

Structural Readiness and Income Upgrading: Evidence from Trade in Value-added

1. Introduction

Economic development is commonly understood as a process of structural transformation, in which economies move from low-productivity activities into more complex and higher value-added forms of production. Early contributions emphasised the reallocation of resources from agriculture to industry (Lewis, 1954; Kuznets, 1966), while more recent work highlights the role of capabilities, diversification, and technological upgrading (Hausmann and Hidalgo, 2011). Despite this progress, policymakers continue to face persistent challenges in identifying:

- when an economy is sufficiently prepared to transition to a more advanced stage of structural transformation, and
- how the economic structures of successful countries evolve over time, in order to determine both where an economy is situated within the development trajectory and which policy strategies are most appropriate at each stage.

These questions are examined in greater detail below. The paper subsequently explores the extent to which Trade in Value-added (TiVA) indicators can contribute to assessing the structural positioning of economies along the development path. In particular, it considers whether such indicators may serve as informative benchmarks, operational targets, or early warning signals, thereby helping to identify not only readiness for economic upgrading but also the types of structural shifts and policy interventions that are most likely to facilitate successful transition.

How can I identify when an economy is structurally prepared to transition to a higher income level?

A large empirical literature has examined the determinants of economic growth and income convergence, often focusing on aggregate indicators such as capital accumulation, human capital, and trade openness (Barro, 1991; Mankiw et al., 1992). Another strand of work uses sectoral composition to track development, emphasising the declining role of agriculture and the rise of manufacturing and services. However, these approaches remain limited in one crucial respect: they provide little information about how production is organised and therefore offer limited guidance on the structural conditions required for upgrading.

Recent advances in the study of global value chains (GVCs) have fundamentally changed how I understand production. As emphasised by Baldwin (2016) and Antràs (2020), production is increasingly fragmented across borders, with different stages of the value chain located in

different countries. In this context, development depends not only on what an economy produces, but also on where it is positioned within global production networks.

Trade in Value-added (TiVA) data provide a way to measure this structure. Following Koopman, Wang, and Li (2014), TiVA decomposes trade flows into their domestic and foreign value-added components, thereby revealing whether countries are:

- participating in downstream assembly activities using imported inputs
- supplying intermediate inputs to other countries (upstream participation)
- developing dense domestic production networks
- or specialising in services embedded in exports

This perspective goes beyond traditional measures of sectoral shares or trade openness and instead provides a direct measure of how economies are embedded in global production. The issue is the extent to which different national economies participate in the process and the value that they extract from it for their domestic economy.

Motivated by this framework, this paper asks:

Can TiVA-based indicators be used as practical guides or targets that signal when countries are structurally prepared to upgrade their income level?

Rather than estimating causal effects, this paper interprets TiVA indicators as diagnostic signals of structural readiness, in the spirit of capability-based approaches to development (Hausmann, Rodrik, and Hidalgo, 2007). I examine whether countries that transition between income groups exhibit distinct patterns of value-added structure prior to upgrading, and whether these patterns differ systematically across stages of development.

Using a panel of countries from 1995 to 2022, I identify transitions between income groups and estimate stage-specific models. I also examine the joint distribution of structural variables using clustering techniques to identify regions of structural space associated with higher upgrade probabilities.

The results reveal a clear and systematic pattern. Structural readiness is stage-specific and sector-dependent. At low-income levels, upgrading is associated with integration into manufacturing value chains and the development of domestic production capacity, consistent with theories of industrialisation. At higher income levels, upgrading is instead linked to the expansion of services value-added, reflecting functional upgrading within global value chains (Baldwin, 2016). In contrast, the intermediate stage between lower-middle and upper-middle income displays more heterogeneous patterns, consistent with the “middle-income trap” literature.

Importantly, I find that upgrading occurs not because countries satisfy a single condition, but because they enter specific regions of the joint distribution of structural indicators. This aligns with recent work on multiple development pathways and the non-linearity of structural transformation (Hausmann and Rodrik, 2003).

This paper contributes to the literature in three ways. First, it bridges the gap between structural transformation theory and GVC-based measurement, providing an empirically grounded framework for identifying structural readiness. Second, it shows that TiVA indicators offer practical, stage-specific benchmarks that can inform policy. Third, it demonstrates that development is best understood as movement within a multidimensional structural space, rather than convergence to a single model.

2. Economic Theory: Structural Readiness in Global Value Chains (with literature)

2.1 Structural transformation and income dynamics

The classical literature on economic development emphasises structural transformation as a shift of resources from low-productivity sectors, particularly agriculture, toward higher-productivity activities in industry and services (Lewis, 1954; Kuznets, 1966). Empirical work has documented the central role of sectoral reallocation in explaining income growth and cross-country differences in productivity (McMillan and Rodrik, 2011).

A related empirical literature focuses on the determinants of income growth and convergence, highlighting the roles of capital accumulation, human capital, and policy variables (Barro, 1991; Mankiw et al., 1992). While these approaches provide important insights into growth dynamics, they offer limited guidance on the structural conditions required for discrete transitions between income groups. In particular, they do not directly identify the production configurations associated with successful upgrading.

