Manufacturing-Finance Comparative Advantage and Global Imbalances

Rui Mao and Yang Yao*

Abstract Treating finance as a tradable service, this paper examines how global current account imbalances can emerge as a result of the Ricardian comparative advantage in manufacturing and finance. The financial sector screens borrowers to limit its risk exposure when it provides finance to manufacturing firms that are born with heterogeneous risks. In a dynamic model of two countries whose heterogeneous rates of productivity growth maintain their positions of comparative advantage, the country with comparative advantage in finance specializes in creating financial assets so it is able to carry over the current savings to the next period. As a result, the other country is willing to save and lend its savings to this country. The amount of lending increases over time because of productivity growth in both countries, so persistent global imbalances emerge in the steady state and its scale increases as the manufacturing-finance comparative advantage gets stronger between the two countries. Our empirical tests of bilateral trade and current accounts with panel data of OECD countries provide consistent and robust supports to these theoretical claims.

Keywords: Manufacturing-finance comparative advantage, global imbalances, international division of labor

JEL Classification Numbers: E22, F21, F32, F36, F41, G21

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1 Introduction

Global current account imbalances are unbalanced trade flows in goods and services. Trade flows correspond to capital flows in the sense that surplus countries export capital and deficit countries import capital. Global imbalances then can be understood in terms of capital flows. Taking capital flows as a result of international trade of financial services, the financial development literature assesses that countries with stronger financial sectors tend to become net capital receivers and thus run current account deficits, and countries with weaker financial sectors tend to become net capital exporters and thus run surpluses (Caballero, Farhi, and Gourinchas, 2008; Mendoza Quadrini, and Rios-Rull, 2009; and Ju and Wei, 2010). However, the financial sector alone may not provide the whole story. Figure 1 compares Germany with Italy for the period 1992 to 2008. Germany has a more developed financial sector than Italy. The figure shows that the gap between the two countries' financial productivity (measured in value-added per labor hour) was increasing in the period. However, instead of running a deficit as the financial development literature predicts, Germany enjoyed a growing trade surplus with Italy almost for the entire period.

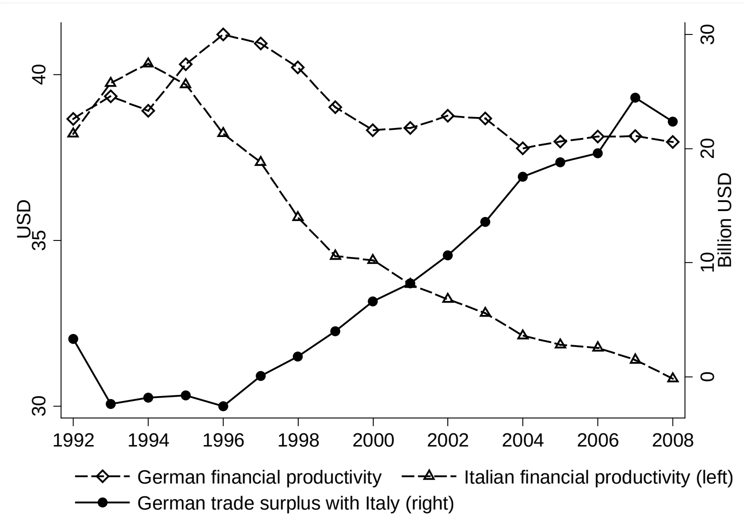

Figure 1. Financial productivities and trade imbalances between Germany and Italy

Notes: Financial productivity is defined as the value-added per labor hour in financial and business services provided by the OECD database.[1] Bilateral trade flows are

[1] Database URL: http://www.oecd-ilibrary.org/statistics.

taken from the UN Comtrade database.[2]

The missing piece may be the relative productivity of manufacturing in Germany and Italy. Germany has a stronger financial sector than Italy, but its manufacturing sector is even stronger than its Italian counterpart. That is, Germany has a comparative advantage in manufacturing and Italy has a comparative advantage in finance. This is shown by the solid line in Figure 2. It is the gap of the two countries' logged manufacturing-finance relative productivities (both measured in value-added per labor hour) in the period 1992-2008. This curve is compared with the gap of the two countries current account/GDP ratios over the same period. It is clear that these two curves moved very closely over time. Therefore, it seems that an explanation based on the manufacturing-finance comparative advantage can do a better job to explain the imbalances between Germany and Italy than an explanation solely relying on the strength of finance.

