.9%, or by about 350,000 jobs. Most of these new jobs are created in the agricultural sector, which explains why the rural poverty headcount declines by five percentage points.[12] Overall, the commodity crisis reduced the number of people in Vietnam living below the US$2-a-day poverty line by 3.1 million people. As shown in Figure 4, the poverty reduction only occurs after the lifting of the rice export ban. This is because the ban limited the increase in producer prices and hence, many of the gains for rural farmers. Lifting of the ban during the second half of 2008 allowed domestic prices to adjust to higher world prices and for rural farmers to increase rice production, causing poverty to decline. Overall, this is a substantial decline in national poverty beyond what would have been expected without the positive terms-of-trade effects caused by the global commodity crisis.

[12] The poverty headcount rate is the share of the population living below the US$2-a-day poverty line.

Figure 4: National poverty headcount, 2007-2010



Source: Results from the Vietnam DCGE and micro-simulation model.
Note: Poverty rate is the US$2-a-day poverty line calculated using 2006 VHLSS (GSO, 2007).

5.4 The 2009 financial crisis and global recession

Table 6 shows how the impact of the financial crisis is decomposed into falling world prices, FDI, and remittances. Productivity growth is also reduced in order to track GDP and trade impacts. As indicated, simulations of the financial crisis are cumulative such that the Remittances column reflects the full impact of the crisis in 2009, without any mitigating government stimulus, and the final column indicates the effect, assuming that the proposed stimulus package is fully enacted. The first two columns of results, labeled Food/fuel scenario, show annual growth rates for 2009, assuming the high world prices prevailing in 2008 had continued into 2009. The remaining columns present contemporaneous percentage point differences from this Food/fuel crisis scenario.

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Table 6: Model results for the 2009 financial crisis

	Food/fuel scenario (2)		2009 prices (3)	FDI outflows (4)	Remit-tances (5)	Stimulus (6)
	Initial, 2008	Change, 2009 (%)	Deviation from Food/fuel scenario, 2009 (%-point)			
Real GDP	100.0	7.2	0.5	-3.4	-3.7	-2.3
Absorption (C+I+G)	115.0	7.6	1.5	-4.1	-5.3	-2.2
Consumption (C)	57.6	5.2	0.9	-2.7	-4.3	-1.8
Investment (I)	43.1	10.6	2.9	-7.5	-8.4	-4.7
Government (G)	14.3	8.2	0.0	0.0	0.0	3.9
Exports (E)	76.2	7.7	-0.6	-4.5	-4.1	-4.4
Imports (M)	91.1	8.1	0.9	-5.3	-6.0	-3.9
Real exchange rate	100.0	1.8	-1.4	-1.2	-0.6	-2.0
Terms of trade	100.0	0.0	0.5	0.5	0.5	0.5
Exports	100.0	0.0	-6.8	-6.8	-6.8	-6.8
Imports	100.0	0.0	-7.3	-7.3	-7.3	-7.3
Consumer price index	100.0	0.9	0.5	0.9	1.0	0.5
GDP at factor cost	100.0	7.3	0.4	-3.4	-3.6	-2.2
Agriculture	21.5	3.2	-0.1	-1.6	-1.8	0.3
Crops	13.2	3.3	-0.6	-1.8	-1.9	0.6
Livestock	2.7	4.6	0.5	-1.8	-2.6	-0.6
Other	5.6	2.3	0.6	-1.3	-1.3	0.1
Industry	42.1	8.4	0.4	-4.6	-4.9	-3.9
Mining	10.9	6.2	-0.8	-1.0	-1.0	-1.1
Manufacturing	20.1	8.4	0.0	-5.2	-5.4	-4.9
Other	11.1	10.6	2.2	-7.2	-8.0	-4.8
Services	36.4	8.3	0.7	-2.9	-3.2	-1.8
Employment (mil.)	40.5	2.7	-0.1	-1.0	-1.1	-0.3
Urban	11.6	3.9	0.6	-0.2	-0.3	0.2
Rural	28.9	2.2	-0.3	-1.3	-1.4	-0.6
National poverty (%)	42.3	-1.3	1.0	3.0	3.3	2.3
Urban	13.6	-0.7	-0.6	0.5	0.5	0.0
Rural	52.7	-1.5	1.6	3.9	4.3	3.2

Source: Results from the Vietnam DCGE and micro-simulation model.
Notes: The first column of numbers is similar to the first column of Table 6, but is based on simulation results from the food-and-fuel-crisis scenario in 2008. From the top, the column contains shares of GDP, reinitialized price index levels, shares of GDP at factor, employment in millions, and the poverty rate. The poverty rate is based on a US$2 per day poverty line calculated using 2006 VHLSS (GSO, 2007).

