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Openness to International Trade and Income Risk in Cemac

Tchakounté Njoda Mathurin[1] & Ankaye Bertin Ablinkaye[2]

Abstract

In this paper, the effects of international trade on income risk are investigated. Arguing that the interaction between international trade and his different channels (export share and import penetration) plays an important role in explaining labour income risk, we employ a sample of 6 central Africa's countries covering the period 1993-2013, in aggregate level, to estimate time-varying individual income risk at the sector level. The relationship between trade and labour income risk is analyzed by combining our estimates of persistent labour income risk with measures of exposure to international trade. It is established that export share have a statistically significant association with labour income risk in the CEMAC countries. Our findings are robust to the econometric techniques used, to the inclusion of a wide range of control variables.

JEL Classification Numbers: F16, E24.

Keywords: Trade, Export share, Import penetration, Income Risk

1. Introduction

The last decades have seen an increased integration of countries into the world economy through trade and capital market liberalization. This has led to a parallel surge of interest in the academic and policy writing on the implications of increased "openness" of countries to cross-border trade in goods and factors (Bhagwati and Srinivasan, 2001; Irwin, 2002). The economic benefits and costs of openness are now being actively debated: While many economists have pointed to the gain in allocational efficiency that results from free international exchange, others have pointed out potential downsides, arguing that openness may lead to an increase in income inequality and, separately, income risk (income volatility). Although there is by now a large empirical literature analyzing the impact of trade openness on wage levels and the distribution of income, an empirical analysis of the effect of trade openness on national and individual income volatility has so far been lacking. The raise in income inequality over the last decades in many modern economies has been well documented[3], but the focus has largely been on the important question of how trade affect wages and, specifically, of how workers in different human capital or occupational categories may be differently affected (on average) by an economy's openness to international trade (Meghir and Pistaferri, 2004). More recently, literature has covered an interesting finding regarding the possible channel through which openness to international trade may expose workers to riskier economic environments causing greater volatility (variance) in their incomes (Krishna and senses, 2009; Feenstra, 2010; and Hogrefe and Yao, 2012). While the large theoretical and empirical literature on the political economy of trade policy has not directly studied income risk as a determinant of cross-sectional variation in trade policy, it is possible that trade policy, which affects export share or import penetration, may itself be endogenously determined by income risk in the sector.

[1] Lecturer, FSEG, University of Ngaoundéré. Phone: (237) 99 871221/ 75259303, Email : mtchakou@yahoo.fr
[2] Ph.D Candidate, FSEG, University of Ngaoundéré. Phone: (237) 748247/ 94 627784, Email: ankayebertin@yahoo.fr
[3] See for example Dollar and Kraay (2002), Feenstra and Hanson (2002), Milanovic and Squire (2005), Anderson (2005), Meschi and Vivarelli (2009).

Income risk is defined as the variance of changes in the unexplained component of individual income. As such, it describes changes in income that are not a result of observable and predictable characteristics like age or education.

It is unexpected variation from an ex-ante perspective. Crucially, we distinguish between transitory and permanent risks to income. Transitory shocks to income are more likely to be smoothed out by self-insurance mechanisms such as saving and borrowing. However, this does not hold for permanent shocks, i.e. shocks that permanently shift an individual's income trajectory. Following the literature, we assume permanent income risk to be uninsurable from an individual or national perspective. In this paper, we study empirically the relationship between trade openness and income risk for the Economic and Monetary Community of Central Africa (CEMAC) using the following approach. First, we estimate individual income (income per capita) risk defined as the variance of unpredictable changes in representative income. In this first step, we are careful to distinguish between transitory and permanent shocks to income since the two types of shocks have very different implications[4]. Second, we use these estimates of individual income risk and sector-level data on trade openness to conduct an empirical investigation of the relationship between international trade and individual income risk. More specifically, we regress (the estimates of) individual income risk on international trade measures, and control for changes in macroeconomic conditions and sector specific effects. We also identify the relationship between income risk and international trade by exploiting the difference across sector with respect to changes in income risk and trade openness over time. To obtain to the openness-volatility link, our research strategy is a simple one: we obtain suitable measures of volatility in individual incomes (taking care to distinguish between temporary and permanent shocks to income) and then exploit the variation in international trade variables in our data to get estimates of the relationship between income volatility and openness (after conditioning suitably for a wide variety of other determinants of income volatility such as general macroeconomic conditions). The rest of the paper proceeds as follows. In section 2 we analyze the trade characteristics of CEMAC sub-region. Section 3 discusses the econometric methodology and data we use to estimate of the relationship between income risk and international trade. Section 4 presents our results and section 5 concludes.

