Thirlwall's Law and Krugman's 45-degree Rule: Mathematically Identical, Mutually Exclusive

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Abstract
Thirlwall's Law and the 45-degree rule, originally formulated by Krugman, are radically different interpretations of the same statistical regularity. This statistical regularity is that a country's long-run growth rate will approximate to the ratio of that country's export growth to its import elasticity of demand. Thirlwall's Law falls under a Post-Keynesian framework which is primarily a demand-side model. The 45-degree rule relies on a supply-side interpretation, a result of its neoclassical origins. This thesis seeks to answer two questions. The first is, are the members of the Post-Keynesian and neoclassical communities working on each of these theories aware of the work being done by the other community? The second is if they are aware of each other, why have they not collaborated on research given that their interpretations are derived from exactly the same mathematical models?

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Thirlwall's Law is a Post-Keynesian model originally conceived as a means of explaining the differences in growth rates of developed countries in the post-World War II time period. It is primarily Post-Keynesians who are interested in the continued development, and the implications, of using this Law (also known as the Balance of Payments Constrained Growth Theory). This model is quite well known by Post-Keynesians, but remains a relatively obscure theory outside of this relatively small circle of economists. Much of the stabilizing theoretical work performed on this model after its initial publication in Thirlwall (1979) is by Thirlwall (1986) and McCombie (1986, 1992). Thirlwall and McCombie managed to successfully frame the model as a demand-side analysis with help from comments by McGregor and Swales (1985, 1986, 1991), who, while not overtly hostile to the model, advocated a more supply-side approach. Thirlwall's Law has been shown to be empirically accurate by its proponents, following primarily on the work of Bairam (see for example Bairam, 1988, 1993) and Atesoglu (see for example, Atesoglu 1993), who at the time employed time-series econometric techniques over many years to consistently reinforce its accuracy. Other economists, such as Thirlwall and Hussain (1982), Hussain (1999), and Moreno-Brid (1999b) have applied the findings of Thirlwall's Law to developing countries in a practical sense.

Similar work to that being done by the Post-Keynesians with Thirlwall's Law is being performed on the side of mainstream economic thought. Krugman (1989) arrives at exactly the same mathematical model as did Thirlwall ten years prior, based off of Houthakker and Magee's(1969) work on income elasticities. Krugman's 45-degree rule is a theory that describes the income elasticities observed by Houthakker and Magee (1969) as misinterpreted supply effects that are able to allow fast growing countries to continue their rapid growth without any secular depreciation in their currencies. The basic argument given by Krugman is that his 45-
degree rule is explained by fast growing countries being more able to produce a large variety of export goods to match a range of tastes. This increasing variety of export goods allows for a fast growing country to maintain the same level of aggregate demand in the world even as its goods become more expensive.

Krugman's model finds support from a number of economists. Caporale and Chui (1999) support the existence of the 45-degree rule as an empirical regularity using advanced econometrics, but question Krugman's assertion that the 45-degree rule is best explained by the new theory of trade (Caporale and Chui 1999, pg 255). Funke and Ruhwedel (2001) use econometric methods to test whether increased product differentiation matters for determining a country's growth rate, and find conclusive proof in favor of Krugman's model of product differentiation. Gagnon (2007), in analyzing the growth of imports in the US from US trade partners, agrees with Krugman's conclusion of the new trade theory being the best explanation for causing the 45-degree rule. Schatz (1989), in a comment on Krugman's (1989) article, argues for the viability of the classical trade model of comparative advantage, and that Krugman is being careless in his exploration of the proposed 45-degree rule. Iwata (1989), in a comment on Krugman (1989) shows cautious acceptance of the model, but asks for improvements to be made, particularly in including intertemporal trade. Wu (2008) generalizes and expands Krugman's 45-degree rule, comparing it against a 45-degree rule where intertemporal trade exists, and finds support for Krugman's 45-degree rule. Gagnon (2007) points out other economists who had already been aware of the "varieties effect" that Krugman had settled on, such as Sato (1977).

Strangely, these two communities (the Post-Keynesians and Mainstream economists) appear to be relatively unaware of each other. The Post-Keynesians have noted, and commented on Krugman's (1989) initial work in Thirlwall (1991), without response. The acknowledgment
by the core group of proponents of Thirlwall's Law of the mainstream work being performed
seems to be limited to Thirlwall's article on Krugman's paper. The mainstream economists have
not addressed Thirlwall's Law with the exception of Wu (2008), who in a footnote mentions that
the mathematical formula given by Krugman to calculate a country's growth based on its
elasticities is identical to that of Thirlwall's Law, with different interpretations of the cause-and-
effect arguments in these models.

The objective of this thesis is to show that even though these two communities appear to
be unaware of each other, the more likely explanation is that there is very little interaction
between the communities because there is little basis for discussion due to methodological
differences. I will establish this first in an historical manner, framing Thirlwall's Law and the 45-
degree rule within the broader continuum of work done on growth and trade theory. In this
section I will also establish that the same original issue from which Thirlwall's Law stems is also
the basis for a tradition of neoclassical work examining the same issues as Thirlwall's Law, but
under a different methodology. Following this, I will conduct a brief overview of the research
done by Houthakker and Magee (1969) on income and price elasticities in world trade, the
original work from which Thirlwall's Law and the 45-degree rule stem. The model specification
for Thirlwall's Law and the Harrod Foreign Trade Multiplier, from which it is derived, and some
early theoretical controversies will be outlined next. The manner in which mainstream
economists have been attempting to deal with the results of Houthakker and Magee, and some
mainstream criticisms of this work, will be presented, and will be followed by a synthesis of the
Post-Keynesian view and the mainstream view. This will be supported by a more applied usage
of each model to more thoroughly show the implications that each model would have in a
simplified form of the real world.
Because the research associated with Thirlwall's (1979) originating work in which he coined his law, and Krugman's treatment of Houthakker and Magee's work with elasticities, is conducted by scholars who appear to be largely unaware of each other, some effort will be made to connect them theoretically through intermediaries. The works of McGregor and Swales (1985, 1989, 1991) will be key to this as being some of the only neoclassical criticisms leveled at Thirlwall's Law. In these criticisms, and Thirlwall's (1985), McCombie's (1986, 1992), and others' responses to them (such as Bairam's 1988, 1990, and 1993 papers, and Bairam and Dempster's (1991) empirical work), the theoretical basis for Thirlwall's Law as a solidly Post-Keynesian, demand-driven model is reinforced.