2.2 Capabilities, diversification, and structural upgrading

More recent approaches argue that development depends on the accumulation of productive capabilities (Hausmann and Hidalgo, 2011). In this framework, countries do not simply move between sectors; they develop the ability to produce increasingly complex goods. The “product space” literature shows that upgrading depends on whether countries possess capabilities that allow them to move into nearby, more sophisticated activities (Hausmann, Hwang, and Rodrik, 2007).

While this literature provides a powerful conceptual framework, it does not explicitly account for the organisation of production across borders. This approach highlights the importance of structural composition beyond broad sectors, but it focuses primarily on the set of goods

countries export rather than on the organisation of production underlying those exports. As a result, it provides limited insight into how countries participate in global production systems or how value is generated within those systems.

This paper complements this literature by focusing on production structure, rather than product composition, as the relevant dimension of structural readiness, and by providing observable, policy-relevant indicators of this structure.

2.3 Global value chains and the organisation of production

The emergence of global value chains fundamentally alters the nature of structural transformation of national economies. As emphasised by Baldwin (2016), the “second unbundling” of production has separated different stages of production across countries. Antràs (2020) further highlights that firms choose where to locate different activities along the value chain based on costs and capabilities. In this context, development depends not only on participation in trade, but on a country’s position within value chains and its ability to capture value.

To measure these dimensions, recent work has used Trade in Value-added (TiVA) data, which decompose gross trade flows into their domestic and foreign value-added components (Koopman, Wang, and Wei, 2014). These measures have been used to analyse vertical specialisation, GVC participation, and the distribution of value across countries and sectors.

In this setting:

- countries can enter industrial production without mastering the entire production process
- different stages of production generate very different amounts of value-added
- development depends on both participation and position within GVCs

This implies that sector-level analysis is insufficient. Two countries with identical manufacturing shares may differ sharply in reliance on imported inputs, domestic production depth and involvement in high-value activities.

2.4 Contribution of this paper

This paper brings these strands together by using TiVA indicators to operationalise the concept of structural readiness for income upgrading.

It contributes to literature in three ways:

1. It links structural transformation theory with GVC-based measures of production structure, moving beyond sectoral composition toward a richer understanding of how value is created.

2. It complements the capability-based literature by showing that upgrading is associated not only with the products countries export, but also with their position and role within global production networks.
3. It provides an empirical framework in which TiVA indicators can be interpreted as stage-specific, policy-relevant signals or targets, identifying the structural configurations associated with transitions between income groups.

Hypotheses

The framework developed above implies that income upgrading is associated with the emergence of stage-specific structural capabilities, observable through value-added indicators. The descriptive evidence confirms that these capabilities are not only theoretically relevant, but are systematically reflected in the data.

Rather than viewing upgrading as driven by a common set of determinants, this paper conceptualises development as a process in which countries must enter, deepen, and reorganise production structures, increasing the intensity and sophistication of their participation in global value chains.

3.1 Early-stage upgrading: Manufacturing capability and structural intensity

At low levels of income, the primary constraint is entry into productive, tradable activities. Overcoming this constraint requires both:

- integration into manufacturing-based global value chains, and
- the development of domestic production linkages and capacity

The descriptive evidence indicates that countries whose economies are in the process of upgrading are not simply larger, but exhibit more intensive production and trade structures, reflected in higher production and import shares, stronger domestic intermediate linkages, and greater participation in GVCs.

This leads to:

H1 (Early-stage manufacturing capability and structural intensity):

Countries are more likely to transition from low to lower-middle income when they exhibit higher levels of manufacturing-based GVC integration, stronger domestic production depth, and greater intensity of production and trade relative to total economic activity.

Intermediate-stage upgrading: Structural deepening and demand diversification

At the lower-middle income stage, initial industrialisation has largely occurred. The constraint shifts toward sustaining and diversifying growth, requiring:

- stronger links between production and final demand, and
- gradual expansion of services and domestic absorption

The descriptive evidence shows that differences between upgrading and non-upgrading countries are smaller and more diffuse, indicating that no single structural margin dominates.

This leads to:

H2 (Structural deepening and demand diversification):

At lower-middle income levels, upgrading is associated with incremental improvements in demand linkages and services value-added, but no single value-added indicator provides a dominant signal.

3.3 Advanced-stage upgrading: Services-led restructuring and value capture

At upper-middle income levels, the nature of upgrading undergoes a further transition. Consistent with the progression outlined in H1 and H2—from entry, to deepening, to reconfiguration—the binding constraint shifts toward the capacity to generate and retain value within increasingly complex production systems. Further progress is therefore less associated with the expansion of production capacity and more with the functional upgrading and reorganisation of economic activity.

The descriptive evidence identifies a clear stylised fact of economies that successfully transition to high-income status have a higher share of services value added embodied in exports

In contrast to earlier stages, this pattern is not accompanied by a systematic increase in foreign value-added reliance. Instead, it reflects a recomposition of domestic production toward more knowledge-intensive and higher value-added activities, particularly in services. Structural upgrading at this stage is therefore better understood as a shift in the functional positioning of domestic capabilities within global production networks, rather than a continued deepening of participation per se.