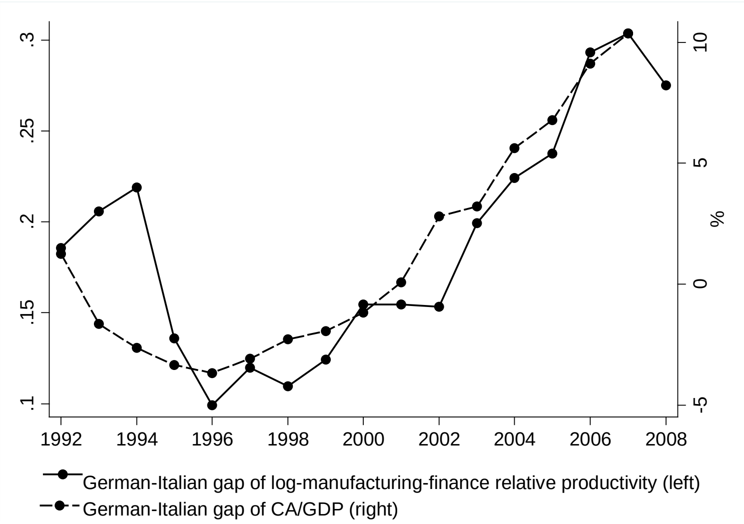

Figure 2. Manufacturing-Finance relative productivities and current accounts in Germany and Italy

Notes: The relative productivity is defined as the ratio of manufacturing and financial productivities, where manufacturing productivity is defined as value-added per labor

[2] Database URL: http://comtrade.un.org/db/default.aspx. Because the UN Comtrade data are reported by local authorities, Country *i*'s export to Country *j* may not coincide with Country *j*'s import from Country *i*. Due to this limitation, we take an average of Country *i*'s export and Country *j*'s import to represent the trade flow from Country *i* to Country *j*. Bilateral trade surpluses (net trade flows) are calculated as the difference of these averaged two-way trade flows.

hour in the manufacturing sector provided by the OECD database. Current account to GDP ratios are taken from the WDI database.

In this paper, we use a Ricardian model embedded in a dynamic growth framework to illustrate how the manufacturing-finance comparative advantage gives rise to global imbalances. In our model, the financial sector creates financial assets for depositors to invest and then provide them to manufacturing firms to finance their production of the final consumption good. Manufacturing firms are born with heterogeneous risks. Investment by the financial sector is irreversible if firms fail. The financial sector thus hires labor to screen borrowers in order to reduce the average risk exposure in its lending. The surviving investment becomes firms' working capital.

We first consider a static model to provide the basic ideas. We show that in a closed economy, the price of working capital is lower when the financial sector's productivity is higher relative to the manufacturing sector's. Then in an open environment with two countries where both the trade in goods and financial services are allowed, a standard Ricardian model can be applied featuring the manufacturing good as the final good and financial services as the intermediate good. The country with a relatively stronger manufacturing sector thus forgoes some or all of its financial sector to focus on producing the final good. As a result, it exports capital and imports financial services. Symmetrically, the other country forgoes some or all of its manufacturing sector to focus on providing financial services to both domestic and foreign firms. The manufacturing-finance comparative advantage thus leads to the international division of labor in the two countries. But in the static framework, the capital importer's revenue from the overseas direct investment (ODI) has to equal its trade deficit in the final good. So there are no current account imbalances.

We then consider a two-period overlapping generation model with differential rates of productivity growth in the two countries. In particular, we examine the case where technological progress reinforces the manufacturing-finance comparative advantage between these two countries over time. The stable equilibrium is characterized by both countries sticking to the states of complete specialization.

Because the country whose manufacturing sector is relatively stronger foregoes it financial sector completely, its young agents have to rely on the other country's financial services to smooth consumption. It implies that their export is more than financial services that they buy for the need of production. In other words, they have a positive position in net foreign assets (NFA) and thus are net savers. Symmetrically, young agents of the other country whose financial sector is relatively strong hold a negative NFA position. They are net borrowers. When agents of both countries step into their old ages, creditors will liquidate their foreign assets, whereas debtors will fulfill their foreign liabilities. If the steady state features no economic or population growth, then in each country of any particular time, the change in the NFA position of the young generation will exactly be offset by the change in the NFA position of the old generation. If the steady state features a constant rate of growth due to technological progress, then in each country the change in the NFA position of the young generation will dominate the change in the NFA position of the old generation. That is, the country with the manufacturing comparative advantage will run a current account surplus whereas the country with the financial comparative advantage will run a deficit. Basically, this is a result of the inter-temporary between the manufacturing-strong country's relative advantage in generating current output and the finance-strong country's relative advantage in generating financial assets that allow people to smooth their consumption over time. We also show that as the manufacturing-finance comparative advantage enhances over time, the scale of global imbalances also increases. In this process, each country has welfare gains because the Ricardian comparative advantage shifts both countries from their relatively low productive sector to their relatively high productive sector.

Our theoretical model allows us to deduct a structural equation to empirically test the relationship between the manufacturing-finance comparative advantage and current account imbalances. We use panel data of OECD countries for the period 1989 to 2008 to conduct our tests. For each country, we define its manufacturing-finance relative productivity by the ratio of the two sectors' value-added per labor hour. Then for any pair of countries, we define one country's manufacturing-finance comparative advantage versus the other country by the difference between its logged manufacturing-finance relative productivity and that of the other country. Our structural equation implies that the gap between any two countries' current account/GDP ratio is proportional to their comparative advantage thus defined.