I will establish that the models are largely incompatible because of differences of interpretation of causation even though mathematically they are exactly the same. At its most basic level, the Post-Keynesian interpretation assumes that demand is the driving force in economic growth, with supply reacting passively to changes in demand. From this the Post-Keynesians see that the income elasticity of demand effects observed in Houthakker and Magee are directly acting upon the economy, driving its economic growth. The neoclassical approach assumes that supply – particularly the growth of factors of production – is responsible for economic growth, and that demand will passively shift to accommodate increasing or decreasing supply. From this they dismiss the notion that the income elasticities of demand could be acting directly on the economy, instead arguing for these income effects being misinterpreted supply effects, and further exploration of the model is to determine what these supply effects are. If these two communities do not wish to relax these most basic assumptions around which they
have constructed their models, there will be little reason for them to acknowledge each other.¹

Section 2: Historical Background

Prior to the 1970s growth theory experienced a significant amount of research interest from the mainstream. Harrod (1939) and Domar (1946) produced groundbreaking work in Keynesian growth theory analysis, and following the development of neoclassical economics, Solow (1956) and Swann (1956) worked to bring Harrod and Domar's work under the scope of neoclassical economic thought. Solow and Swann's publications essentially became the basis for mainstream growth theory research in the post WWII period.

Mainstream growth theory fell out of favor as a research subject starting in the 70's. It faced numerous problems with becoming too complex and becoming too distant from the real world, unable to be used for empirical modeling in comparison to the much simpler and much more effective models that development economists were using. Mainstream growth theory additionally fell out of favor because of its inability to explain long-run growth without breaking key assumptions at the same time as macroeconomists began to focus much more on short-run business cycles rather than long-term economic stability.

Following this dearth of research, mainstream growth theory experienced a resurgence of interest with the development of Endogenous Growth Theory by Romer (1986). Endogenous Growth Theory avoids the pitfalls of earlier mainstream growth theory by relaxing the assumptions, particularly the assumption of perfect competition, that made growth theory too rigid to incorporate technological change as an endogenous variable while avoiding a complete theoretical breakdown in interpretation of the model.

¹ An exception to this is that there does exist an attempt to generalize Thirlwall's Law and the 45-degree rule into a spectrum of models of international competitiveness by Blecker (1998), with Thirlwall's Law and the 45-degree rule being opposite ends of this spectrum. However, this paper has had almost no impact within either community, and as a result can be considered outside the scope of the general paradigm of both communities.
In the gap that developed in the evolution of mainstream growth theory in the 1970's and early 80's is when we see the development of a fringe economic growth theory by A. P. Thirlwall (1979). Examining the work done by Houthakker and Magee (1969) on price and income elasticities of developed countries, he developed the model that would become known as "Thirlwall's Law," or the Balance of Payments Constrained Growth Theory. Since its inception it has been argued by Thirlwall, McCombie, and others that the ratio of the income elasticity of demand for imports vs. the income elasticity of demand for exports of any given country can be used as an accurate and robust predictor for the long-run growth rates between nations.

The work done by Houthakker and Magee has been a motivating factor for more than just Thirlwall. Krugman (1989) draws attention to the supposed paradox of the results at which Houthakker and Magee had arrived, and coins his 45-degree rule. Krugman's 45-degree rule is an interpretation that argues that the correlation between economic growth rates and income elasticities is not actually caused by income effects. That is, other effects are being misinterpreted as the income effects shown in the income elasticities of demand. In this case, it is posited that a rapidly growing country's capability to maintain an ever-expanding array of export goods is the misinterpreted effect. Much later, Gagnon (2007) shows that Krugman was not the first to notice this paradox citing studies that have found similar results in Sato (1977), and traces a tradition of working with the "Elasticities Approach" all the way back to Leamer and Stern (1970).

The economists working with Thirlwall's Law are aware of Krugman's 45-degree rule (Thirlwall, 1991), which they cite frequently, but there is little evidence that they are concerned with the continued work on Houthakker and Magee's paradox by mainstream economists. There is little evidence that these mainstream economists, with the exception of Wu (2008, pg. 670)
who mentions Thirlwall's Law in a footnote, are concerned with the work being done by economists supportive of Thirlwall's Law, or their criticisms of mainstream economic models.

Section 3: Houthakker and Magee's Income Elasticities

Houthakker and Magee's research was at the forefront of interest in the importance of income elasticities of demand with relation to trade. Previously, price elasticities of demand had been regarded as much more important than income elasticities of demand. Around this time it was realized that income elasticities of demand could also play a potentially significant role in altering trade balances between nations. The main purpose of their work is to calculate income and price elasticities for a number of developed countries between 1951 and 1966 (Houthakker and Magee, pg. 111).

Their findings show that the income elasticities of demand for exports and imports for many countries are extremely similar, which is the expected finding. A country whose income elasticities of demand for imports and exports are similar will be able to maintain its standard of living by growing at a rate similar to that of the rest of the world, which will result in maintaining a fixed exchange rate. Britain and Japan are cited as two outliers – Japan, according to their estimates, has an income elasticity of demand for its exports that is almost three times that of its income elasticity of demand for imports (Ibid., pg. 114), and Britain is calculated as having an income elasticity of demand for exports at approximately one half the value of its income elasticity of demand for imports (Ibid., pg. 115). Theoretically, if relative prices and exchange rates were held constant, Japan's income would be able to grow at three times the rate of the rest of the world's income without its imports getting out of line of its exports, whereas Britain's income would only be able to grow at half the rate of the rest of the world if it wanted to maintain its exchange rate. They posit that these discrepancies between the income elasticities of
demand for imports and exports are at least partially behind Japan's phenomenal rate of growth over the previous years, and the declining value of Britain's currency.

Section 4: Model

Thirlwall's Law is based off of the above findings of Houthakker and Magee: it reflects the idea that the ratio of a country's income elasticity of demand for exports to its income elasticity of demand for imports can serve as an accurate approximation to the country's long-term growth rate. The model is derived from the Harrod Foreign Trade Multiplier which claims that a country's level of income is determined by its volume of exports if it is not fundamentally resource-constrained, and is given by the following equation (McCombie, 1985, pg. 55):

\[ GDP = (1/m)X \]

Where \( m \) is the marginal propensity to import, and \( X \) is the total quantity of exports.

Thirlwall's Law operates under the following basic assumptions, and is a dynamic specification of the above Harrod Foreign Trade Multiplier:

1. Foreign and domestic prices are the same, measured in common currency.
2. Demand equations contain as arguments only relative prices and real income.
3. Imports are not supply constrained.
4. A country's current account is in balance.