This leads to:

H3 (Services-led upgrading and structural repositioning):

Countries are more likely to transition from upper-middle to high income when they exhibit higher levels of services value added embodied in exports, reflecting a shift toward higher value-added activities and enhanced domestic value capture.

3.4 Structural readiness as configurations

Finally, upgrading is not driven by individual variables in isolation, but by the joint presence of complementary structural characteristics.

The descriptive evidence shows that:

- upgrading observations cluster strongly at early and advanced stages
- while intermediate stages exhibit weaker separation

This leads to:

H4 (Configurational structural readiness):

Income upgrading is associated with specific combinations of structural characteristics, with clearly defined high-readiness configurations at early and advanced stages, and more diffuse configurations at intermediate stages.

Table 1: Summary of Hypotheses, Mechanisms, and Empirical Strategy

Hypothesis	Structural mechanism	Key indicators	Empirical model	Expected pattern
H1: Manufacturing capability and structural intensity (L → LM)	Entry into GVCs + development of domestic production capacity and intensification of production structures	Manufacturing FVA; Manufacturing IDC; production and import intensity (sh_PROD, sh_IMGR)	Probit (stage 1); clustering (manufacturing space)	Strong positive coefficients on FVA and IDC; positive role of intensities; clear high-readiness cluster
H2: Structural deepening and demand diversification (LM → UM)	Expansion of demand linkages + gradual structural rebalancing toward services	Final demand value-added (FFD); services VA; export intensity (emerging)	Probit (stage 2); clustering (mixed structural space)	Weak or diffuse coefficients; no dominant margin; limited cluster separation

H3: Services upgrading and GVC repositioning (UM → H)	Functional upgrading + reconfiguration of participation in GVCs toward higher-value activities	Services VA in exports; foreign value-added (FVA); trade intensity (exports/imports)	Probit (stage 3); clustering (services/GVC space)	Strong positive coefficient on services; positive role of FVA; clear high-readiness cluster
H4: Configurational structural readiness	Joint accumulation of complementary structural capabilities	Stage-specific combinations of the above indicators	Clustering (all stages); structural mapping	Strong separation at early and advanced stages; weak separation at intermediate stage

4. Data and Empirical Strategy

4.1 Data

The empirical analysis is based on a balanced panel of countries covering the period 1995–2022, combining macroeconomic indicators with Trade in Value-added (TiVA) measures of production structure. TiVA data provide detailed decompositions of exports and value-added, distinguishing between domestic and foreign contributions and allowing production processes to be mapped across sectors and stages of global value chains.

Consistent with a global value chain (GVC) perspective, economic activity is decomposed into four broad sectors: agriculture, mining, manufacturing, and services. This sectoral disaggregation allows us to distinguish not only between sectors, but also between different forms of participation within sectors, including the use of foreign inputs, the role of domestic intermediate linkages, and the contribution of services to export value.

The dependent variable is a binary indicator,

$$\text{Upgrade}_{i,t+1}$$

equal to one if country i transitions to a higher income group in period $t + 1$, and zero otherwise. Income classifications follow standard World Bank thresholds. By focusing on discrete transitions,

the empirical framework directly targets **income upgrading events**, rather than continuous income growth.

Countries are grouped into three development stages:

- Low income (transition from L → LM)
- Lower-middle income (LM → UM)
- Upper-middle income (UM → H)

All estimations are performed separately for each group. This is critical, as the theoretical framework implies that different structural constraints are binding at different stages of development.

4.2 Measuring structural readiness

To capture structural readiness, this paper constructs a set of TiVA-based indicators corresponding to the mechanisms outlined in Section 3. Importantly, all indicators are expressed either as shares or relative positions, ensuring that the analysis captures differences in production structure rather than absolute economic scale.

(i) Manufacturing integration and production depth (H1)

$FVA_{manuf,i,t}$: foreign value-added embodied in manufacturing exports

$IDC_{manuf,i,t}$: domestic intermediate inputs used in manufacturing production

These variables capture, respectively:

- downstream participation in global value chains (through foreign inputs)
- domestic production depth and internal linkages

(ii) Structural deepening and demand linkages (H2)

$FFD_{i,t}$: final demand value-added

This variable captures the extent to which domestic production is linked to final demand (both domestic and foreign), reflecting the intensity and composition of demand-side linkages.

(iii) Services and functional upgrading (H3)

$SERV_{i,t}$: services value-added embodied in total exports

This measure captures the role of services and intangible activities, which are central to value creation and value capture at higher stages of development.

(iv) Structural intensity and trade integration

To complement value-added measures, this paper includes indicators of production and trade intensity:

sh_PROD_{*i,t*}: production intensity (gross output relative to total activity)

sh_IMGR_{*i,t*}: import intensity

sh_EXGR_{*i,t*}: export intensity

These variables capture:

- the degree of engagement in production systems (production intensity)
- the openness and integration of the economy (trade intensity)

Using intensity-based measures ensures that the analysis reflects how economic activity is organised, rather than differences driven purely by country size.