We first approximate bilateral imbalances with trade flows to test, for any pair of two countries, whether the one with a stronger manufacturing sector tends to be the net bilateral exporter. We also test whether the size of their bilateral trade imbalances is proportional to their comparative advantage. Then we estimate our structural equation with current account/GDP rations. Our benchmark regression uses country-pair group means over the whole 20-year period because our theoretical predictions sit on cross-country variations in relative productivities and current imbalances. We also follow Chinn and Prasad (2003) to construct a non-overlapping five-year averaged panel dataset and perform OLS regressions where only period dummies are included and two-way fixed-effect panel regressions where country-pair dummies are additionally included. In addition, we split the data into two ten-year subsamples and check if results are robust over time. All those specifications provide strong and consistent supports to our theoretical claims. We have also done two more robustness checks. One is to take into account multilateral resistance to check if our results are affected by the third-country effects, and the other is to instrument our comparative advantage index by the legal origins of the countries in each pair. Both exercises support our baseline results.

Our theory of the manufacturing-finance comparative advantage is motivated by the existing literature of finance and global imbalances. Caballero et al. (2008) highlight the mismatch between financial demand and supply. They specifically considered two cases: an asset market collapse in emerging economies and a gradual integration of fast growing economies of limited ability to generate assets for savers or excessive demand for assets (saving-glut). In both cases, emerging economies will run current account surpluses, while the financially advanced countries will run deficits. Mendoza et al. (2009) construct a multi-country dynamic stochastic general equilibrium model with incomplete asset markets and credit constraints and show the emergence of two-way international capital flows, i.e., financially developed economies will accumulate a large stock of foreign liabilities and in the same time make outward investment on high-return yet risky physical assets in emerging markets. Ju and Wei (2010) also produce this kind of two-way capital flows by introducing two wedges between the expected marginal return to capital and the interest rate of savings in a Hechscher-Ohlin model. These wedges respectively come from financial intermediation costs and agency costs due to moral hazard. All these papers explain current account imbalances from the point of view of the absolute disparities in financial development. Because financially weak economies need to pay to their advanced counterparts for financial services, liberalization of the global capital market may hurt surplus countries.

We differ from these works in two aspects. Firstly, we make a step forward by considering both manufacturing and financial sectors. Compared with previous works where countries running current account surpluses are weak in finance either because they lose the ability to generate financial assets (Caballero et al., 2008) or their financial sectors are institutionally incomplete (Mendoza et al., 2009; Ju and Wei, 2010), we allow countries to optimally give up their financial sector according to their comparative advantages. Secondly, financially underdeveloped countries gain from their manufacturing sectors although they partially sacrifice their financial sectors. Conditional on the current form of comparative advantage, trade and financial liberalization leads to a Pareto improvement.

The rest of the paper is organized as follows. Section 2 presents the theoretical model in the static case and solves the international division of labor. Section 3 then turns to an OLG model with differential rates of productivity growth and shows how current account imbalances take place in the steady state as a result of inter-temporary trade between the two countries with different comparative advantages. Section 4 provides various empirical tests and robustness checks for our theoretical predictions using panel data of OECD countries. Section 5 concludes the paper.

2 The Static Model

2.1 The closed economy

Consider a model economy consisting of two sectors, the financial sector comprised of identical banks that serve as the financial intermediary between depositors and firms, and the manufacturing sector comprised of firms producing the final product. Suppose that the depositors are endowed with K units of savings. Banks play two roles. One is to generate financial assets for depositors to invest, and the other is to provide credits to firms. In this static model, we simply normalize the rate of return of the financial assets to zero. The production of manufacturing firms is comprised of two steps. In the first step, investment is made, and in the second step the final product is produced. Investment has to be financed by bank credits. Firms are identical except that their investments are subject to different degrees of risks. Particularly, each firm here faces an idiosyncratic shock after the investment is made. The investment can succeed with a probability of θ, which is determined by the nature and distributed by a cumulative distribution function $G(\theta)$ with mean $\bar{\theta}$. If the firm fails, the bank loses the loan. If instead the firm succeeds, its investment becomes its working capital which then serves as an input to the production of the final good. We assume that perfect competition prevails in both sectors.

Suppose firms have an identical and constant-return-to-scale production function when they produce the final good, $M = F^{\alpha}(A^M l^M)^{1-\alpha}$, where M is output, F is working capital, and l^M and A^M are the amount of labor hired and their productivity, respectively. This implies that all firms will apply for a loan. Then without prescreening by the banks, each firm also gets a loan of an equal share of K, so the expected amount of working capital in the economy is $\bar{\theta}K$.