2. Major Trade Characteristics in Cemac

The CEMAC countries are very dependent on international trade. In CEMAC region, like in the majority of sub-Saharan African countries, international trade and capital flows play a key and significant role in the full utilization of the country's potential (Collier and Gunning, 1999; Tchakounté and zolo Eyea, 2011). CEMAC represents a market of 42.5 million people spread over more than 3 million km2, with huge natural resources. In fact, although it has been in existence for what will soon be 20 years, CEMAC has not yet succeeded in promoting trade among its members, despite the various texts adopted with a view to establishing a customs union, with, of course, its free trade area component. Apart from supply-side restrictions, this situation can be attributed, in particular, to communication infrastructure (road, rail and port networks) that is either lacking or in poor condition, the haphazard supply of energy and its high cost, and financing which is scarce and therefore expensive. The production and trade structure in CEMAC member states is characterized by production and exports of natural resources and primary commodities. Over 50 % of CEMAC's exports are mineral fuels and extracted oils. Oil exports represent over 90 % of exports in Chad, Republic of Congo, and Equatorial Guinea. Only the Central African Republic differ from this pattern, but his economy is heavily dependent on diamonds (Table 1). Apart from oil and diamonds, agriculture is the only other sector generating substantial export revenues for the region. Cameroon relies on agriculture and timber for its export earnings, with cocoa and rubber production comprising the major subsectors of its economy. Timber is Gabon's second largest export. Taken as a whole, agriculture is limited, and over 50 % of the region's food needs are satisfied by imports. Table 1 also presents the main CEMAC exports for each member state. The region's total merchandised exports were valued at approximately $23 billion in 2005. The United States, EU and China are the major import markets for the region, accounting for over 95 % of total CEMAC exports. This is especially the case for crude oil products, which account for 64 % of exports from Congo, 45 % from Equatorial Guinea, 69 % from Gabon, and more than 80 % from Chad. EU imports from Central Africa are mostly agro-based merchandise.

[4] More specifically, a substantial body of work has shown that agents can self-insure against transitory income shocks by using their own savings, which implies that the effect of such shocks on consumption and welfare are relatively small (Blundell, Pistaferri and Preston, 2002).

Trade in the CEMAC region is hampered and distorted due to the low complementarities of natural endowments, cumbersome and costly border procedures, and the region's small markets. Other obstacles are a poor transportation infrastructure, security problems, administrative capacity constraints, as well as national restrictions and exemptions in defiance of the common rules that members have agreed on (Tsangarides and Martijn, 2007).

Compared with other regional unions in sub-Saharan Africa, the common external tariffs implemented by CEMAC member states have been relatively high (e.g. 19 % vs. 12 % for the West African Economic and Monetary Union (WAEMU)). The breakdown of import tariff, for instance, indicates that rates of 23 % or more, on average, are put on footwear, wood products, and agricultural produce that can also be produced domestically. CEMAC tariffs are also more dispersed than those of the WAEMU, which further complicates customs administration and creates price distortions across imported goods. Even though external tariffs remain an important source of fiscal revenue for CEMAC countries, trade liberalization could have a positive impact on economic growth and poverty reduction (Romalis, 2006; Berg and Krueger, 2003). Trade liberalization could also foster development, diversifying exports away from oil and diamonds. Although tariff reductions could be effective in boosting development, measures to compensate for lost tariff revenues may also be needed in order to moderate income risk.

3. Econometric Analysis

Model Specification

We construct our model by assuming that the logarithm of labour income of individual in representative countries *i* employed in sector *j* in time period (year) *t*, $logw_{ijt}$, is given by the standard Mincer (1974) human capital earnings function :

(1) $logw_{ijt} = \beta_{jt} + \alpha_t y_{ijt} + u_{ijt}$.

In equation (1), β_{jt} and α_t denote time-varying coefficients, y_{ijt} is a vector of observable characteristics (such as education, sector,…), and u_{ijt} is the stochastic component of earnings (error terms). Changes in the stochastic component represent individual income changes that are not due to changes in the return to observable worker characteristics. For example, income changes that are caused by an increase in the skill (education) premium are not contained in changes in u_{ijt}. In this sense, changes in u_{ijt} over time measure the unpredictable part of changes in individual income.

We suppose that the stochastic term is the sum of two (unobserved) components, a permanent component γ_{ijt} and transitory component η_{ijt} :

(2) $u_{ijt} = \gamma_{ijt} + \eta_{ijt}$.

Permanent shocks to income are fully persistent in the sense that the permanent component follows a random walk:

(3) $\gamma_{ij,t+1} = \gamma_{ijt} + \varepsilon_{ij,t+1}$.

The innovation terms, $\varepsilon_{ij,t+1}$, are independently distributed over time and identically distributed across individuals, $\varepsilon_{ijt} \sim N(0, \sigma^2_{\varepsilon jc})$, where *c* denotes the CEMAC panel. In this basic specification, transitory shocks have no persistence, that is, the random variables η_{ijt} are independently distributed over time and identically distributed across individuals, $\eta_{ijt} \sim N(0, \sigma^2_{\eta jc})$. Note that the parameters describing the magnitude of both transitory and persistent shocks are assumed to depend on the sector *j* and the CEMAC panel *c*, but do not depend on *t*.

Consider the change in the residual of income of individual *i* between period *t* and *t+n* (we drop the subscript *s* for notational convenience; it is understood that the estimation exercises are conducted separately for each panel):

(4) $\Delta_n u_{ijt} = u_{ij,t+n} - u_{ijt} = \varepsilon_{ij,t+1} + \cdots + \varepsilon_{ij,t+n} + \eta_{ij,t+n} - \eta_{ijt}$.