(v) Normalisation: Relative structural position

All structural variables are transformed into percentile ranks within income groups and years:

$$\tilde{X}_{i,t} = \text{pct}(X_{i,t} \mid \text{income group}, t)$$

This transformation captures a country's relative structural position among peers, rather than its absolute level.

It serves two key purposes:

- ensuring comparability across heterogeneous development stages
- interpreting upgrading as driven by relative readiness within a stage, rather than absolute thresholds

4.3 Empirical specification

4.3.1 Baseline model: Stage-specific probit

To test hypotheses H1–H3, this paper estimates stage-specific probit models of the form:

$$\Pr(\text{Upgrade}_{i,t+1} = 1) = \Phi(\alpha_g + \beta'_g \tilde{X}_{i,t})$$

where:

- $\Phi(\cdot)$ is the standard normal cumulative distribution function
- $\tilde{X}_{i,t}$ is a vector of structural indicators
- $g \in \{L, LM, UM\}$ indexes income group

All models are estimated separately by stage.

Stage-specific specifications

(1) Low income (H1: manufacturing capability and structural intensity)

$$\Pr(\text{Upgrade}_{i,t+1} = 1) = \Phi(\alpha + \beta_1 \widetilde{\text{FVA}}_{\text{manuf},i,t} + \beta_2 \widetilde{\text{IDC}}_{\text{manuf},i,t} + \beta_3 \widetilde{\text{Intensity}}_{i,t})$$

where intensity includes production and import shares.

$$\beta_1 > 0, \beta_2 > 0, \beta_3 > 0$$

(2) Lower-middle income (H2: structural deepening and demand diversification)

$$\Pr(\text{Upgrade}_{i,t+1} = 1) = \Phi(\alpha + \beta_1 \widetilde{\text{FFD}}_{i,t} + \beta_2 \widetilde{\text{IDC}}_{\text{manuf},i,t} + \beta_3 \widetilde{\text{SERV}}_{i,t})$$

$\beta_1 > 0$ (demand effects)

- no single dominant coefficient

(3) Upper-middle income (H3: services upgrading and GVC repositioning)

$$\Pr(\text{Upgrade}_{i,t+1} = 1) = \Phi(\alpha + \beta_1 \widetilde{\text{SERV}}_{i,t} + \beta_2 \widetilde{\text{FFD}}_{i,t} + \beta_3 \widetilde{\text{FVA}}_{i,t})$$

- $\beta_1 > 0$ (dominant)
- $\beta_3 > 0$ (GVC repositioning)

Coefficients are interpreted as structural readiness signals, not causal effects. A positive coefficient indicates that countries positioned higher in the distribution of a given structural characteristic are more likely to upgrade.

4.3.2 Sectoral composition benchmark (H2 comparison)

To assess whether standard structural measures capture similar information, this paper estimates:

$$\Pr(\text{Upgrade}_{i,t+1} = 1) = \Phi(\alpha + \gamma_1 \text{Share}_{\text{ag},i,t} + \gamma_2 \text{Share}_{\text{manuf},i,t} + \gamma_3 \text{Share}_{\text{serv},i,t})$$

This provides a benchmark to evaluate whether **sectoral composition alone** explains upgrading relative to TiVA-based measures.

4.3.3 Structural configurations (H4)

To test the configurational hypothesis, this paper applies k-means clustering to the vector of structural indicators:

$$C_{i,t} = \text{kmeans}(\tilde{X}_{i,t})$$

Clusters are constructed separately for each stage using stage-specific variables.

The following is then estimated:

$$\Pr(\text{Upgrade}_{i,t+1} = 1 \mid C_{i,t} = c)$$

This allows comparison of upgrading probabilities across structural configurations and identification of high-readiness regions in structural space.

4.4 Identification and interpretation

The empirical strategy is designed to characterise structural conditions associated with upgrading, rather than identify causal effects.

Several features support this interpretation:

- Lagged structure: structural indicators are measured at time t , while upgrading occurs at $t + 1$
- Within-stage comparisons: percentile transformations ensure comparisons are made within income groups
- Stage-specific estimation: avoids imposing homogeneous relationships across development levels
- Intensity-based measures: ensure that results capture structural characteristics rather than differences in economic size

5. Descriptive Evidence and Variable Selection

This paper systematically examines the full set of TiVA indicators. Variables are retained based on two criteria: (i) systematic variation across income groups, and (ii) ability to distinguish upgrading from non-upgrading countries.

5.1 Structural transformation across income groups

This paper begins by examining how key indicators of production structure vary across income groups. To avoid conflating structural differences with scale effects, all indicators are expressed as shares or intensities relative to total activity. This allows us to focus on composition and organisation of production, rather than absolute size.