The end form of the model, Thirlwall's Law, is produced below:

\[ y = x/\pi \]

Where \( x \) represents the rate of growth of export volume, and \( \pi \) represents the domestic income elasticity of demand for imports. The process of moving from the Harrod Foreign Trade Multiplier to Thirlwall's law is reproduced below from McGregor and Swales, 1985. This is to provide a reference for criticism of the model detailed later, which will refer back to specific
equational forms.

\[(2) \quad p_d + x = p_f + m + e\]

Where all variables are measured as percent changes,
- \(p\) represents prices
- \(m\) represents the volume of imports
- \(e\) represents the domestic price of foreign currency,
- \(d\) and \(f\) subscripts refer to the domestic and foreign economies respectively.

The conditions of equation 2 must hold for the balance of payments equilibrium growth rate \((y_B)\). As this is in equilibrium, the rate of growth of the value of exports must equal the rate of growth of the value of imports.

The demand functions for exports and imports are assumed to take a multiplicative form, with relative prices and foreign income (for exports) and national income (for imports) as arguments. Therefore:

\[(3) \quad x = \eta(p_d - p_f - e) + \epsilon z\]

\[(4) \quad m = \psi(p_f + e - p_d) + \pi y\]

\( \eta \) and \( \psi \) represent the price elasticity of demand for exports and imports \((\eta, \psi < 0)\)
- \(\epsilon\) and \(\pi\) represent the income elasticity of demand for exports and imports
- \(z\) and \(y\) represent the growth in foreign and domestic real income respectively.

If equations 3 and 4 are substituted into Equation 2, we find the balanced trade domestic growth rate \((y_B)\) is given by the equation:

\[(5) \quad y_B = ((1 + \eta + \psi)(p_d - p_f - e) + \epsilon z) / \pi\]

In order to derive Equation 1 from Equations 3 and 5, it is necessary to argue both that:

\[(6) \quad p_d - p_f - e = 0\]

so that:

\[(7) \quad y_B = \epsilon z / \pi = x / \pi\]

and that:

\[(8) \quad y = y_B\]

Thirlwall’s original form of this theory was for use solely with developed countries based off of the original dataset provided by Houthakker and Magee, but considerable work has been done since to expand this theory in terms of scope and accuracy. Application of the theory to developing countries, as well as an extended model of Thirlwall’s Law that relaxes the assumptions of constant relative prices and no capital flows, was produced jointly by Thirlwall and Hussain (1982). This extended model takes the form of:

\[(9) \quad y_B = [(1 + \Theta \eta + \psi)(p_d - e - p_f) + \Theta \epsilon z + \pi(k - p_d)] / \pi\]

\(\Theta\) is defined as the proportion of the total import bill financed by export earnings, such that \(\Theta = P_dX(P_dX + K)\)
\( \tau \) is defined as the proportion of the total import bill financed by capital flows, such that \( \tau = K/(P_{e}X + K) \)

The basic premise of the theory is that a country will be constrained by its balance of payments. That is, there is an equilibrium rate of growth, based upon whether a country's exports are growing faster than its imports, at which a country is able to grow indefinitely. A different way of looking at this would be to shift some terms around in (7) to arrive at:

\[
\frac{y_{B}z}{\pi} = \frac{\varepsilon}{\pi}
\]

where the ratio of domestic growth to world growth equals the ratio of the income elasticity of demand for exports to the income elasticity of demand for exports. The implication here is that a country's income level will increase in relation to the world's income level based on its propensity to export versus its propensity to import. As an example, a country that has an income elasticity of demand for exports that is twice as large as its income elasticity of demand for imports will be able to grow up to twice as fast as the rest of the world without breaking its balance of payments constraint and requiring other economic effects (such as capital inflows or real currency depreciation) to maintain its growth. Conversely, a country with an income elasticity of demand for exports that is half as large as its income elasticity of demand for imports will only be able to grow at half the rate of the rest of the world without requiring other economic effects to maintain its growth.

Also note that by the extended model if a country has a steady inflow of foreign capital, it is capable of growing at a rate exceeding its balance of payments constraint. If the capital inflows do not exist, or cannot be maintained indefinitely, eventually real domestic growth of income will deteriorate to bring growth of imports in line with growth of exports. It is also possible that a country may grow slower than its balance of payments constraint for various
reasons. A desire to acquire foreign capital, or being fundamentally resource constrained such that productive growth cannot match the balance of payments constraint (as in the case of Japan) are two such cases (McCombie, 1989). The difference between this model and the Harrod Foreign Trade Multiplier is that Harrod's model provides the level of income at any given time based off an absolute quantity of exports and marginal propensity to import, whereas Thirlwall's Law provides the percent change in a country's income from one time period to the next given a percent change in exports, imports, or both.

This model ran into considerable controversy in its early stages when McGregor and Swales questioned many aspects of its formulation from a neoclassical perspective. These issues of model specification, validity of assumptions, and empirical problems were then worked through by McGregor and Swales (1985, 1986, 1991), Thirlwall (1985), and McCombie (1986, 1992).

Expansions by Atesoglu (1997), Moreno-Brid (1998-99, 2003), and later Alleyne and Francis (2008) to improve the accuracy of the model, especially with relation to developing countries, have been added over time following in the footsteps of Hussain and Thirlwall (1982). These expansions have been made to explain the importance of monetary flows to developing countries, which often have debt problems that affect growth in ways not measurable by the original model. Interest rate payments on debt have been added to show the major slowdown effect debt can have on an economy. Capital inflows have been added to show the importance of foreign funds in promoting growth, especially if a country's current account does not balance. Capital inflows often contribute significantly to a country's debt as well. Net transfers, in particular to model remittances, have been included as a particular subset of debt-free capital inflows that are critical to many developing nations' economies.
Section 5. The 45-Degree Rule

The 45-degree rule is also derived from Houthakker and Magee's research, and is taken to be an empirical regularity – that is, there should be the expectation that there will be a correlation between higher growth rates and higher relative export to import levels in a given country. If graphed, this data would result in most countries being clustered around the 45-degree line starting from the origin, hence the name of the empirical regularity. It is, however, taken that this empirical regularity is not directly a result of income effects. Supply effects being misinterpreted as income effects through the income elasticities of demand are instead argued to be the primary cause of this regularity.

First, to give mathematical support to the argument of the existence of the 45-degree rule, Krugman frames the significance of income elasticities off of partial equilibrium analysis of trade flows, described as the “workhorse of practical trade balance analysis (Krugman, 1032).” Because this is viewed by Krugman as a trade problem and not a growth problem, partial equilibrium analysis is an appropriate tool to use here. It is not the most complex tool available, but it is a good approximation of trade flows.