We have the following expression for the variance of these income changes:

(5) $var[\Delta_n u_{ijt}] = \sigma^2_{\varepsilon j,t=1} + \cdots + \sigma^2_{\varepsilon j,t=n} + \sigma^2_{\eta jt} + \sigma^2_{\eta j,t+n}$.

The parameters $\sigma_{\varepsilon j}^2$ and $\sigma_{\eta j}^2$ are assumed to be constant within the period covered by a single CEMAC panel.

Given this constancy variance, equation (5) can be written as:

(6) $var\left[\Delta_n u_{ijt}\right] = 2\sigma_{\eta j}^2 + n\sigma_{\varepsilon j}^2$.

Thus, the variance of observed *n*-period income changes is a linear function of *n*, where the slope coefficient is equal to $\sigma_{\varepsilon j}^2$. This insight, that the random walk component in income implies a linearly increasing income dispersion over time, is the basis of the estimation method used by several authors. We follow Carroll and Samwick (1998) and estimate the parameters in variance (6) by regressing individual measures of $var\left[\Delta_n u_{ijt}\right]$, the square of the individual deviation from mean income difference over the *n* periods, on *n*. Variance in (6) is estimated independently for each sector and panel. As is well recognized in the literature, the transitory term in the specification of the income process will absorb the measurement error in individual income. Given this and the fact that the welfare effects of transitory shocks to income are much smaller (as we have discussed), we will focus on persistent shocks and their relation to trade.

Estimation Analysis

Our goal in this point is to give methodological framework to estimate parameters measuring income risk and see how changes in these parameters over time (i.e., across panel) may be related to international trade. Estimation of $\sigma_{\varepsilon jc}^2$ and $\sigma_{\eta jc}^2$ will therefore give us sector specific, time varying estimates of transitory and permanent income risk faced by individuals in each CEMAC country. Equation (1) is defined by allowing the fixed effects β_{jt} to vary across sectors, but that the coefficients λ_t and α_t is restricted to be equal across sectors. The latter assumption is made in order to ensure that the number of observations is large compared to the number of parameters to be estimated. However, in addition to specification (1), we also conduct our analysis using alternate specifications. As we have just discussed, mincerian labour income process (1) takes out any changes to income that may have occurred due to changes in returns to observable characteristics. Another possibility is to treat these changes as unpredictable by requiring the coefficients α to be time-invariant within a panel. In this case, estimated income risk will incorporate any changes in the returns to observable characteristics that take place in reality. Which set of estimates to use will depend on whether we think of changes in the coefficients on observable worker characteristics to be predictable or not. While this an interesting conceptual issue, in practice, estimates of the parameters representing income risk do not seem to depend very much on whether the changes in returns to observable characteristics are accounted for by allowing α to be time varying, or not, in estimating (1).

Notice that the inclusion of sector dummies in (1) filters out mean income changes in a sector but also filters out from our measure of individual risk any volatility in the changes of the mean sector earnings. Our risk estimates therefore measure idiosyncratic income risk (effectively individual variation around the sector mean, conditional on the other covariates in (1)) experienced by individuals. Our specification of the labour income process (Equations (1)–(3)) describes shocks to income to be either purely transitory or purely persistent and is in accordance with other empirical work on CEMAC labour income risk. However, this specification does not capture shocks that have duration greater than one (annual) period (i.e., are not purely transitory) but that are also not permanent (i.e., last for a finite amount of time). Estimation of permanent income risk in this case requires us to filter out such shocks of longer duration (Meghir and Pistaferri, 2004). To achieve this, we admit into the specification some Moving Average (MA) terms:

(7 $u_{ijt} = \gamma_{ijt} + \sum_{k=0}^{q} \eta_{ijt-k}$,

with *q* indicating the number of MA terms taking into account. In addition to the benchmark specification where transitory shocks have no persistence ($k = 0$), we consider alternative specifications of the labour income process that allow for transitory shocks that last up to 2 years ($k=2$) and, separately, up to *q* years ($k=q$). We denote the corresponding parameters estimating permanent income risk by $\sigma_{\varepsilon,k=0}^2$, $\sigma_{\varepsilon,k=1}^2$, $\sigma_{\varepsilon,k=2}^2$, …, $\sigma_{\varepsilon,k=q}^2$ respectively. Note that we expect the estimates of permanent income risk to be smaller in magnitude when shocks of shorter duration have been filtered out; that is, we expect $\sigma_{\varepsilon,k=0}^2 > \sigma_{\varepsilon,k=1}^2 > \sigma_{\varepsilon,k=2}^2 > \ldots > \sigma_{\varepsilon,k=q}^2$. But $\sigma_{\varepsilon,k=q}^2$ is our preferred risk estimate because we are interested in permanent income risk and this specification of the labour income process allows us to filter out transitory shocks of greater duration than the additional estimates do.

The relationship between income risk $\sigma^2_{\varepsilon jc}$, export-share in production x_{jc} and import penetration ratio m_{jc}, using a linear regression specification that includes sector fixed effects and time fixed effects is given by :

(8) $\sigma^2_{\varepsilon jc} = \beta_c + \beta_j + \beta_x x_{jc} + \beta_m m_{jc} + v_{jc}$.