Banks can evaluate firms' probabilities of success to control their average risk exposures. Consistent with the actual evaluation process, we assume that banks check a predetermined array of each firm's characteristics and rate its default risk according to a uniform formula. Those rated above a certain threshold are granted a loan of an equal share of K and those below the threshold do not get any. We assume that this risk evaluation has a positive effect in the sense that the probabilities of success of firms that have passed the screening are subject to a truncated distribution of $G(\theta)$ whose mean is larger than $\overline{\theta}$. We assume that the mean of this truncated distribution is simply the product of the amount of people hired by the banks and their productivity. It implies that banks have a constant-return-to-scale technology of screening. Hence, we can also think about the financial sector as consisting of just one bank. Let l^F be the amount of labor hired by this bank and A^F be its labor productivity. Then the average probability of success in firms that eventually obtain loans is $A^F l^F$. The constant-return-to-scale technology allows us to aggregate the firms having passed the screening into one firm. Its expected amount of working capital for production is $KA^F l^F$. Subsequently, we will normalize both capital endowment K and labor endowment L to unit for simplicity.

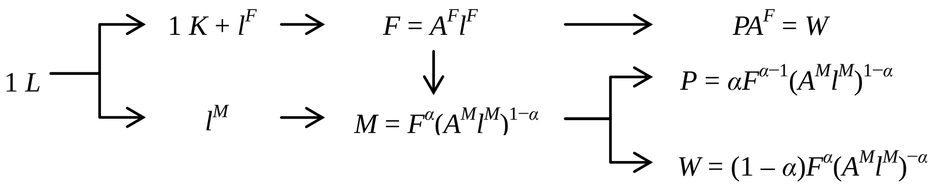

Figure 3. Production in a closed economy

Figure 3 summarizes the production process in a closed economy. Labor is allocated between the bank and the (aggregate) manufacturing firm by l^F and l^M respectively. In particular, the bank hires l^F units of labor to conduct screening when it makes a loan to the firm. The firm makes investment using the loan, and the nature decides whether each investment is successful. Since capital endowment sums up to one, the expected amount of working capital actually realized in the manufacturing sector, F, is $A^F l^F$. The final column in Figure 3 lists the three first-order conditions for equilibrium. The first is for the bank's optimal hiring of labor, the second and third are respectively for the firm's optimal demand for working capital and labor. In the equations, P is the price of working capital, and W is the wage rate (the price of the final product is assumed to be unity).

It is obvious that in equilibrium, employment of the financial sector, l^F, and that of the manufacturing sector, l^M, are respectively α and $1-\alpha$. Thanks to credit screening by the financial sector, the probability of success in the manufacturing process becomes αA^F, which also equals the economy's total working capital. Then, the output of the final good is $M = \alpha^{\alpha}(1-\alpha)^{1-\alpha}(A^F)^{\alpha}(A^M)^{1-\alpha}$. It also equals the wage rate, W, because labor totals to one. It also measures the social welfare because both sectors have constant-return-to-scale technologies.

The equilibrium manifests that in a closed economy, neither the financial productivity nor the manufacturing productivity has an impact on labor allocations between sectors. Yet an increase in either of them promotes social welfare. When the financial productivity rises, more working capital is available to the final production and subsequently more manufacturing goods are produced. On the other hand, a rise of the manufacturing productivity increases the final output for any level of working capital. Hence, productivity growth in either sector is welfare-improving.

It is specifically worth noting that in the equilibrium, the price of working capital, P, equals $\alpha^{\alpha}(1-\alpha)^{1-\alpha}\lambda^{1-\alpha}$, where λ is the ratio between manufacturing productivity and financial productivity. Obviously, P and λ are positively correlated. The price of working capital essentially represents the risk-adjusted lending rate. When the economy has a stronger manufacturing sector, the financial sector finds it harder to compete with manufacturing for labor. As a result, the cost of credit screening is higher. So is the price of working capital. In contrast, working capital becomes cheaper if the country has a stronger financial sector because it has a lower average level of risk exposure in investment. Proposition 1 below summarizes these results.

Proposition 1 *In a closed economy, the relative price of working capital is lower when a country's financial sector has higher productivity relative to its manufacturing sector*.

This proposition hints that a country with a relatively stronger financial sector will specialize in providing financial services in an open economy environment. Conversely, a country with a relatively stronger manufacturing sector will specialize in producing the final good.

2.2 Two open economies

$$1\,L \rightarrow \begin{cases} 1\,K + l_i^F \rightarrow F_i = A_i^F l_i^F \rightarrow PA_i^F = W_i, \text{ if } l_i^F \neq 0 \\ \quad\quad\quad\quad\quad\quad\quad \downarrow \pm T \\ l_i^M \rightarrow M = (F_i \pm T)(A_i^M l_i^M)^{1-\alpha} \rightarrow \begin{cases} P = \alpha(F_i \pm T)^{\alpha-1}(A_i^M l_i^M)^{1-\alpha}, \text{ if } l_i^M \neq 0 \\ W_i = (1-\alpha)(F_i \pm T)^{\alpha}(A_i^M l_i^M)^{-\alpha}, \text{ if } l_i^M \neq 0 \end{cases} \end{cases}$$