He begins by asking us to consider a two-country world, defined as follows:

\[ y, y^* \text{ are the domestic and foreign real output} \]
\[ p, p^* \text{ are the prices in local currency of these outputs} \]
\[ e \text{ is the price of foreign currency in terms of domestic} \]
\[ r = e p^* / p \text{ is the real exchange rate, which is the price of foreign relative to domestic goods.} \]
\[ x \text{ is export volume} \]
\[ m \text{ is import volume} \]

The standard trade balance model is as follows:

Export volume depends on foreign output and the relative price of domestic goods:

\[ (11) \quad x = x(y^*, r) \]
Import volume depends on domestic income and the relative price of imports:

\[ m = m(y, r) \]

The trade balance (in domestic currency):

\[ B = px - ep^* m = p(x - rm) \]

So the trade balance in terms of domestic output is:

\[ b = x - rm \]

Krugman cites Johnson (1958) to claim that if the above framework is "a reasonable description of trade balance determination" then a country will experience secular changes in its real exchange rate as a result of economic growth (Krugman, 1033). He presents another model to establish this case, defined as follows:

\[ \xi \] is the income elasticity of demand for exports
\[ \xi_m \] is the income elasticity of demand for imports
\[ \epsilon_x \] is the price elasticity of demand for exports
\[ \epsilon_m \] is the price elasticity of demand for imports
\[ \dot{y} \] is the rate of growth of domestic output, i.e. \((dy/df)/y\)
\[ \dot{y}^* \] is the rate of growth of foreign output
\[ \hat{r} \] is the rate of real depreciation

Differentiating (4) above we get:

\[ \frac{db}{dt} = x[\xi \dot{y}^* + \epsilon_x \hat{r}] - rm[\xi_m \dot{y} + (1- \epsilon_m)\hat{r}] \]

Suppose that initial \( b = 0 \), so that \( x = rm \). Then in order to keep a zero trade balance, we must have:

\[ \xi \dot{y}^* - \xi_m \dot{y} + (\epsilon_x + \epsilon_m - 1)\hat{r} = 0 \]

This implies a trend in the real exchange rate of:

\[ \hat{r} = \frac{[\xi \dot{y}^* - \xi_m \dot{y}]}{(\epsilon_x + \epsilon_m - 1)} \]

More generally, there will be a trend in the real exchange rate unless:

\[ \frac{\xi}{\xi_m} = \frac{\dot{y}^*/\dot{y}}{1} \]

which we would imagine unlikely by a typical analysis that expects secular depreciation of currency as a result of higher growth rates.

Yet in a controversial assertion supported by other economists over time, Krugman, standing on the shoulders of Houthakker and Magee, claims the elasticities of demand and growth rates do match up like this. However, because Krugman claims that these income effects are actually caused by misinterpreted supply effects, the explanatory value of this mathematical

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1 If we multiply both sides of (16) by \( \dot{y}^* \), we arrive at \( \dot{y} = \dot{y}^* \xi/\xi_m \). This is mathematically identical to Thirlwall's Law, (7) \( \ddot{y} = \epsilon \ddot{x}/\ddot{x} = x/\pi \).
model outside of claiming an empirical regularity is dubious under the given assumptions. The nature of these supply effects, and the implications for world economies of this theory will be discussed later due to the uncertain mathematical explanatory power of this model.

Section 6. Theoretical Irregularities of Thirlwall's Law

The assumptions under which this model has been formulated have drawn criticism for being unclear, inappropriate, or unsupported by available economic theory. Lack of supply constraints on imports makes this theory incompatible with neoclassical thought, though it is argued that there is no basis for making this assumption. The exact nature of how foreign and domestic prices remain the same when measured in a common currency has been called into question. That the demand equations contain only relative prices and real income as arguments is regarded as too aggregative for a trade model. The arguments for these criticisms, and responses, are detailed below.

A. “The Law of One Price” Debate

In formulating the assumption that foreign and domestic prices remain the same when measured in common currency (equation 6), Thirlwall has a few explanations. He originally uses the term “Law of One Price,” to refer to one mechanism by which this happens. Alternatively, he posits that depreciation of a country’s exchange rate could increase domestic prices to equilibrium (Thirlwall, 1979, p. 184). A third option is given by McGregor and Swales as having been sent to them by private correspondence, that relative prices might remain unchanged under oligopolistic competition (McGregor and Swales, 1985, p. 20).

Describing this mechanism as the Law of One Price indicated to McGregor and Swales that the model was operating under neoclassical assumptions. The Law of One Price, as clarified by McGregor and Swales, is the mechanism by which a small, open economy operates under
perfect competition with a world market. The small, open economy does not have the sheer trade capability to influence international markets, and therefore is a price taker for both imports and exports. This, however, assumes that nations are supply-constrained, and that the income elasticities of demand for imports and exports are infinite – a rather absurd notion given the specification of Thirlwall's Law (McGregor and Swales, 1985, p. 21).

The argument that relative prices remain unchanged under oligopolistic competition is regarded as rational, but has little connection with Thirlwall's Law. Because producers in an oligopolistic market compete over non-price factors, the model is argued to imply that oligopolistic producers have a fixed market share because the model only accounts for market pricing. The lack of any terms to represent non-price competition in an oligopolistic market reduces the model's explanatory power if this is taken to be the mechanism by which relative prices are maintained (McGregor and Swales, 1985, p 22).

B. Sticky Prices

Thirlwall responds to these initial criticisms by acknowledging that the strict definition of the Law of One Price is not compatible with his model. He claims his usage of the term “Law of One Price” was a loose generalization to refer to “sticky” international prices. His usage of the term “law of one price” was not meant to be understood that the model is consistent with a “small, open economy, neoclassical model.” He clarifies his position to being that the “law of one price,” when used in his earlier writing (Thirlwall 1979), should be taken to mean that it is not unrealistic for a decrease in domestic prices to be matched by foreign competitors, or that oligopolistic competition produces “sticky” international prices through non-price competition.