In variance equation (8), the inclusion of sector dummies, β_j, in the specification allows us to control for any time invariant sector-specific factors that may affect the level of riskiness of income in that sector. Similarly, the time dummy, β_c, controls for any changes in macroeconomic conditions that affect the level of income risk. While this ensures that our estimation results are not driven by changes in macroeconomic conditions (such as business cycle effects and/or long-run structural changes) unrelated to trade, it also means that identification of the relationship between $\sigma^2_{\varepsilon jc}$, x_{jc}, and m_{jc}, will have to be based on the differential rate of change in export-share and import penetration in production across sectors over time.

Welfare Analysis

It is also possible to make a numerical analysis of the link between income risk and welfare by using a simple dynamic model with incomplete markets and (exclusively) permanent income shocks (see Krebs, 2004; and Krebs, Krishna and Maloney, 2010). We assume a group of ex-ante identical workers with Constant Relative Risk Aversion (CRRA) preferences facing an income process with variance of permanent income risk σ^2_c. Assume that workers are unable to insure themselves against permanent shocks to their labour income (market incompleteness), and that they can only use their own savings to smooth consumption. Consider now an increase in permanent income risk measured by Δ_σ, so that $\sigma^2_{c'} = (1 + \Delta_\sigma)\sigma^2_c$, is the risk to income that they face forever going forward. Therefore, the problem is to determine the welfare effect of this increase in risk, in compensating variation terms.

Following Krebs, Krishna and Maloney (2010), the percent change in consumption Δ_c, in each period and each economy (of the CEMAC), required to compensate the individual for the change in risk Δ_σ is given by :

(9) $\Delta_c = \left\{\frac{1-\kappa(1+\mu)^{1-\gamma}exp\left[0.5\tau(\tau-1)(1+\Delta_\sigma)\sigma^2_\varepsilon\right]}{1-\kappa(1+\mu)^{1-\tau}exp\left[0.5\tau(\tau-1)\sigma^2_\varepsilon\right]}\right\}^{\frac{1}{1-\tau}} - 1, if\ \tau \neq 1$

and $\Delta_c = \left[\frac{\kappa\Delta_\sigma\sigma^2_\varepsilon}{2(1-\kappa)^2}\right] - 1, if\ \tau = 1$;

where κ is the pure discount factor, τ the coefficient of relative risk aversion, μ the mean growth rate of income and σ^2_ε the estimated variance of the permanent component of labour income shocks. The welfare expression (9) has standard properties. With $\tau > 0$, individuals are risk averse and risk is costly. That is, an increase in risk, $\Delta_\sigma > 0$, requires positive compensation, $\Delta_c > 0$, for the individual to be just as well off as before. The magnitude of this compensation is increasing in the degree of risk aversion, τ. Using the percentage change in consumption (9) along with estimates of change in risk associated with trade, Δ_σ, and standard values for the parameters α and τ, we could obtain suggestive estimates of the benefits or costs of trade through the income risk channel. Equation (9) is derived under the assumption that increase in permanent income risk, Δ_σ, associated with the decrease in export share lasts forever. Similarly, specification (8) is a "long-run" specification associating the level of export share with the level of income risk.

The welfare change corresponding to a change in the variance of the permanent income shocks (income risk) for *T* years is given by:

(10) $\Delta_c = \left[\frac{(1-x)(1-x^{T+1})}{(1-x')(1+xx^T)}\right]^{\frac{1}{(\tau-1)}}, if\ \tau \neq 1$ and

$\Delta_c = \left[\frac{\alpha(1-\alpha^T)\Delta_\sigma\sigma^2_\varepsilon}{2(1-\alpha)^2}\right] - 1, if\ \tau = 1;$

where $x = \alpha(1 + \mu)^{1-\gamma}exp(0.5\tau(\tau - 1)\sigma^2_\varepsilon)$ and $x' = \alpha(1 + \mu)^{1-\gamma}exp\left(0.5\tau(\tau - 1)(1 + \Delta_\sigma)\sigma^2_\varepsilon\right)$.

In respect with those developments, we now examine our empirical results by considering CEMAC data.

4. Empirical Results

Macro Level Data

Our empirical work in this paper use panel data. Six countries are concerned; taken together, we have 3 complete panels of 5, 6, and 7 years respectively, spanning a total of 21 years (1993 to 2013). In order to implement the estimation strategy, our data has to meet certain requirements. On the one hand, we need a sufficient amount of variation within each country for each year. On the other hand, it is desirable to have a long time dimension in order to track the relationship of trade openness and income risk for several years. We have two different datasets at our disposal, each of which has its particular advantages. The first dataset is a long-run survey provided by World Bank national accounts data. The second is a sample from CEMAC national accounts data files. Income risk is conceptualized as a deviation of the future income stream from its expectation and defined here as the variance of unpredictable changes in country's earnings. Note that we carefully distinguish between transitory and persistent income shocks. The traditional way in which income risk is decomposed into its transitory and persistent components in the labour economics literature is simply by taking multi-period changes as income and then comparing what these might look over time. Several variables are use to construct this dependent variable: Gross Domestic Product (GDP) (in Local Current Unit (LCU)); gross national income (LCU), previously called gross national product; population, total persons, taken from World Bank staff estimates and various sources; final consumption expenditure; consumer price index (2000 = 100) from the International Monetary Fund and International Financial Statistics; and nominal exchange rates (LCU per US$). The main variable, share of exports (exports of goods and services as percentage of GDP), represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude labour and property income (formerly called factor services) as well as transfer payments. A positive coefficient is anticipated.