Figure 4. Production in an open economy

Figure 4 represents the production of Country i, i = 1, 2, in a two-country open environment. The only difference with the closed economy is that international investment is allowed here. Therefore, the two countries can trade manufacturing goods for working capital. Without loss of generality, let $\lambda_1 > \lambda_2$. In other words, Country 1 has comparative advantage in manufacturing, whereas Country 2 has comparative advantage in finance. Since its autarkic relative price of working capital is higher, Country 1 will partially forgo finance and focus on manufacturing once it trades with Country 2. Likewise, in line with its comparative advantage in finance, Country 2 will forgo some of its manufacturing and concentrate on providing financial services. Country 1 will export final goods to Country 2, and Country 2 will export financial services to country 1 in return. This implies that Country 2 makes direct investment in Country 1. Let T denote the Country 1's net import of ODI from Country 2. Then Country 1 eventually has a total of $A_1^F l_1^F + T$ units of working capital for its manufacturing production, while Country 2 has $A_2^F l_2^F - T$ units. The last column of Figure 4 gives the three first-order conditions for Country i. In equilibrium, three cases can be obtained depending on whether the international division of labor is complete.

Case 1: Country 1 specializes incompletely, Country 2 specializes completely

When $\alpha A_1^F > (1-\alpha)A_2^F$, i.e. the financial productivity of Country 1 is not too low relative to that of Country 2, Country 1 does both finance and manufacturing. In particular, its labor force in the financial sector, l_1^F, is $\alpha-(1-\alpha)A_2^F/A_1^F$, and that in the manufacturing sector, l_1^M, is correspondingly $(1-\alpha)(1+A_2^F/A_1^F)$. Country 2, however, completely abandons manufacturing production and concentrates on providing financial services. So $l_2^F = 1$ and $l_2^M = 0$. The amount of working capital in the manufacturing sector of Country 1 totals to $A_1^F l_1^F + A_2^F$, where A_2^F units come from the ODI made by Country 2. Thus, the manufacturing output of Country 1, M_1, is $P(A_1^F + A_2^F)$, Please check whereas Country 2 produces nothing. The price of working capital, P, is exactly at the autarkic level in Country 1, $\alpha^\alpha(1-\alpha)^{1-\alpha}\lambda_1^{1-\alpha}$. Additionally, the wage rate of Country 1 is PA_1^F, unchanged from the autarkic case. In contrast, because Country 2 concentrates on providing financial services at a price higher than that in the autarkic case, its wage rate rises to PA_2^F. That is, trade brings a Pareto improvement to the world.

Case 2: Country 1 specializes completely, Country 2 specializes incompletely

When $(1-\alpha)A_2^M > \alpha A_1^M$, i.e. the manufacturing productivity of Country 2 is not too low relative to that of Country 1, Country 2 does both manufacturing and finance. In particular, its labor force in the financial sector, l_2^F, is $\alpha(1+A_1^M/A_2^M)$, and that in the manufacturing sector, l_2^M, is correspondingly $1-\alpha-\alpha A_1^M/A_2^M$. Country 1, however, completely abandons its financial sector and concentrates on manufacturing production. That is, $l_1^F = 0$ and $l_1^M = 1$. The bank of Country 2 provides financial services to manufacturing firms in both countries. The total working capital it provides equals $A_2^F l_2^F$, among which $\alpha A_1^M \lambda_2^{-1}/(1-\alpha)$ units go to Country 1. Thus, the manufacturing output of Country 1, M_1, is $(A_1^M)^{1-\alpha}T^\alpha$, while that of Country 2, M_2, is $A_2^M l_2^M M_1/A_1^M$. The price of working capital, P, is exactly at the autarkic level in Country 2, $\alpha^\alpha(1-\alpha)^{1-\alpha}\lambda_2^{1-\alpha}$. Additionally, the wage rate of Country 2 is PA_2^F, unchanged from the autarkic case. In contrast, because Country 1 can trade for financial services at a price lower than if it produces on its own, its wage rate rises to PA_1^M/λ_2. Again, we have a Pareto improvement.

Case 3: Both countries specialize completely

When $\alpha A_1^F \leq (1-\alpha)A_2^F$ and $\alpha A_1^M \geq (1-\alpha)A_2^M$, Country 1 only keeps the manufacturing sector and Country 2 only keeps the financial sector. So $l_1^F = 0$ and $l_1^M = 1$, whereas $l_2^F = 1$ and $l_2^M = 0$. The working capital in the manufacturing sector of

Country 1, which equals A_2^F, entirely comes from the ODI made by Country 2. Thus, the manufacturing output of Country 1, M_1, is $(A_2^F)^\alpha(A_1^M)^{1-\alpha}$, whereas Country 2 produces nothing. The price of working capital, P, is $\alpha(A_1^M/A_2^F)^{1-\alpha}$. Because they completely give up the sectors without comparative advantages, both countries enjoy welfare gains. Compared with the autarkic case, the wage rate of Country 1 rises to $(1-\alpha)M_1$, and the wage rate of Country 2 rises to αM_1. So we have a Pareto improvement as well.

In all three cases, Country 1 is the net exporter of final goods because it has a relatively stronger manufacturing sector. It also receives international investment and buys financial services from Country 2. On the contrary, Country 2 is the net international investor because it has a relatively stronger financial sector. No country loses in this process of international specialization. These results are summarized in the following proposition.