In response to the comment by McGregor and Swales that there is nothing in the model to represent non-price competition, Thirwall argues that the entire model is built around non-price
competition as a determinant for demand. He states that if the world market were perfectly
competitive, an export demand function would be inappropriate, and income would not have
been an independent variable. It is because his specification does not apply to small open
economy, one world price assumptions that it can be claimed that non-price competitive factors
are captured in the income elasticity of demand for exports. (Thirlwall 1986, Pg. 1260).
(McGregor and Swales, 1986, p. 1266)

Addressing McGregor and Swales’ criticisms of the model based on direction of causality
and the Law of One Price, McCombie argues that Thirlwall’s Law implies correlation between
growth of exports and income, but says nothing about causation. Causation needs to be
determined separately of the regression analysis by other empirical factors. He draws upon the
work of Cornwall (1977) as evidence, who argues that causation is in the direction of growth of
exports contributing to a growth in income. Capital accumulation is a result of expected growth
of output, and as a result is endogenous. Additionally, “given the lack of any factor supply
constraint,” it seems more plausible that growth of income is determined by growth of exports
working through the dynamic Hicks’ super multiplier. (McCombie 1989, pg. 612-613)

In response to McGregor and Swales’ claim that the lack of variation of relative price is
consistent with the neoclassical interpretation of the “law of one price,” McCombie argues that
under the neoclassical interpretation there can be no balance of payments. Price elasticities of
demand for exports and imports are assumed to be infinite under the neoclassical interpretation,
leaving relative prices to be the fundamental determinants of export and import growth. Price
mechanisms will then ensure that expansion of exports to pay for additional imports will always
be possible without any change in income. By McCombie’s view, it is then a question of
empirics to determine whether the neoclassical interpretation of the Law of One Price, or
oligopolistic pricing, is responsible for determining the nature of the economic system (McCombie 1989, pg. 613).

McCombie goes on to cite several previous studies that characterize the Law of One Price as being "systematically and flagrantly violated by empirical data," and shows support for oligopolistic pricing as the underlying nature of the economic system. The income elasticities of demand, according to several additional studies he cites, are clearly less than infinity, which contradicts the neoclassical assumption of infinite income elasticities of demand for imports and exports under the Law of One Price.

McGregor and Swales take umbrage at being accused of launching a neoclassical attack on Thirlwall’s Law by attempting to force the model into using the neoclassical Law of One Price. The Law of One Price was originally used as terminology by Thirlwall, and one of the purposes of McGregor and Swales (1985) was to illustrate the analytical problems associated with the usage of this law in the model. They agree that the shift from the Law of One Price to "sticky" oligopolistic pricing is an improvement for the internal consistency of the model, but believe more work needs to be done on the model. (McGregor and Swales 1991, pg 16)

McCombie (1989) and Thirlwall (1986) clarify that non-price competition, while not included in the model, is picked up and included in the income elasticity of demand. However, "It seems almost inconceivable that relative export non-price competitiveness would depend only on world income," write McGregor and Swales. Doing so involves bunching in the supply responses of firms, as well as some factor regarding the profitability of exporting. Overall, this turns into the reduced form of a supply and demand system rather than an export demand function if the coefficient on world income is taken to be the weighted sum of the $\epsilon_i$ terms for individual industries.
In addition to all of this, McGregor and Swales are not impressed with McCombie's argument that the very fact that Thirlwall's Law is accurate for a majority of the countries in the sample means it is capturing changes in market shares. The arguments against are that highly aggregative time series data tends to give high $R^2$ terms, and income is highly trended. Because of this, the coefficient on the income term could by unreliable due to a combination of other factors being bunched in (McGregor and Swales, 1991, Pg. 17).

C. Difficulties in Theoretical Interpretation

Based on the model, if non-price competition were contained in the income elasticities of demand, there are two main problems with interpretation vis a vis supply-side or demand-side constraints (McGregor and Swales, 1986, p. 1269). This is if we take the following equation to be a valid model for a country's market share in a certain industry, as derived from Thirlwall's Law:

\[ s_i = c_i q_i \]

where $s_i$ is a country's market share for a specific good in the world market, and $q_i$ is the growth of that market (McGregor and Swales, 1986, p. 1268).

A critical point to note here with their analysis is that the $c_i$ terms are not choice variables. The $c_i$ terms are taken to be interpreted as a country's capability to compete through non-price competition in a specific market. A very strong positive value for a given $c_i$ means that the country in question has very strong capability for competing in a market, whereas a negative $c_i$ term means that even with an expanding market the country is losing competitive ability, and therefore market share.

The veracity of this equation is taken to be necessary for the overall functioning of the model if non-price competition is the means of maintaining sticky prices. The first problem here is that Thirlwall's theory requires that the relationship between the change in a country's share of
the world market for a particular good, and the growth of that market, must be linear and homogeneous. If this requirement is satisfied, then it implies that, given a static world market for this good, there will be no change in an individual country’s market share for this good.

The second problem is that it is unclear what manner of mechanism would support the above equation. McGregor and Swales believe that the model most likely to be able to explain such a relation incorporates supply side processes as an important driving factor. Their argument is that industries devote resources to non-price competition commensurate with the rate of growth of a specific market. They will then compete the most vigorously in the most rapidly expanding markets. But, seeing as the \( c \) terms are driven by supply considerations with demand passively reacting to purchase the best designed product on the market, it is difficult to make the case that Thirlwall’s Law is demand driven.

This model was originally formulated as a demand-constrained, neo-Keynesian growth model, as has been mentioned. This is supported in the assumptions by imports not being supply constrained, but it is argued that, barring this assumption (which is viewed as unnecessary), there is no reason for this theory to not be extreme neoclassical, or anything in between the two extremes.

There is no supply side to the model, labor and capital supply functions are absent. However, supply conditions are not taken to be irrelevant for the model as it might seem even though the model is primarily demand driven.

This may be seen by considering the fact that the growth of income is also given as \( \varepsilon_2/\pi \), where \( \varepsilon \) is the rest of the world’s income elasticity of demand for the country’s exports, and \( z \) is the growth of the rest of the world’s income (i.e. \( x = \varepsilon z \)). The estimated values of \( \varepsilon \) and \( \pi \) show considerable variation between countries and this reflects differences in various aspects of non-price competition – the quality, reliability etc., of manufactured goods.” (McCombie 1989, pg. 611)
These are non-price competitive supply aspects that are critical factors of a country’s growth rate in comparison to the rest of the world. In contrast, whereas non-price factors contribute significantly to a country’s growth, variations in price measured in a common currency have had very little impact on the growth of exports of a given country during the post-war period. In addition, McCombie also states that, “the closeness of fit between $y$ and $y_B$ suggests that, for most countries, the growth of capital flows were also of limited importance in circumventing the balance of payments constraint.”

For McGregor and Swales, the question of the interpretation of Thirlwall’s Law is still unresolved. The work done by McCombie and Thirlwall up to this point does not sway them from their point that one does not necessarily need to adopt a strictly neoclassical or Keynesian view for the model to function. They respond on three points. First, addressing McCombie and Thirlwall’s objections that in a small, open-economy neoclassical model the income variable should not be significant in an export demand function, they claim that while “permanent income” is more important to a neoclassical interpretation, Thirlwall’s model is incapable of distinguishing between the theories.

Second, as we had seen earlier, McCombie shows that estimates for elasticities of exports are significantly less than infinity. The fallacy here is that the values produced show that trade is affected by changes in relative price – something Thirlwall and McCombie do not allow for as part of the interpretation of the model.