We first focus on changes in world prices (see the third column of Table 6). Falling world prices in 2009 improved Vietnam's terms of trade even beyond the levels achieved in 2008. Based on 2007 trade shares, trade-weighted import prices fell faster than export prices. Note that import prices receive a larger weight

in the terms-of-trade calculation due to Vietnam's trade deficit. The decline in the import price index is driven principally by falling prices for imported intermediates, such as metals, fuels, and textiles. The falling prices for imported investment goods, such as machinery and transport equipment, also reduces the import price index. Relative to the world prices prevailing under the food-and-fuel crisis, prices under the financial crisis improve terms of trade by 0.5%. This causes the real exchange rate to appreciate by a further -1.4%.

Together, lower prices for major exports and the real appreciation cause real exports to fall by 0.6% relative to the level registered in the Food/fuel scenario in 2009. The real appreciation also favors imports, whose volume expands by 0.9%. Changes in sector production are opposite to those experienced during the 2008 commodity crisis. Crop production falls alongside world rice prices. Urban employment increases while rural employment declines. In terms of the components of absorption, the high import intensity of investment permits real investment to rise due to lower world prices for imported investment goods combined with the real appreciation. Consumers also benefit from the improved terms of trade in the aggregate; but declining agricultural GDP reduces farm incomes for poorer rural households, with poverty rising as a result.

The impact of the financial crisis is both negative and more pronounced in the FDI and Remittances scenarios (see columns (4) and (5) in Table 6). As expected, falling FDI causes a substantial contraction in total investment. The reduced demand for imported capital goods helps maintain external balance without a large depreciation of the real exchange rate. At the same time, reduced FDI implies a reduction in the growth rate of the capital stock. Since the model is run on a semester basis, the reduction in FDI in the first half of 2009 leads to reduced capital in the second half of 2009. Overall, by end 2009, real GDP declines due to reduced capital availability and lower levels of labor employment; it declines in factor-specific productivity growth of 0.5 and 1.5 percentage points for rural and urban factors, respectively. This decline in economic activity causes household incomes and real consumption spending to fall. The results for the Remittances scenario indicate that half of the overall decline in consumption spending during the financial crisis was due to falling remittances, which directly affects households' incomes. Declining remittance inflows also reduces the real appreciation.

The largest reduction in economic growth following the crisis was in manufacturing and other industry. This is consistent with the declines in prices, demand, and foreign direct investment actually observed. The largest declines in production were for textiles and clothing. Machinery and construction ("Industry, other") also contracted sharply because of lower investment demand, which uses these commodities intensively. FDI accounts for about a tenth and a third of total investment in agriculture and agro-processing, respectively, and so these sectors

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contracted in the FDI Outflows scenario. Declining world prices and weaker consumer demand also contributed to the decline of agriculture during the financial crisis. These results are consistent with the observed declines in sector GDP in 2009.

The financial crisis caused employment to fall by 1.1% relative to the employment levels obtained following the food-and-fuel crisis. More than 90% of the 430,000 job losses were in rural areas, which is where most of the workforce is employed. However, urban employment also fell. The share of the population below the US$2-a-day poverty line increased by 3.3 percentage points relative to the level attained in the Food/fuel scenario in 2009. This is equivalent to an additional three million people living below the poverty as a result of the financial crisis. Furthermore, even though agriculture experienced the smallest relative contraction in output, rural poverty increases by more than in urban areas due to the declines, including job losses, in labor-intensive crop production. The bunching of rural households at consumption levels near the poverty line also implies a greater sensitivity of the poverty rate to consumption changes in rural versus urban areas.

5.5 The 2009 government stimulus package

Four components of the stimulus package are simulated, namely interest rate support to the private sector; public investments in agriculture; direct tax relief; and social transfers to households.[13] We assume that the government borrows from abroad in order to stimulate private sector investment. This lowers the decline in investment demand relative to the remittances scenario (see the final column in Table 6). Tax relief and social transfers also increase consumption spending, although it is insufficient to fully compensate for the decline in household incomes caused by the financial crisis. The increase in recurrent government spending reflects additional expenditure on agriculture. Together the increase in investment, consumption, and recurrent spending offsets some of the decline in absorption caused by the financial crisis. The incoming foreign capital drives a real appreciation in the currency relative to the remittances scenario, thus encouraging imports and further reducing exports.