Proposition 2 *In a two-country open economy framework, the country with a higher relative productivity of manufacturing over finance will tend to specialize in manufacturing, while the country with a higher relative productivity of finance over manufacturing will tend to specialize in finance. This international division of labor brings a Pareto improvement to both countries.*

But in the static model, Country 2's deficit of goods trade, which equals M_1-W_1, is always equal to the revenue it receives from its ODI, which is PT. In other words, both countries have balanced current accounts. This is because in the static model, instantaneous budget constraints must hold for agents in both countries. Consequently, net cross-border borrowing and lending is ruled out.

3 The Dynamic Model

Obviously, persistent global imbalances cannot be sustained in a long-lived agent model. Here we consider an overlapping generation model where people live for two periods in both countries. We assume there is no population growth. So in each country, total population always remains unity. Specifically, half of the population is the young generation, and the other half is the old generation. People have log-utilities. So in Country i, i = 1, 2 in any period t, the problem facing a representative young agent is

$$(1)\quad \underset{\substack{C_{it}^{Y}, C_{it+1}^{O}, \\ K_{it+1}, B_{it}}}{Max} \; U_{it}^{Y} = \ln C_{it}^{Y} + \beta \ln C_{it+1}^{O}$$

$$\text{s.t.}\quad C_{it}^{Y} + K_{it+1} = \frac{1}{2} W_{it} + B_{it} \,,$$

$$C_{it+1}^{O} = \frac{1}{2} W_{it+1} - B_{it}(1 + r_{t+1}) \,.$$

In the problem, C_{it}^{Y} and C_{it+1}^{O} are, respectively, Country i's young agent's consumption in period t and his consumption in period t + 1 when he becomes old, and β is the discount factor. In addition, W_{it} and W_{it+1} are the wage rates in periods t and t + 1, respectively. K_{it+1} is the amount of income that the young agent sets aside to buy the financial assets offered by the domestic bank. It will be lent to domestic firms by the bank. We assume that it completely depreciates in one period after it is turned into working capital used by firms. It is worth noting that because the amount of financial assets needs not be unity, the total amount of working capital in period t is $A_{it}{}^{F}K_{it}$. B_{it} is the international borrowing (if positive) or lending (if negative) made by the young agent. The difference between K_{it+1} and B_{it} is that the latter earns an interest r_{t+1} offered in the other country whereas the former is going to be invested domestically so W_{it+1} increases. We assume that the production process is exactly the same as in the static model. So the wage rate also has a similar expression. The specific wage rates in the two countries depend on which case of international specializations takes place in the static equilibrium of that period.

Note that Country i's current account deficit in period t is $B_{it} - B_{it-1}$. Therefore, a country has to borrow more and more to sustain a current account deficit. Without growth, this will not happen in our model. Furthermore, it will not happen either if the four sectors in the two countries have the same rate of growth in their labor productivities. In Problem (1) set up for the agents, cross-border lending/borrowing is necessary only when there are gains from trade, which in turn requires different rates of productivity growth of the four sectors in the two countries. However, the

Ricardian comparative advantage is sensitive to the growth rates of productivity in the four sectors. Depending on the combinations of growth rates, it can be easily reversed over time. This will make it hard for us to get definitive results out of our analysis.

Because the starting point of our analysis is the comparative advantage between the two countries, a pertinent scenario is when the two countries' positions of comparative advantage do not change. For that, let $g_i^j = A_{it+1}^j / A_{it}^j \geq 1$ denote the rate of productivity growth in Country i = 1, 2, sector $j = M, F$. We assume that $g_1{}^M > g_2{}^M$ and $g_2{}^F > g_1{}^F$ and both growth rates are constant. Economic growth is necessary for persistent current account imbalances, because otherwise the steady state of this dynamic framework will collapse to a static equilibrium where no international borrowing and lending take place on net. We consider a specific case, where the manufacturing productivity grows faster in Country 1 whose manufacturing sector is relatively strong, and the financial productivity grows faster in Country 2 whose financial sector is relatively strong. In other words, the strength of the manufacturing-finance comparative advantage between these two countries enhances over time. Otherwise, if the growth of manufacturing productivity is slower in Country 1, or the growth of financial productivity is slower in Country 2, the manufacturing-finance comparative advantage between these two countries may get reversed at some point of time. Consequently, there will not be a stable dynamic equilibrium.

Because there are three possible cases of international specializations in the static equilibrium of any period, we will first discuss how the economy transits across these cases as productivities grow over time. In particular, we will analyze how the economy evolves subsequently if a specific static equilibrium occurs in period t. We will then show that when $g_1{}^M > g_2{}^M$ and $g_2{}^F > g_1{}^F$, the economy eventually stabilizes in the case with complete specializations in both countries. We will explicitly solve for the global imbalances in this steady state.