Third, there is the continuing assertion from defenders of the theory that the model is not supply constrained, rendering it incompatible with neoclassical thought.

Section 7. Mainstream Approach to Houthakker and Magee

A. Krugman’s Theoretical Explanation
Mainstream economists approach the data given by the income elasticities found by Houthakker and Magee as a trade issue. This data requires a new look from theorists because, according to Krugman (1989), and supported by others (Gagnon 2007) it can only be explained with difficulty by classical trade theories such as comparative advantage. These theories have the expectation that, given differences in income elasticities and growth rates between countries, faster growing countries would need to steadily depreciate their currencies to maintain their export growth and thus maintain the same income elasticity of demand for exports. The findings of Houthakker and Magee run counter to this, instead showing that countries that face a higher income elasticity of demand for exports tend to grow faster while being able to maintain their exchange rates.

Krugman dismisses the notion that income effects (and thereby the income elasticities themselves), and by extension, balance of payments problems could be the cause of a country's slow economic growth, or accelerated economic growth, over the long term. The balance of payments would have relatively little effect on closed economies, like the US in the 50's and 60's, the time-frame from which the data is drawn.

Given that the income elasticities themselves could not (by his logic) be causing these growth disparities, he moves to examining supply-side effects for a possible cause. First he considers the research of Bhagwati (1958, 1961) and Johnson (1958). When countries are not specializing in export goods the trends in their real exchange rates will be ambiguous. A higher proportion of export goods being produced will likely require a secular depreciation of the currency to maintain the same terms of trade, whereas a higher proportion of import-substitution goods may increase the terms of trade. While it has some explanatory power, this theory is rejected for its inability to consistently explain why there are no secular trends in the exchange
rates of fast growing countries. "[...] the 45-degree rule could happen, but there is no particular reason why it should." (Krugman 1989, pg. 1038)

He dismisses the commonly held trade theory of comparative advantage being an incentive for trade. If comparative advantage was an accurate theory for trade, then developed countries would trade based on differences in productive capacity. But, developed economies are developed because they have similar economic structures, and thereby are capable of producing essentially the same goods. He instead moves to the new theory of trade, where the argument for trade between similar countries is a result of "arbitrary" specialization not motivated by comparative advantage but by increasing returns (Krugman 1989, pg. 1039).

Given his dismissal of income related effects and traditional trade theory models based on competitive advantage, he lays out a theory of how supply-side effects could produce the strange effects detailed by Houthakker and Magee. In exploration of the means by which countries like Japan have been able to continue to expand exports without seeing a secular depreciating trend in their real exchange rate, Krugman posits that increasing product differentiation is a likely supply-side mechanism (Krugman 1989, Pg. 1039). A country exporting goods cheaply should face a real appreciation of their currency as increased national income increases the domestic price level. He tries to explain the lack of a real appreciation of currency as a result of a fast growing country being better able to expand its range of exported products to a broader range of tastes than a slower growing country. As a result, the 45-degree rule applies for fast growing countries because they are better able to increase aggregate demand for their products as their domestic price level increases with an increasingly large range of exports. No secular trend in real exchange rate would be present in this case because aggregate demand and aggregate supply would be increasing at nearly the same rate, maintaining the exchange rate even as the domestic
price level increases.

B. Validity of Krugman's 45-degree Rule

Schatz (1989, pg. 1051) takes issue with Krugman's claim that the 45-degree rule is an empirical regularity. First, he believes the issue at hand – that of adjustments (or lack thereof) in the real exchange rate as a result of changes in a country's trade balance – has already been dealt with. The condition isn't that a fast growing country's currency must depreciate if the country wishes to increase its exports, it is that it depends on the difference between the country's growth rate and the ratio of its income elasticities of demand. If a country's growth rate is greater than its ratio of income elasticities then it must depreciate its currency to maintain its growth rate, but if the country's growth rate is equal to, or less than the ratio of its income elasticities, it will experience no change or an appreciation in its currency, respectively. It is unclear to Schatz because of this reason why Krugman comes to the conclusion that a fast growing country's currency must necessarily depreciate if the country wishes to increase exports.

As for empirical evidence, Schatz believes Krugman is deriving his evidence based on outliers alone. Schatz argues that Japan, the U.S., and the U.K., which are important to many of Krugman's points due to their significance as examples of fast- or slow-growing countries, are simply outliers that have skewed Krugman's perception. By removing these three countries from the country sample he cuts down the overall fit of the regression from an $R^2$ term of 0.754 in Krugman's analysis to 0.05. Without these three countries to form significant endpoints for the dataset, the rest of the countries form a cluster that has no significant relation with a 45-degree line. Because of this lack of empirical relation between the non-outlier countries and the 45-degree rule, Schatz feels that Krugman is taking the 45-degree rule for granted.

In Schatz' opinion, taking the 45-degree rule for granted provokes Krugman to search for
a trade theory that would support the 45-degree rule in all cases. It is for this reason that Krugman chooses against using traditional trade theory; as Krugman says, there is no specific reason why traditional trade theory should cause the 45-degree rule (Krugman 1989, pg. 1038). Yet Schatz provides evidence (though he neglects to cite his source) of the terms of trade for industrial countries changing significantly over the period from 1955 to 1965 and the period from 1970 to 1986 (Schatz 1989, pg. 1053). The implication of these terms of trade adjustments is that there will be significant deviations from the 45-degree rule over time (Schatz 1989, pg. 1054).

Caporale and Chui (1999), though uncertain of Krugman's results at first due to what they consider unsatisfactory estimation of the long-run elasticities, find empirical support for the 45-degree rule to exist. They estimate the income elasticities of 21 countries over the period 1960-92 using two different methods. These methods, due to more recent research into econometric methods, avoid many of the now-recognizable biases that were present in standard practice methods of Krugman (1989) and other literature around the same time period (Caporale and Chui 1999, pg. 256). Using the first method, fourteen of the tested countries show very accurate approximation to the 45-degree rule. The seven outliers are distributed relatively evenly above and below the 45-degree line when graphed, implying no general trend deviating from the 45-degree rule (Caporale and Chui 1999, pg. 260). The second method shows much better grouping of the tested countries around the 45-degree line, with only one real outlier, but also shows some small bias for countries having a greater elasticity ratio than growth ratio. That is, most (17) of the countries tested lie slightly above the 45-degree line that would represent equality between the elasticity ratio and growth ratio (Caporale and Chui, pg. 261).

The cause of the 45-degree rule is outside the scope of their paper, but they question
Krugman’s theory as being unsubstantiated.