Agricultural GDP growth accelerates under the simulated stimulus package. This reduces the decline in rural employment. Increased investment generates immediate demand for construction (i.e., "Industry, other"), which now declines at a slower rate. The overall decline in industrial GDP caused by the financial crisis is also lessened by the stimulus package due to higher productivity

[13] Note that our analysis does not consider the long-term implications of expanding the fiscal deficit and long-term debt position.

levels and greater capital stock (despite the lag between providing interest rate support and the eventual translation of higher investment into new capital stocks). However, manufacturing relies on external demand, which is unaffected by the stimulus package. Thus, manufacturing growth remains largely unchanged. Rather, it is in the service sectors that the stimulus package generates additional urban employment. Lowering taxes and providing social transfers increases households' demand for consumer goods. Non-traded services, unlike industry, are less affected by import competition caused by the real appreciation. These results suggest that some of the resurgence in agriculture, construction, and services during late 2009 can be attributed to the stimulus package.

Ultimately, the stimulus package prevents around two-fifths of the decline in total GDP caused by the financial crisis. The stimulus has a larger impact on employment and causes a significant reduction in poverty. This is evident in Figure 4, which shows how the stimulus package lowers the increase in poverty caused by the financial crisis by about one third. This means that about 860,000 people are kept above the US$2-a-day poverty line as a result of the simulated stimulus package. While this is still above the poverty levels that prevailed following the 2008 commodity crisis, it is well below the baseline scenario which excludes the gains from the 2008 commodity crisis. However, the gap between the Food/fuel and Stimulus scenarios in Figure 4 suggests that the increase in poverty caused by the financial crisis will persist well into the future.

6. Conclusion

From a macroeconomic perspective, Vietnam has weathered the recent global crises relatively well. However, there is little rigorous analysis of why the effects were relatively small and not much quantitative evidence is available on how workers and households were affected, especially those at the lower end of the income distribution. In this paper, a dynamic economy-wide model was developed to decompose the effects of the crises and to translate the macro-level impacts of the crises into household incomes and poverty.

Model results indicate that the 2008 commodity crisis improved Vietnam's terms of trade. It raised aggregate welfare and reduced poverty, mainly by expanding exports in labor-intensive sectors. The 2009 financial crisis reversed the welfare gains from 2008. Even though world price shifts in 2009 improved Vietnamese terms of trade beyond the gains observed in 2008, reductions in demand for exports, FDI, and remittances caused a contraction in economic activity. The financial crisis pushed three million people below the US$2-a-day poverty line relative to the Food/fuel scenario. The vast majority of the population that fell into poverty resided in rural areas. Agriculture and the rural nonfarm

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economy were limited in their ability to cushion the effects of the financial crisis. Vietnam's agricultural sector has a strong export orientation, which makes it vulnerable to world market conditions.

The simulated impact of the government's stimulus package shows that it offset some of the welfare losses caused by the financial crisis and substantially reduced the impact on poor households. Overall, the combined net effect of the two crises had little effect on poverty (and other principal macroeconomic indicators) compared with the baseline (no crises) path, even assuming the stimulus policies designed to counter the financial crisis had no effect on current welfare. Under the assumption of an effective stimulus package, poverty rates are actually lower than the baseline (no crises) path.

Appendix: DCGE model elasticities

Table A1: Trade substitution elasticities

Paddy rice	5.05	Dairy products	3.65	Wood products	0.30
Rubber	2.50	Seafood	2.00	Paper products	2.95
Sugarcane	2.70	Vegetables	3.30	Fuels	0.20
Other crops	3.25	Husked rice	2.60	Chemicals	3.30
Pork and beef	2.00	Refined sugar	2.70	Nonmetallic minerals	2.90
Poultry	1.30	Other foods	2.00	Metal products	2.95
Fisheries	1.25	Beverages	1.15	Machinery	0.80
Forestry	0.30	Textiles	3.75	Other manufactures	1.10
Crude oil	0.50	Clothing	3.70	Utilities	2.80
Other mining	0.90	Leather	4.05	Services	0.70
Meat products	3.85	Footwear	0.50		

Table A2: Household income elasticities

	Rural	Urban
Rice	0.14	0.15
Pork and beef	0.99	1.11
Poultry	0.72	0.92
Seafood	0.86	0.82
Other foods	0.46	0.52
Vegetables	0.82	1.01
Tobacco	1.38	1.25
Beverages	1.21	1.07
Non-foods	1.46	1.10

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