The trade openness variable measured as the ratio of exports plus imports to gross domestic product is used in this analysis. Taxes on international trade include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes. Import penetration is simply defined as Imports/(Shipments – exports + imports). Natural resources abundance is measured by exports of oil as % of total exports. Educational attainment refers to gross enrolment of secondary education; it measures the average number of years of secondary schooling and is included in the model to control for the effect of human capital on income risk. The terms of trade effect equals capacity to import less export of goods and services in constant prices. Data are in constant local currency. Lastly, labour productivity = Output/Labour, base year: 1994; aggregated to 2-digit SIC using employment shares as of 1997 as weights. Unfortunately, the coverage of our data is sparse and comes from different sources. The analysis is hampered by severe data limitations: sufficiently detailed recent international macroeconomic data for most exercises in this paper were available for Cameroon, Gabon, and the Central African Republic only. Chad, Equatorial Guinea, and the Republic of Congo reported their latest external trade statistics for 1995. More recent data are available in the Un-Comtrade database, derived from mirror flows (i.e., flows declared by partner countries), but these are partial data, which do not add up to total imports as estimated by the monetary authorities.

Results and Discussions

Using methodology describe in the preceding section who provided us a detailed description of the general econometric framework, we estimate the risk parameters, σ_{ε}^2 and $\sigma_{\eta c}^2$, separately for the three panels and each economic variables in the CEMAC zone. First, table 2 gives us a summary on the main statistics. These summary statistics are calculated at the beginning of each panel, except depreciation in real exchange rate and offshoring intensity. Since this last variable is not available before some years, summary statistics are no computing; but we reported it in regression for one year lags. Table 3 describes the estimates obtained using our benchmark specification, where transitory shocks are purely transitory and have no persistence at all ($\sigma_{\varepsilon,k=0}^2$) as well as when we allow for transitory shocks of longer duration ($\sigma_{\varepsilon,k=1}^2$ and $\sigma_{\varepsilon,k=2}^2$). As indicated in Table 3, the mean value of the annual variance of the persistent shock, $\sigma_{\varepsilon,k=0}^2$, for the 1993-1998 panel is estimated to be 0.0477. For the 1999-2005 and 2006-2013 panels, the corresponding estimates for annually $\sigma_{\varepsilon,k=0}^2$ are 0.0661 and 0.0732, respectively. Notice that the corresponding standard deviations of permanent income growth (computing as $\sigma_{\varepsilon,k=0}^{2\,\frac{1}{2}}$) are 0.218, 0.257 and 0.270.

Clearly, income risk is rising over time: on average, $\sigma^2_{\varepsilon,k=0}$ rose by 3.9 % between the 1993-1998 and 1999-2005 panels and by a further 1.3 % between the 1999-2005 and 2006-2013 panels. In addition, table 3 also reports the summary statistics for the estimates of some values of $\sigma^2_{\varepsilon,k=1}$ and $\sigma^2_{\varepsilon,k=2}$. As expected, allowing for shocks of greater duration, but which are not permanent, lowers our estimates of risk: The mean estimate of the value of $\sigma^2_{\varepsilon,k=1}$ is 0.0028 and 0.0035 for the (beginning date) 1993 and the 1999 panels, respectively. The standard deviations of the reported estimates of $\sigma^2_{\varepsilon,k=1}$ are 0.0529 and 0.0591 these panels, respectively. Other greater details on $\sigma^2_{\varepsilon,k=1}$ and $\sigma^2_{\varepsilon,k=2}$ for each country are given on table 4. We now use these time-varying, sector-specific estimates in conjunction with observations on trade exposure to examine the relationship between income risk, $\sigma^2_{\varepsilon,k=0}$, export-share, x_{jc}, and import penetration m_{jc}. The first potential concern with our estimation of equation (8), which relates trade to income risk, is that export share (or import penetration) may not be fully exogenous to income risk. One possible reason for this is the endogenous choice of trade policies. While the large theoretical and empirical literature on the political economy of trade policy has not directly studied income risk as a determinant of cross-sectional variation in trade policy (Davidson, Magee and Matusz, 2005), it is possible that trade policy, which affects import penetration (or export share), may itself be endogenously determined by income risk in the sector. Consider an "equity" minded government that uses trade policy to reach its goal of equalizing welfare across individuals in this economy. This administration will choose high (low) protection levels for those industries with intrinsically high (low) levels of income risk, in order to say, increase (decrease) the mean level of wages in these industries.