Table 2. Structural Characteristics Across Income Groups

Variable	Low Income	Lower-Middle	Upper-Middle	High Income
Foreign VA share (FVA)	16.5	20.0	22.8	26.0
Domestic VA share (DVA)	83.5	80.0	77.2	74.0
Domestic intermediate share (IDC)	23.5	25.9	28.9	26.5
Services VA in exports	28.2	33.5	36.2	41.3
Final demand VA (FFD)	23.5	24.3	27.7	33.0
Production intensity (sh_PROD_T)	182.0	195.4	203.4	205.3
Import intensity (sh_IMGR_T)	34.4	36.3	38.1	44.0
Export intensity (sh_EXGR_T)	29.0	31.9	38.0	48.7

Global value chain integration

The share of foreign value-added increases steadily with income, while domestic value-added declines. This confirms a clear pattern of deepening integration into global value chains, where production becomes increasingly dependent on cross-border inputs.

Domestic production and structural complexity

Domestic intermediate use rises from low to upper-middle income levels before stabilising. This reflects a process of production deepening, in which countries develop more complex internal linkages before potentially specialising at higher income levels.

Importantly, production intensity (sh_PROD_T) also rises steadily across income groups, indicating that richer countries do not simply produce more, but exhibit more production relative to final demand, consistent with more complex production systems.

Trade intensity and openness

Both import and export intensities increase monotonically with income. Import intensity rises particularly strongly at higher income levels, while export intensity increases sharply between lower-middle- and high-income groups. This reflects a transition from limited outward participation toward highly open, trade-intensive economies.

Services-led upgrading

The share of services value-added in exports exhibits one of the strongest monotonic patterns. This provides clear evidence that functional upgrading toward services and intangible activities is a defining feature of higher income levels.

Final demand and structural rebalancing

Final demand value-added increases gradually, with a stronger rise at higher income levels. This suggests that development is associated with a shift toward demand-driven and consumption-based structures, complementing production-side changes.

5.2 Structural differences within income groups

This paper next examines whether these indicators distinguish countries that upgrade from those that do not, within each stage of development.

Table 3. Panel A: Low Income (L → LM)

Variable	Non-upgraders	Upgraders
Production intensity (sh_PROD_T)	180.6	197.7
Import intensity (sh_IMGR_T)	34.3	35.2
Export intensity (sh_EXGR_T)	29.0	28.7
Domestic intermediate share (IDC)	23.2	26.8

Foreign VA share (FVA)	16.2	19.1
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At low income levels, upgrading countries exhibit higher production intensity and stronger domestic intermediate linkages. They also have higher foreign value-added shares, indicating greater participation in global value chains.

In contrast to absolute production measures, the differences in intensities show that upgrading is not simply driven by scale, but by more intensive and integrated production structures. This supports the idea that early-stage upgrading depends on both integration and domestic production capacity, consistent with H1.

Table 4. Panel B: Lower-Middle Income (LM → UM)

Variable	Non-upgraders	Upgraders
Production intensity (sh_PROD_T)	195.0	202.7
Import intensity (sh_IMGR_T)	36.3	35.8
Export intensity (sh_EXGR_T)	31.7	34.4
Final demand (FFD)	24.2	26.3
Services VA in exports	33.3	35.9

At the intermediate stage, differences between countries who transition from lower-middle to upper-middle, and those who are remaining stagnant in lower-middle, are relatively modest. Upgrading countries exhibit slightly higher export intensity, final demand, and services value-added embodied in exports, but no single dimension stands out.

This confirms that this stage is characterised by diffuse structural conditions, where upgrading depends on incremental improvements across multiple margins rather than a single dominant factor.

Table 5. Panel C: Upper-Middle Income (UM → H)

Variable	Non-upgraders	Upgraders
Production intensity (sh_PROD_T)	203.1	208.7
Import intensity (sh_IMGR_T)	37.6	46.0
Export intensity (sh_EXGR_T)	37.6	44.4

Foreign VA share (FVA)	22.6	26.6
Services VA in exports	36.0	39.6
Final demand (FFD)	27.5	30.7

At upper-middle income levels, strong differences re-emerge.

Upgrading countries exhibit substantially higher import and export intensities, indicating deeper integration into global trade. They also have higher foreign value-added shares, suggesting more intensive participation in international production networks.

At the same time, upgrading is associated with higher services value-added in exports and stronger final demand linkages. This indicates a shift toward value capture and demand-driven growth.

Importantly, these patterns suggest that upgrading at this stage reflects not a reduction in external dependence, but a reconfiguration of global integration, consistent with more specialised and higher-value roles within global value chains.

5.3 Variable selection

The descriptive evidence provides a clear basis for selecting variables for the empirical analysis.

This paper retains indicators that:

1. Vary systematically across income groups
2. Distinguish upgrading from non-upgrading countries within groups
3. Capture structurally meaningful dimensions of production, avoiding pure scale effects

This leads to a core set of variables:

- Foreign value-added (FVA): GVC integration
- Domestic intermediate inputs (IDC): production depth
- Services value-added (SERV_DVA): functional upgrading
- Final demand value-added (FFD): demand linkages
- Import and export intensities (sh_IMGR, sh_EXGR): trade integration
- Production intensity (sh_PROD): structural capacity

These variables jointly capture the key dimensions of structural transformation: integration, production organisation, value composition, and demand structure, and form the basis of the empirical analysis.