Funke and Ruhwedel (2001) and Gagnon (2007) supply the support that was missing from Caporale and Chui’s (1999) evidence. By examining direct measures of export varieties for 10 East Asian economies, Funke and Ruhwedel were able to show with a high degree of significance that faster growth and increasing product differentiation are correlated.

Gagnon takes a different approach than Funke and Ruhwedel to arrive at a similar conclusion. By examining US imports from many of the US’ trading partners, he is able to find more empirical support for correlation between increased growth rates and increased product differentiation.

C. A Generalized Model With Intertemporal Trade

Iwata (1989) stops short of Schatz’ outright criticism of Krugman’s methods, instead thinking of them as an interesting exploration of supply effects that are currently lacking in support. Iwata’s most important point is the suggestion to attempt to model an expansion Krugman’s 45-degree rule that includes intertemporal allocation of consumption. Doing so, he feels, would help the model to explicitly define investment allocation between developed countries, and the effects of capital account shocks on trade flows (Iwata, pg. 1048).

Wu (2008), in considering this question, formulates a generalized version of Krugman’s 45-degree rule. Wu’s model expands on Krugman’s earlier model by allowing for price effects, trade imbalances, and intertemporal trade (Wu 2008, pp. 656). Because Wu suspects that intertemporal trade has only a partial effect on the observed income elasticities, he performs his tests twice with two new model specifications. One specification does not allow for intertemporal trade, while the other assumes that any intertemporal trade will have a full effect on the observed income elasticities. By setting these two specifications as the test baselines, Wu
can then get an idea of where the actual results of his analysis will fall without testing every
different model specification.

In testing, Wu first finds that Krugman's original model shows statistically significant
results. Having shown that the basic model is valid, Wu tests the two model specifications he
has created, with and without intertemporal trade. It is found that while both new models show
the relationship between the income elasticities of demand and growth rates, the intertemporal
trade model consistently produces a regression slope that is less than unity. Because of this, the
model without intertemporal trade is considered a more accurate model due to data that is more
consistent with the given economic theory. This finding supports Krugman's model against the
comments of Iwata (1989).

Section 8: Contrasting Thirlwall's Law and Krugman's 45-Degree Rule

The theoretical basis for Thirlwall's Law and the 45-degree rule have been established,
but what about the actual usage of the models? According to the empirical evidence, the models
have some amount of explanatory power. The mechanisms through which these models work,
particularly the factors that would cause slower or faster growth relative to the rest of the world
will be discussed for each model. An overview of the empirical evidence will then be provided
to show the validity of these mechanisms, and how they may differ in countries based on their
varying economic statuses.

A. Thirlwall's Law

Before jumping into the specific mechanisms that will cause a country to grow at a faster
or slower rate than the world according to Thirlwall's Law, let us consider again the basic model
and some general implications for the model.

\[ y_B = \frac{\varepsilon}{\pi} = \frac{x}{\pi} \]
As can be seen from the given variables, with the two major deterministic variables being income elasticities of demand, Thirlwall's Law is a demand-driven model, with supply passively responding to any change in demand. Growth of world income is not necessarily a variable, though it is an important deterministic factor. Given that this is a long-run model concerned with average income growth over an extended period of time, growth rates (including the world growth rate) over the given time frame can be considered to be constant. This is a modeling simplification. In the real world, the concept of "circular and cumulative causation" could potentially apply – that is, an economic boom in one country, resulting in a faster rate of growth, could cause an increase in exports in its trading partners, thereby increasing their rates of economic growth. The result is a feedback loop that will result in continuously stronger economic growth for all involved countries to a certain point. The exact nature of this feedback loop, where or if it stops, and the empirics behind such an event are outside of the scope of this thesis.

Because the income elasticities of demand are the main deterministic factor of the simple mathematical form of Thirlwall's Law, it follows that the only means by which a country can control its own growth would be a case in which it can reduce its own propensity to import or its citizen's purchasing power, or in which it can somehow convince a foreign country to import more of its goods. Oligopolistic competition is an important assumption to have here. That an oligopolistically competitive market is based off of non-price competition – i.e. advertising – implies that oligopolies acquire market share by influencing the tastes, and thereby the income elasticities of demand for exports of foreign countries. could negotiate more advantageous trade agreements with its trading partners.

The extended model developed by Nureldin and Thirlwall (1982) removes the
assumption of constant relative prices, and allows for the inclusion of capital flows. Removing
the constraint of constant relative prices between countries allows for changes to the balance of
payments constrained growth rate based on the price elasticities of demand. Usually, with the
assumption of constant relative prices based off of:

\[ p_d - p_f - e = 0 \]

the price elasticities of demand can have no effect, as can be seen in:

\[ x = \eta(p_d - p_f - e) + \epsilon z \]
\[ m = \psi(p_f + e - p_d) + \pi y \]

where \( \eta \) and \( \psi \) are the price elasticities of demand for exports and imports, respectively. As a
result, any effect which changes relative prices, such as currency depreciation or appreciation, or
technological progress in efficiency of production

Given these factors, there is strong theoretical support for countries, especially
developing countries that need to be able to grow much faster than the rest of the world, to
pursue Export Oriented Industrialization as a development strategy. Strangely though, many of
the factors that make Export Oriented Industrialization function act through the price elasticities
of demand rather than the income elasticities of demand. Tariffs and other trade protections
serve to artificially increase the price level of the rest of the world rather than decrease the
propensity to consume foreign goods. The main reason for a developed country to import goods
from a developing country is again likely due to prices rather than tastes, the goods from
developing countries being much cheaper comparatively even though tastes in the developed
countries may lean towards higher quality (but more expensive) goods from other developed
countries.

Including capital flows in the model gives it some explanatory power for some unusual
economic situations. The premise is that the capital flows can replace the value of exports that would otherwise be needed to increase the economic growth rate. Assuming that the export rate and income elasticity of demand for imports stay constant, and a country is growing at 3% but would like to be growing at 4%, the value of capital flows must permanently increase by enough to be equal to the value of a further $x/r = 1\%$. This concept can explain the functioning of, for example, the government stimulus packages as a result of the recent financial crisis. Under the assumption that a country's available financial resources have already been committed to other projects, a government running in deficit is essentially the recipient of massive capital inflows, which it then injects into the economy to increase economic growth. If Thirlwall's Law is accurate, then the approximate value of stimulus packages over a given time period to reach a desired economic growth rate can be calculated without too much difficulty. The criticism of this idea would be that, because this is a long-run model, the exact causes of any short term effects such as stimulus spending would be unknown. With this I would agree, but I would also comment that if by the extended model capital inflows can be considered a substitute for exports, and if stimulus spending is maintained at the value of export growth lost because of the recession, then long-run growth should not change. In fact, if the recession is severe enough to lower the country's income elasticity of demand for imports for a significant period of time, long-run growth may actually increase!