Nevertheless, our fixed-effects estimates of β_m, identified by within-industry variation, will not be biased due to such cross-sectional variation in the determinants of trade policy. But it is also plausible that this (external) economic policy could increase (decrease) protection and lower (raise) import penetration in industries that experience an increase (decrease) in income risk. If this is the case, such endogeneity of policy will bias our estimates of the relationship between income risk and import penetration (β_m) downwards (i.e., towards not finding a positive relationship between trade and risk) and therefore strengthen the results presented in this empirical analysis. In table 5, we estimate two separate regressions described by equation (8), including, separately, export share at the beginning of each panel (i.e., for 1993, 1999 and 2006) and export share lagged one year. For each specification, the dependent variable is income risk measured either by filtering out purely transitory shocks ($\sigma^2_{\varepsilon,k=0}$) or by filtering out transitory shocks that last up to a year ($\sigma^2_{\varepsilon,k=1}$). Since the dependent variable is estimated, we adjust the standard errors for heteroskedasticity using a White correction. We find that export share is significantly associated with income risk in each of the specifications we examine (see table 5). When only purely transitory shocks are filtered out, the coefficient on export share (measured at the beginning of each panel) is estimated to be $\hat{\beta}_X$ = 0.0107. This estimate indicates that an increase in import penetration by 1% of its initial (1993) level would raise $\sigma^2_{\varepsilon,k=0}$ by a little over 0.01%. In the second specification, when transitory shocks of duration up to a year are filtered out, the coefficient estimate is larger, $\hat{\beta}_X$ = 0.020. This corresponds to an increase in $\sigma^2_{\varepsilon,k=1}$ by about 0.93%. Our estimates change very little when we instead include lagged values of export share as the independent variable.

The second potential concern with our estimation of equation (7), which relates trade to income risk, is that export share may not be fully exogenous to income risk. One possible reason for this is the endogenous choice of trade policies. If this is the case, such endogeneity of policy will bias our estimates of the relationship between income risk and export share (β_x) downwards (i.e., towards not finding a positive relationship between trade and risk) and therefore strengthen our results. We consider the importance of that bias and find that this concern is greatly mitigated because some countries characteristics are taken into account by our fixed effects estimation. Our main results reported include both country and year fixed effects in addition to export share. These estimates will be biased if there are time varying country specific factors that are correlated with both income risk and export share simultaneously. We incorporate additional explanatory variables to explore this possibility. Logically, we include import penetration. If the risk faced by individuals employed in the import sector is lower, and importing sectors face lower export competition, then omission of this variable could lead to an overestimation of the coefficient on export competition. Sectors with high levels of final good imports tend to import high levels of intermediate inputs.

Increased imports of intermediate inputs could lead to an increase in income risk due to an increased elasticity of labour demand (Rodrik, 1997). On the other hand, off-shoring could insulate domestic workers from output volatility by shifting the non-core activities of an industry abroad and hence decreasing risk for those who remain (Bergin, Feenstra and Hanson, 2009). To address this issue, we incorporate share of imported intermediate inputs as a measure of off-shoring. Third, we include labour productivity against the possibility that a negative productivity shock in an industry could simultaneously lead to an increase in both export share and in income risk. Finally, omission of union density could bias our estimates if union density changes in response to increased export competition and if higher unionization rates are associated with lower levels of risk. Concerning welfare calculations, results are provided separately for parameter values for the coefficient of risk aversion at $\tau = 1$ and $\tau = 2$ and for durations of $T = 5$, 6 and 7 years. All of the calculations use a discount factor $\alpha = 0.98$. With $\tau = 2$, for our central set of risk estimates with $k = 1$, the increase in persistent income risk associated with a 1 % increase in import penetration is certainty equivalent to a reduction in lifetime consumption in the range of 0.3 % to 0.5 %. On the other hand, with $\tau = 2$ and $k = 0$, the welfare cost is estimated instead to be between 1 % and 2 % reduction in lifetime consumption.

5. Conclusions

We have investigated the effect of trade openness on income risk and how this effect is shaped by the presence of exports share. Trade openness contracts some activities and expands others. The percentage of raw materials export (mainly to Europe and Asia) by CEMAC countries is higher. Apart from Chad, the other five countries derive substantial export earnings from it. Imports are dominated by manufactured goods and come mainly from Europe, Africa and Asia. Intra-Community trade remains at a low level, even as compared with the levels achieved by other economic groupings in Africa. Constraints that are characteristic of central African economies (i.e. small economic size, lack of structural complementarities as manifested in the narrow set of similar low-value primary export products and basic minerals produced, dependence on imports of intermediate and final goods) enable them to expected stable income in long term. The framework developed here for analysis of this question proceeds in three steps. In the first step, macro-level data on countries average incomes is used to estimate the risk to incomes faced by CEMAC economies in time and to decompose this risk into its permanent and temporary components. In the second stage, the variation in trade openness experience of the various economies is used to identify the relationship between income risk and trade openness. In the last stage, a simple dynamic model with incomplete markets is used to calculate the welfare effect of trade policy using estimates of the relationship between trade openness and income risk. Our preliminary findings using CEMAC data are as follows: increase export share and import penetration have a statistically and economically significant effect on labour income risk; the welfare effects of the increased income risk are economically significant. Income risk also appears to be related to exchange rate movements and to movements in the aggregate output. Our finding of economically significant negative effects through the income risk channel does not suggest that the gains from trade are negative overall. It indicates instead that the income risk channel should be considered seriously in exercises evaluating the overall gains from trade.