6.1 Structural readiness and upgrading: Stage-specific evidence

This paper begins by estimating the stage-specific probit models described in Section 4. Table 1 reports the baseline results linking value-added indicators to income upgrading across development stages. All specifications use percentile-transformed variables, so coefficients capture the effect of a higher relative structural position within each income group.

Table 6. Structural Readiness and Income Upgrading (Probit Estimates)

(Dependent variable: Upgrade at $t+1$)

Variable	(1) L → LM	(2) LM → UM	(3) UM → H
Manufacturing FVA	1.26** (0.52)	—	—
Manufacturing IDC	1.79*** (0.56)	—	—
Final Demand (FFD)	—	1.50*** (0.55)	1.18** (0.51)
Services VA	—	1.03** (0.40)	1.13*** (0.39)
Import intensity	—	-1.26** (0.49)	—
Constant	-3.28***	-2.34***	-3.05***
Observations	226	483	465
Pseudo R ²	0.103	0.051	0.073

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

6.1.1 Low income: Manufacturing capability and early-stage upgrading (H1)

At low levels of income, upgrading is strongly associated with manufacturing-based structural capabilities. Both measures of manufacturing readiness enter positively and are statistically significant.

The coefficient on manufacturing foreign value-added (FVA) is 1.26 ($p = 0.016$), while domestic intermediate use in manufacturing (IDC) is 1.79 ($p = 0.001$). These results indicate that lower-income countries on an upward trajectory are positioned higher in the distribution of

manufacturing integration and production depth are significantly more likely to transition to lower-middle income.

Importantly, these effects are obtained using relative (percentile) measures, confirming that upgrading is not driven by economic size, but by how production is organised. Countries that combine participation in global value chains with stronger domestic supply linkages exhibit a clear structural advantage.

Model fit is relatively strong compared to other stages (Pseudo $R^2 = 0.10$), and additional variables such as services or agriculture are not significant when included. This indicates that early-stage upgrading is sector-specific, driven by capabilities in tradable manufacturing rather than broader structural conditions.

Overall, these findings provide strong support for H1: early development hinges on the joint emergence of global integration and domestic production capacity within manufacturing.

6.1.2 Lower-middle income: Structural deepening and demand diversification (H2)

At the lower-middle income stage, the structure of results changes markedly. While upgrading remains associated with structural indicators, the pattern becomes more complex and less concentrated on a single margin.

Both final demand value-added (FFD) and services value-added enter positively and significantly. The coefficient on FFD is 1.50 ($p = 0.006$), indicating that stronger linkages between production and final demand are associated with upgrading. Services value-added is also positive and significant (1.03, $p = 0.010$), suggesting an emerging role for services activities.

At the same time, import intensity enters with a negative and significant coefficient (-1.26, $p = 0.011$). This indicates that excessive reliance on imported inputs, without corresponding domestic upgrading, may act as a constraint at intermediate stages.

Despite these effects, overall explanatory power remains modest (Pseudo $R^2 = 0.05$), and alternative specifications show that no single variable consistently dominates. This confirms that upgrading at this stage is associated with incremental improvements across multiple dimensions, rather than a single structural threshold.

These findings align closely with H2. They suggest that the lower-middle income stage is characterised by structural deepening and rebalancing, where demand conditions, services expansion, and production structure interact, but no single factor is decisive.

6.1.3 Upper-middle income: Services and functional upgrading (H3)

At upper-middle income levels, a clearer pattern re-emerges. Upgrading to high income is strongly associated with services value-added in exports and, to a lesser extent, final demand.

Services value-added is the strongest and most robust predictor in the entire analysis, with a coefficient of 1.13 ($p = 0.003$). Final demand also remains positive and significant (1.18, $p = 0.021$), indicating the importance of both value creation and demand-side expansion.

In contrast, manufacturing variables are no longer significant when included, confirming that traditional industrial capabilities are no longer the binding constraint at this stage.

Model fit improves relative to the lower-middle income stage (Pseudo $R^2 = 0.073$), indicating a clearer structural signal.

These results provide strong support for H3. They show that upgrading at advanced stages is driven by functional upgrading, reflected in the increasing role of services embedded in exports. Rather than expanding production volumes, successful countries shift toward higher-value activities within global value chains.

6.2 Sectoral composition versus value-added structure

To assess whether traditional sectoral indicators capture similar dynamics, Table 2 reports results using sectoral shares.

Across all stages, sectoral composition provides limited explanatory power compared to value-added indicators. At low income levels, sectoral shares are not statistically significant and generate substantially weaker model fit. While some patterns emerge at higher income levels—particularly the negative role of agriculture—these effects remain less consistent and less informative.

The key limitation of sectoral measures is that they cannot distinguish between different modes of participation within sectors. For example, manufacturing can range from low-value assembly to complex production, and services can be final consumption activities or high-value inputs embedded in exports.

The TiVA-based measures used in this paper capture these differences directly. The results therefore support H2 in a broader sense: structural readiness depends on how production is organised within sectors, rather than on sectoral composition alone.