3.1 Economic transitions

Case 1 occurs in period t

When Case 1 occurs in period t, the static equilibrium features an incomplete specialization in Country 1 and a complete specialization in Country 2. If $\alpha A_{1t+1}{}^{F}K_{1t+1} > (1-\alpha)A_{2t+1}{}^{F}K_{2t+1}$, Case 1 will occur again in the next period. Because both countries have their own financial sectors, all young agents can choose between lending to or borrowing from their domestic banks and the international capital market to realize inter-temporal consumption smoothing. In equilibrium, there must be no arbitrage between domestic and international capital markets. Because for each country, an additional saving to the domestic bank generates $\partial W_{it+1}/\partial K_{it+1}$ in the next period, while lending in the international capital market faces a uniform gross interest rate, which we donate as $1+r_{t+1}$, the no-arbitrage condition implies $\partial W_{it+1}/\partial K_{it+1} = 1+r_{t+1}$, $i = 1, 2$. According to the solution of the static equilibrium, wage rates in Case 1 are respectively $W_{1t+1} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}(A_{1t+1}{}^{M})^{1-\alpha}(A_{1t+1}{}^{F}K_{1t+1})^{\alpha}$ and $W_{2t+1} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}(A_{1t+1}{}^{M})^{1-\alpha}(A_{1t+1}{}^{F}K_{1t+1})^{\alpha-1}A_{2t+1}{}^{F}K_{2t+1}$. As a result, the no-arbitrage condition leads to $\alpha A_{1t+1}{}^{F} = A_{2t+1}{}^{F}$. That is, for Case 1 to successively occur in period t and t+1, the financial productivities of both countries must satisfy this linear equation.

Even if $\alpha A_{1t+1}{}^{F} = A_{2t+1}{}^{F}$ holds for period t+1, however, this relation must fail in period t+2, because we assume that the financial productivity grows faster in Country 2, i.e. $g_2{}^{F} > g_1{}^{F}$. In other words, if Case 1 occurs in period t, it can at most last for one more period. Afterwards, the static equilibrium will fall into either Case 2 or Case 3. Hence, the dynamic growth economy cannot stabilize in Case 1.

Case 2 occurs in period t

When Case 2 occurs in period t, the static equilibrium features a complete specialization in Country 1 and an incomplete specialization in Country 2. If $(1-\alpha)A_{2t+1}{}^{M} > \alpha A_{1t+1}{}^{M}$, Case 2 will occur again in the next period. Because Country 1 totally gives up its financial sector, its young agents can only borrow and lend in the international capital market, facing an international gross interest rate at $1+r_{t+1}$. K_{1t+1} thus will be zero. Young agents in Country 2 still need to satisfy the no-arbitrage condition between domestic and international capital markets, $\partial W_{2t+1}/\partial K_{2t+1} = 1+r_{t+1}$. First order conditions for inter-temporal consumption smoothing in both countries are respectively $\beta(1+r_{t+1}) = [½W_{it+1}–B_{it}(1+r_{t+1})]/[½W_{it}+B_{it}–K_{it+1}]$, i = 1, 2. According to the solution of the static equilibrium, wage rates in Case 2 are respectively $W_{1t+1} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}A_{1t+1}{}^{M}(A_{2t+1}{}^{F}K_{2t+1}/A_{2t+1}{}^{M})^{\alpha}$ and $W_{2t+1} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}(A_{2t+1}{}^{M})^{1-\alpha}(A_{2t+1}{}^{F}K_{2t+1})^{\alpha}$. Note that in each period, international borrowing and lending in these two countries always sum up to zero. That is, $B_{1t}+B_{2t} = 0$. According to the no-arbitrage condition for young agents in Country 2 and the two inter-temporal first order conditions for young agents in both countries, the equilibrium interest rate will be

$$1+r_{t+1} = \alpha^{2\alpha}(1-\alpha)^{1-\alpha}\left(A_{2t+1}^{F}\right)^{\alpha}\left[\frac{A_{1t+1}^{M}+(1+2\alpha\beta)A_{2t+1}^{M}}{\beta(W_{1t}+W_{2t})}\right]^{1-\alpha},$$

and international positions of both countries are respectively

$$-B_{1t} = B_{2t} = \frac{\beta W_{2t}A_{1t}^{M}\left[(1+2\alpha\beta)g_{2}^{M}-g_{1}^{M}\right]}{2(1+\beta)\left[A_{1t+1}^{M}+(1+2\alpha\beta)A_{2t+1}^{M}\right]},$$

where $W_{1t} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}A_{1t}{}^{M}(A_{2t}{}^{F}K_{2t}/A_{2t}{}^{M})^{\alpha}$ and $W_{2t} = \alpha^{\alpha}(1-\alpha)^{1-\alpha}(A_{2t}{}^{M})^{1-\alpha}(A_{2t}{}^{F}K_{2t})^{\alpha}$.