References

Anderson, E. (2005), Openness and Inequality in Developing Countries: A Review of Theory and Recent Evidence, World Development, 33, 1045-1063.

Berg, A. and Krueger, A. (2003), Trade Growth and Poverty, IMF Working Paper, International Monetary Fund, 03(30).

Bergin, P., Feenstra, R. and Gordon, H. (2009), Offshoring and Volatility: Evidence from Mexico's Maquiladora Industry, American Economic Review, 99(4): 1664-71.

Bhagwati, J. and Srinivasan, T. N. (2001), Outward Orientation and Development: Are The Revisionists Right?, in Lal et. al. (eds), Trade, Development and Political Economy: Essays in Honor of Anne Krueger, London, Palgrave.

Blundell, R., Pistafferi, L. and Preston, I. (2002), Partial Insurance, Information, and Consumption Dynamics, IFS Working Paper, 02/16.

Carroll, C. D. and Samwick, A. A. (1998), How Important Is Precautionary Saving?, The Review of Economics and Statistics, 80(3): 410-419.

Collier, P. and Gunning, J. (1999), Explaining African Economic Performance, Journal of Economic Literature, 37(3), 64-111.

Davidson, C., Magee, C. and Matusz, S. (2005), Trade, Turnover and Tithing, Journal of International Economics, 66(1), 157-176.
Dollar, D. and Kraay, A. (2002), Growth is Good for the Poor, Journal of Economic Growth, 7, 195-225.
Feenstra, R. (2010), Offshoring in the Global Economy: Microeconomic Structure and Macroeconomic Implications, The MIT Press.
Feenstra, R. and Hanson, G. (2002), Global Production and Inequality: A Survey of Trade and Wages, in Choi and Harrigan (eds), Handbook of International Trade, Basil Blackwell.
Hogrefe, J. and Yao, Y. (2012), Offshoring and Labor Income Risk, ZEW Discussion Paper, No 12-025.
Irwin, D. (2002), Free Trade Under Fire, Princeton University Press, Princeton, NJ.
Krebs, T. (2004), Consumption-Based Asset Pricing Models with Incomplete Markets, Journal of Mathematical Economics, 40, 191-206.
Krebs, T., Krishna, P. and Maloney, W. (2010), Trade Policy, Income Risk and Welfare, Review of Economics and Statistics, 92(3): 467-481.
Krishna, P. and Senses, M. (2009), International Trade and Labor Income Risk in the United States, NBER Working Paper, No 14992.
Meghir, C. and Pistaferri, L. (2004), Income Variance Dynamics and Heterogeneity, Econometrica, 72(1), 1–32.
Meschi, E. and Vivarelli, M. (2009), Trade and Income Inequality in Developing Countries, World Development, 37, 287-302.
Milanovic, B. and. Squire, L (2005), Does Tariff Liberalization increase Wage Inequality? Some Empirical Evidence, World Bank Policy Research Working Paper, 3571.
Mincer, J. (1974), Schooling, Experience and Earnings, NBER Press, New York.
Ngeleza, G. K. and Muhammad, A. (2009), Preferential Trade Agreements between the Monetary Community of Central Africa and the European Union, IFPRI Discussion Paper 00859.
Rodrik, D. (1997), Has Globalization Gone Too Far?, Institute for International Economics, Washington, DC.
Romalis, J. (2006), Market Access, Openness and Growth, University of Chicago, in gsbwww.uchicago.edu/fac/john.romalis/research.
Tchakounté, N. M. and Zolo Eyea, A. R. (2011), Commerce International et Emploi Informel en Zone Cemac, African Statistical Journal, 13, 50-81.
Tsangarides, G. C. and Martijn, J. K. (2007), Trade Reform in the CEMAC: Developments and Opportunities, IMF Working Papers, 07/137.

Table 1: CEMAC Exports by Country

Country	Exports	Oil exports as a share of total exports	Diamond exports as a share of total exports
Cameroon	Crude oil, petroleum products, timber, cocoa, aluminum, coffee, cotton	49.60%	-
Chad	Cotton, oil, livestock, textiles	93.31%	-
Central African Republic	Diamonds, timber, cotton, coffee, tobacco	0.38%	50.83%
Congo	Oil, timber, plywood, sugar, cocoa, coffee, diamonds	90.26%	-
Equatorial Guinea	Petroleum, timber, cocoa	94.20%	-
Gabon	Crude oil, timber, manganese, uranium	76.24%	-

Source: Ngeleza and Muhammad (2009).