6.3 Structural configurations and upgrading (H4)

This paper next examines whether upgrading depends on combinations of structural characteristics. Table 3 reports upgrade rates across clusters defined by stage-specific indicators.

At the low-income level, clusters show strong separation. Countries in the high-readiness cluster exhibit an upgrade rate of 18.1%, compared to 2–5% in other clusters. This implies that countries with favourable combinations of manufacturing integration and domestic production depth are several times more likely to upgrade.

At the lower-middle income stage, cluster differences are minimal, with upgrade rates ranging between 4% and 6%. This confirms the regression results: structural conditions are more diffuse, and no single configuration dominates.

At the upper-middle income stage, strong separation reappears. The highest-readiness cluster exhibits an upgrade rate above 9%, compared to near-zero rates in the lowest-readiness group. This indicates that specific structural configurations—particularly those involving services upgrading—are strongly associated with high-income transitions.

These findings provide strong support for H4. They demonstrate that upgrading depends not on individual variables alone, but on combinations of complementary structural characteristics, and that these configurations are most clearly defined at early and advanced stages.

6.4 Structural readiness in continuous space

Across all stages, upgrading does not occur at fixed thresholds. Instead, upgrading observations are more likely to be found in specific regions of the structural distribution:

- manufacturing-intensive regions at low income
- diffuse, overlapping regions at lower-middle income
- services-intensive regions at upper-middle income

This pattern indicates that structural variables operate by shifting probabilities, rather than deterministically.

6.5 Synthesis

Taken together, the results strongly support the stage-specific framework.

- H1: Early-stage upgrading is driven by manufacturing integration and domestic production capacity
- H2: Intermediate-stage upgrading reflects diffuse structural deepening, with no single dominant driver
- H3: Advanced-stage upgrading is driven by services-based functional upgrading and value capture
- H4: Upgrading depends on configurations of complementary structural characteristics

More broadly, the evidence shows that structural readiness is:

- stage-specific, reflecting changing constraints
- multidimensional, involving production, demand, and value composition

- relative, depending on position within structural distributions rather than absolute levels

This supports a view of development as a process of progressive restructuring within global value chains, rather than simple expansion of output or sectoral shifts.

7. Natural Resources, Structural Readiness, and Upgrading

7.1 Resource dependence and upgrading across stages

This paper now examines whether natural resource dependence is associated with lower probabilities of income upgrading. To do so, the baseline stage-specific models is augmented with a measure of resource intensity based on mining-related value-added.

Table 7. Resource Dependence and Income Upgrading

(Dependent variable: Upgrade at $t+1$)

Variable	(1) L → LM	(2) LM → UM	(3) UM → H
Manufacturing FVA	1.73*** (0.58)	—	—
Manufacturing IDC	2.35*** (0.62)	—	—
Final Demand (FFD)	—	0.49 (0.37)	1.24*** (0.43)
Services VA	—	0.63* (0.37)	0.76* (0.41)
Resource share	-1.16 (0.57)	-0.08 (0.36)	-0.84 (0.41)
Constant	-3.24***	-2.17***	-2.39***
Observations	226	483	465
Pseudo R ²	0.138	0.019	0.095

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

At low-income levels, resource intensity is negatively and significantly associated with upgrading (coefficient = -1.16, $p = 0.04$). This indicates that countries more specialised in extractive activities are less likely to transition into lower-middle income status.

At upper-middle income levels, a similar negative effect re-emerges (-0.84, $p = 0.04$), suggesting that resource dependence also constrains transitions into high-income status.

7.2 Resource dependence and structural mechanisms

Now the question is not just whether resource dependence affects not only the likelihood of upgrading, but also the mechanisms through which structural upgrading occurs.

To test this estimate interaction models at the low-income stage.

Table 8. *Resource Dependence and Manufacturing Capability (Interactions, Low Income)*

Variable	Coefficient
Manufacturing FVA	5.09*** (1.70)
Manufacturing IDC	5.03*** (1.58)
Resource share	4.67 (2.88)
FVA × Resource share	-5.31 (2.52)
IDC × Resource share	-4.22* (2.45)
Constant	-6.83*** (1.86)
Observations	226
Pseudo R ²	0.188

While both manufacturing integration (FVA) and domestic production depth (IDC) remain strongly associated with upgrading, their effectiveness declines sharply as resource dependence increases. In particular, the interaction between FVA and resource share is negative and statistically significant (-5.31, $p = 0.035$), indicating that participation in global value chains translates less effectively into upgrading in resource-intensive economies.

A similar (though weaker) pattern emerges for domestic production depth.

These findings suggest that the resource curse operates not only by reducing upgrading probabilities, but by weakening the structural channels through which upgrading occurs, particularly those linked to manufacturing and global value chain participation.

7.3 Alternative pathways: Evidence from split-sample analysis

To further investigate these mechanisms, we compare upgrading determinants between resource-rich and resource-poor countries at low-income levels.

Table 9. *Structural Determinants by Resource Endowment (Low Income)*

Variable	Resource-poor	Resource-rich
Manufacturing FVA	1.51** (0.66)	2.05 (1.75)
Manufacturing IDC	1.77*** (0.65)	2.58** (1.20)
Constant	-3.32***	-3.62***
Observations	132	94
Pseudo R ²	0.136	0.116

The split-sample results provide a clear picture of diverging development pathways.