The empirical evidence supports many of the implications of the model. One factor of particular note is that generally $\epsilon > r$ has been found for developing countries, and the reverse, $\epsilon < r$ has been found for developed countries (Bairam, 1993). As a result, developed countries will face declining trade balances and developing countries will see increasing trade balances in times of significant economic growth.
The work of Hussain (1999) has been particularly useful with regards to showing the link between Thirlwall's Law and the effectiveness of Export Oriented Industrialization. This research is also useful in establishing that the extended model generally has much greater explanatory power than the basic model over a broad spectrum of countries. A cross-sectional analysis of African and Asian countries. The findings showed that in general African countries have much higher income elasticities of demand for imports than income elasticities of demand for exports, and receive a significant quantity of capital inflows while still showing generally lower growth rates. In fact, of the 29 African countries in the sample, 14 would have negative growth rates were it not for capital inflows. The Asian countries, which generally have much higher income elasticities of demand for exports than for imports and receive much less in the way of capital inflows, are generally shown to have higher growth rates. Some exceptions to this are Pakistan and Sri Lanka, which, like the 14 African countries, would have negative growth rates were it not for capital inflows.

B. 45-Degree Rule

The 45-degree rule is more difficult to use in this fashion because it is a much more indirect interpretation of the mathematical model. Mathematically, demand is given to be the driving factor in economic growth because the ratio of a country's growth to the rest of the world approximates to that country's income elasticity of demand for exports over its income elasticity of demand for imports. The posited means of interaction of these two ratios is taken to be a supply effect, however, which means that interpretation of the effects causing an increase or decrease in either of the income elasticities of demand will be more complex. Additionally, the model was not created to explain differences in economic growth, but rather to explain why there are no secular trends in the exchange rates of fast growing countries.
Let us review the premise of the 45-degree rule. The empirical evidence produced by Houthakker and Magee (1969) has shown that faster growing countries tend to face much more favorable ratios of income elasticities of demand for exports versus imports, while slower growing countries face much less favorable ratios. This was counter to the economic thought of the time, which claimed that faster growing countries would only be able to maintain their level of exports by depreciating their currencies in order to mitigate the effect on export prices that the increasing domestic price level would have. This was found to be untrue, or at least highly unlikely, and it was then posited that countries can maintain these favorable income elasticities of demand for exports by developing and exporting an increasingly broad array of goods. This is in turn possible because the high growth rate of the country better allows it to develop these goods. This process of growth is claimed to be a tautological explanation in Thirlwall (1991), though because there has been no neoclassical response to this criticism, discussion of this point is outside the scope of this paper.

One major implication that the development of an increasing range of goods as a necessity for faster economic growth has is in the case of countries with abundant supplies of primary goods. Hussain (1999) and others working in a North-South development framework like Dutt (2002) and Vera (2006) have shown that countries relying primarily on exports of primary goods show slower growth rates than other countries. Hussain (1999) also finds that oil exporting African nations grow below their balance-of-payments constraint – that is, they are fundamentally resource constrained.

While the above is using Post-Keynesian research, there is a point to be made here – these countries are not developing and exporting any new goods. If the 45-degree rule is taken to be a true representation of growth issues, then countries relying solely on the export of primary
goods will always grow slower than their counterparts because they cannot increase their total number of export goods, and thereby will only be able to increase their exports by devaluing their currency to make their goods cheaper in the world market. The logical step out of this would be to invest more money in industrial expansion to allow for producing a broader range of products, thereby increasing the growth rate as diversity of exports increases.

Section 9: Conclusions

We have so far seen that, even though Thirlwall's Law and Krugman's 45-degree rule are mathematically identical, the interpretations of their causes are extremely different. Thirlwall's Law is derived from a Post-Keynesian model of aggregate demand driving export growth, while Krugman's 45-degree rule is derived from a more mainstream (though for its time, new) theory of trade. Thirlwall's Law focuses more on the policy implications, determining how best a country can take account of the Law to accelerate its growth. Krugman's 45-degree rule is regarded more as a trade problem, with the key factor of inquiry being the effect of accelerated growth (particularly through increased product differentiation) on a country's exchange rate.

This is not to say that the 45-degree rule does not have implications for economic growth; there is still the implication that higher levels of exports are tied to faster economic growth, just that economic growth is not the prime focus of the model. It is easy to see that the intellectual frameworks for these two theories are extremely different, and it would be difficult for these two frameworks to interact in a cohesive manner. Two questions were considered here. First, are these two communities aware of each other? Second, if the two communities are aware of each other, why do they not interact?

The answer to the first question, that of the communities being aware of each other, is a muted "yes," for the Post-Keynesians, and unknown for the mainstream economists. There is a
large amount of evidence that the economists working with Thirlwall's Law are aware of Krugman's work. Thirlwall himself published an article critiquing the theories laid out in Krugman (1989), and this is an extremely heavily cited article by those publishing about Thirlwall's Law. The only evidence for the mainstream economists being aware of the work of the Post-Keynesians is in an endnote in Wu (2008, pg. 670), which simply states that Thirlwall's Law and Krugman's 45-degree rule are mathematically identical, but the interpretations are different. This is not unexpected – it is much easier for a fringe school of thought to watch for, and respond to, topics related to their work to show up in mainstream thought than it is for mainstream economists to watch for these same topics in all the different schools of economic thought, let alone respond to them.

An important intellectual expansion of the theories discussed in this thesis is the development of a generalized model incorporating both Thirlwall's Law and the 45-degree rule, as in the work of Blecker (1998). Such a model could help to alleviate some of the problems of describing cases not in line with the overall fit of one or both of Thirlwall's Law and the 45-degree rule. An example of this would be the case of "resource constrained" countries under Thirlwall's Law. Thirlwall's Law mostly accepts these countries as exceptions to the rule. These situations may be better explained, however, with the 45-degree rule's notion that they do not have the range of export goods to experience a rate of growth they may otherwise have been able to reach. The case of the developing countries mentioned above in section 8B, which largely export primary goods, serves as an example to this point. Their growth constraint may be better explained by having a lack of product diversity (and thereby industrialization), rather than by being unable to acquire the materials needed to produce goods at a rate that would allow their growth to reach its balance-of-payments constraint.
Working Bibliography


Thirlwall, A. P. “Professor Krugman's 45-Degree Rule.” *Journal of Post Keynesian Economics*, Fall, 14(1), pp. 23-28