Table 2: Summary Statistics (Panels) on all Explanatory Variables

	L1	G	D	T1	T2	E1	I	E2	L2	N
1993										
(1)	26.323	5790664.99	-2,05976E+11	1,05752E+11	83.906	80.436	54.986	28.692	425908.678	75.270
(2)	25.606	1647621.74	1,55643E+11	88724504920	17.433	5.580	8.160	10.217	20328.466	20.508
(3)	25.334	3601347.05	-4,91831E+11	0	60.504	72.290	43.614	13.221	391721.541	17.594
(4)	27.041	8119022.6	-16336284672	2,6002E+11	108.303	90.956	72.624	41.417	451746.039	85.614
1999										
(1)	26.402	5802246.32	-1,25107E+11	1,06122E+11	84.200	80.717	55.179	28.793	427399.359	75.533
(2)	25.682	1650916.98	80306166976	89035040687	17.494	5.600	8.188	10.253	20399.616	20.580
(3)	25.410	3608549.75	-2,15667E+11	74320000000	60.716	72.543	43.766	13.267	393092.566	17.656
(4)	27.122	8135260.64	0,000213623	2,6093E+11	108.682	91.274	72.878	41.562	453327.150	85.914
2006										
(1)	26.612	5866071.03	9,11561E+11	1,11534E+11	88.494	84.834	57.993	30.261	449196.726	79.386
(2)	25.887	1669077.07	1,02376E+12	93575827762	18.386	5.886	8.606	10.776	21439.996	21.629
(3)	25.613	3648243.79	-3,2647E+11	82950000000	63.812	76.242	45.999	13.944	413140.287	18.556
(4)	27.339	8224748.51	2,07894E+12	2,74238E+11	114.225	95.929	76.595	43.681	476446.835	90.296

Notes1: L1= Logarithm of real average earning, G= GDP per capita, D= Terms of trade adjustment, T1= Tax on international trade, T2= Trade openness, E1= Export-share in GDP, I= Import penetration ratio, E2= Educational attainment, L2= Labour productivity, N= Natural resources abundant.
Notes2: (1)=Mean, (2)=Standard deviation, (3)=Minimum and (4)=Maximum.

Table 3: Risk Estimates Statistics

	Mean	Median	Standard deviation
1993-1998			
$\sigma^2_{\varepsilon,k=0}$	0.0477	0.0231	0.2184
$\sigma^2_{\varepsilon,k=1}$	0.0028	0.0015	0.0529
$\sigma^2_{\varepsilon,k=2}$	0.0013	0.0014	0.0360
1999-2005			
$\sigma^2_{\varepsilon,k=0}$	0.0661	0.0463	0.2570
$\sigma^2_{\varepsilon,k=1}$	0.0035	0.0022	0.0591
2006-2013			
$\sigma^2_{\varepsilon,k=0}$	0.0732	0.0035	0.2705

Note: Reported mean, median and standard deviations are calculated across point estimates for eighteen 2-digit SIC.

Table 4: Risk Estimates by Country and Panel

	$\sigma^2_{\varepsilon,k=0}$			$\sigma^2_{\varepsilon,k=1}$	
	1993-1998	1999-2005	2006-2013	1993-1998	1999-2005
Cameroon	0.075*** (0.0003)	0.064*** (0.0002)	0.026*** (0.0003)	0.064*** (0.0010)	0.033*** (0.0007)
Central African Republic	0.022*** (0.0002)	0.034*** (0.0002)	0.015*** (0.0003)	0.021** (0.0006)	0.001** (0.0005)
Chad	0.024*** (0.0008)	0.013*** (0.0001)	0.004*** (0.0001)	-0.011*** (0.0002)	-0.001 (0.0004)
Equatorial Guinea	0.013*** (0.0004)	0.002*** (0.0004)	0.002*** (0.0001)	0.014*** (0.0001)	0.005*** (0.0001)
Gabon	0.041*** (0.0003)	0.032*** (0.0004)	0.012*** (0.0005)	0.023*** (0.0001)	0.003*** (0.0001)
Republic of Congo	0.015*** (0.0002)	0.012*** (0.0003)	0.002*** (0.0003)	0.012*** (0.0005)	0.003*** (0.0001)

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: International Trade and Income Risk

	$\sigma^2_{\varepsilon,k=0}$			$\sigma^2_{\varepsilon,k=1}$	
Constant	6.169*** (0.00661)			0.321*** (0.172)	
Logarithm of real average earning	-	0.580*** (0.00324)			-0.408** (0.417)
GDP per capita	-	0.318*** (0.00517)	-0.0706*** (0.0222)	-0.00193** (0.000806)	
Depreciation in real exchange rate	0.0522*** (0.000617			-0.00208** (0.000901)	-0.000937 (0.000966)
Tax on international trade	-0.0984*** (0.00343)		-0.0322 (0.0189)		-0.421*** (0.142)
Trade openness	-	0.00893*** (0.000101)			0.01291** (0.00174)
Export-share in GDP	0.0107** (0.00470)		0.0383 (0.0228)	0.00208** (0.000901)	-
Export-share in GDP (-1)		0.0037** (0.00470)	-	-	0.508** (0.217)
Import penetration ratio	-	0.00849 (0.00677)		-0.000936 (0.000966)	-0.00194** (0.000896)
Educational attainment	-0.0189*** (0.00569)	-	-0.0377 (0.0236)		
Labour productivity	-	-0.0121** (0.00421)	-0.0371 (0.0233)		
Natural resources abundant	0.0280 (0.0248)	-	-0.197 (0.126)		
offshoring intensity (-1)	0.0298 (0.0264)	-	-0.235*** (0.0531)	-0.0721 (0.0602)	
Time effects	-	-	Included	-	Included
Country fixed effects	-	-	Included	-	Included
R squared	0.16	0.17	0.17	0.20	0.22
Number of observations	30	36	42	30	36

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.