Among resource-poor countries, upgrading is strongly associated with both manufacturing integration and domestic production depth. This corresponds to the standard industrialisation pathway, where participation in global value chains and domestic linkages reinforce each other.

In contrast, among resource-rich countries, the role of manufacturing integration becomes weaker and statistically insignificant, while domestic production depth remains positive and significant. Importantly, no alternative structural variables—including final demand, services, or trade intensity—emerge as robust predictors of upgrading.

This indicates that resource-rich economies do not follow a distinct alternative pathway, but rather experience a weakening of the conventional one. In particular, they are less able to translate global value chain participation into upgrading outcomes.

7.4 Marginal effects and structural responsiveness

To further quantify these differences, the marginal effects are computed by resource endowment.

Table 10. *Key Marginal Effects (Low Income)*

Variable	Non-resource	Resource-rich
FVA (marginal effect)	0.225**	0.111 (n.s.)
IDC (marginal effect)	0.264***	0.215*

The marginal effects confirm a clear asymmetry:

- The impact of manufacturing FVA on upgrading is substantially stronger in non-resource economies
- In resource-rich countries, this effect is weaker and not statistically significant
- By contrast, domestic production depth remains relevant in both groups

This reinforces the conclusion that external integration into global value chains is less effective as a pathway to development in resource-dependent economies, whereas internal production capabilities continue to matter.

8. Conclusion and Policy Implications

This paper has examined whether Trade in Value-added (TiVA) indicators can be used to identify the structural conditions associated with income upgrading. By focusing on discrete transitions between different income groups and analysing value-added structures across sectors and stages of development, it develops a novel empirical framework for measuring structural readiness in a global value chain context.

The results provide a clear and consistent picture of development as a stage-specific process of structural transformation, rather than a uniform path driven by common determinants.

Three central findings emerge.

First, structural readiness is inherently stage-specific. At low levels of income, upgrading depends on the emergence of manufacturing-based capabilities, combining integration into global value chains with the development of domestic production linkages. At advanced stages, the drivers of upgrading shift decisively toward services and value capture, reflecting functional upgrading within global production networks. Between these stages, the relationship between structure and upgrading becomes more diffuse, consistent with the idea that middle-income transitions are characterised by multiple, interacting constraints.

Second, value-added indicators provide a fundamentally richer characterization of structural transformation than traditional sectoral measures. While sectoral shares capture broad shifts in economic composition, they fail to reflect how production is organised within sectors - particularly the distinction between low- and high-value activities, the role of imported inputs, and the contribution of services embedded in exports. By contrast, TiVA-based measures capture these dimensions directly and generate stronger and more consistent signals of upgrading potential.

Third, upgrading is a configurational process rather than a marginal one. Countries do not transition to higher income levels simply by focusing on a single dimension, but by achieving specific combinations of structural characteristics. These configurations are most clearly defined

at early and advanced stages, where constraints are more tightly specified. They become more diffuse at intermediate stages.

Taken together, these findings suggest a reinterpretation of development as movement within a multidimensional structural space shaped by global production linkages. Progress depends not on convergence toward a single model, but on the alignment of structural characteristics with the requirements of each stage of development.

Policy implications

The results carry important implications for development policy.

First, they suggest that economic development policy should be explicitly stage-contingent. Strategies that are effective at one level of development may be ineffective—or even counterproductive—at another. In particular:

- At low-income levels, the priority is to establish manufacturing capability, combining participation in global value chains with the development of domestic production linkages.
- At intermediate stages, policy should focus on strengthening demand linkages and structural diversification, recognising that no single margin is sufficient to drive upgrading.
- At higher income levels, the emphasis shifts toward services, intangibles, and value capture, supporting the transition to more knowledge-intensive and coordinated roles within global value chains.

Second, the results highlight that the manner in which countries integrate into global value chains matters more than whether they integrate. In early stages, integration facilitates learning and capability formation. In later stages, continued upgrading requires repositioning toward higher-value segments, rather than disengagement from global production networks.

Third, TiVA-based indicators provide a practical tool for policymakers to diagnose structural constraints and benchmark progress relative to peer economies. Because the analysis is based on relative (percentile) measures, it allows countries to identify whether they are lagging or leading along key structural dimensions, without relying on arbitrary thresholds.

Importantly, these indicators should be interpreted as probabilistic signals rather than policy targets. Improving structural characteristics increases the likelihood of upgrading, but does not guarantee it, as outcomes also depend on institutional, macroeconomic, and external conditions.

Implications for future research

More broadly, the framework developed in this paper opens new avenues for research on development and structural transformation. In particular, it suggests that future work should move beyond static measures of sectoral composition and instead focus on:

- the organisation of production within global value chains,
- the interaction between structural dimensions across stages, and
- the dynamic evolution of structural positions over time.

Understanding how countries move within this structural space—and how policy can influence that movement—remains a central challenge for development economics.