There are two forces driving the international borrowing and lending in this case. First of all, because the productivity growth rates differ between these two countries, their output shares in the world economy may change over time. Specifically, because $W_{1t}/W_{2t} = A_{1t}{}^{M}/A_{2t}{}^{M}$ holds for each period, as long as $g_1{}^{M} > g_2{}^{M}$, the output share of Country 1 will rise, while that of Country 2 will fall. In order to smooth consumption inter-temporally, the young agents in Country 1 tend to lend to their cohorts in Country 2. Things are reversed if $g_1{}^{M} < g_2{}^{M}$. We call this the *output share effect*. Secondly, even if $g_1{}^{M} = g_2{}^{M}$ and the output shares are constant over time, the young agents in Country 1 still tend to lend, because the working capital for manufacturing productions all comes from domestic deposits by young agents of Country 2. When they save to the domestic bank, their instantaneous consumption becomes less, so they have a higher marginal utility to consume. As a result, their cohort in Country 1 tends to lend, even if output shares of these two countries are always the same. We call this the *marginal utility effect*.

Depending on the relative strength of these two forces, three different cases may take place. When $(1+2\alpha\beta)g_2{}^{M} = g_1{}^{M}$, these two effects exactly offset each other, so there is no international borrowing or lending, i.e. $B_{1t} = B_{2t} = 0$. When $(1+2\alpha\beta)g_2{}^{M} >$

g_1^M, however, the *marginal utility effect* dominates, so the young agents of Country 1 lend, while those of Country 2 borrow. That is, $-B_{1t} = B_{2t} > 0$. In any period t, the young agents of Country 1 hold a positive NFA position of $-B_{1t}$, while those in Country 2 hold a negative position of B_{2t}. However, at the same time, the old agents of Country 1 liquidate their previous foreign assets of $-B_{1t-1}$, while those in Country 2 fulfill their previous foreign liabilities of B_{2t-1}. As a result, the current account balance of Country 1, CA_{1t}, is $-B_{1t}+B_{1t-1}$, whereas that of Country 2, CA_{2t}, is $B_{2t}-B_{2t-1}$. Note that because $g_1^M > g_2^M$, we can rewrite the scale of international borrowing and lending, $|B_{it}|$, as $const \cdot W_{2t}/[g_1^M+(1+2\alpha\beta)g_2^M\gamma_t^M]$, where *const* is a constant that equals $\beta|(1+2\alpha\beta)g_2^M-g_1^M|/[2(1+\beta)]$, and γ_t^M equals A_{2t}^M/A_{1t}^M that decreases over time. Therefore, the scale of international borrowing and lending is increasing. Consequently, Country 1 runs a current account surplus, i.e. $CA_{1t} > 0$, whereas Country 2 runs a deficit, i.e. $CA_{2t} < 0$. Finally, when $(1+2\alpha\beta)g_2^M < g_1^M$, the *output share effect* dominates. Because the output share of Country 1 rises, its young agents borrow from their counterparts in Country 2. That is, $-B_{1t} = B_{2t} < 0$. In this case, Country 1 runs a current account deficit, while Country 2 runs a surplus.

Therefore, when Case 2 occurs in the static equilibrium of period t, it will occur again in the next period as long as $(1-\alpha)A_{2t+1}^M > \alpha A_{1t+1}^M$. However, because $g_1^M > g_2^M$, this productivity inequality will eventually be reversed after finite periods. In other words, Case 2 can successively occur for at most finite periods. Afterwards, the static equilibrium will fall into Case 3. Hence, the dynamic growth economy cannot stabilize in Case 2 either.

Case 3 occurs in period t

When Case 3 occurs in period t, the static equilibrium features complete specializations in both countries. Because $\alpha A_{1t}^M \geq (1-\alpha)A_{2t}^M$ and $g_1^M > g_2^M$, $\alpha A_{1t+\tau}^M > (1-\alpha)A_{2t+\tau}^M$ will hold for any positive τ. It implies that after period t, Case 2 will never occur as a static equilibrium. Suppose Case 3 occurs in period t+1, then because Country 1 completely gives up its financial sector, K_{1t+1} will be zero. This means that $\alpha A_{1t+1}^F K_{1t+1} < (1-\alpha)A_{2t+1}^F K_{2t+1}$ naturally holds. Therefore, the two productivity inequalities for complete specializations are both satisfied in period t+1, indicating that Case 3 will be the static equilibrium again. If instead, Case 1 occurs in period t+1, then our previous analysis shows that $\alpha A_{1t+1}^F = A_{2t+1}^F$ must hold. However, because $g_2^F > g_1^F$, the economy must go back to Case 3 in period t+2 since $\alpha A_{1t+2}^F < A_{2t+2}^F$. In addition, Case 1 will never occur as a static equilibrium again. Hence, the dynamic growth economy can only stabilize in Case 3. The following proposition summarizes these results.

Proposition 3 *When the manufacturing productivity grows faster in the country with a relatively strong manufacturing sector and the financial productivity grows faster in the country with a relatively strong financial sector, such that the manufacturing-finance comparative advantage enhances over time, the stable equilibrium of the dynamic growth economy features complete specializations in both countries.*

3.2 The steady state

In the steady state, both countries enjoy complete specializations. We can then solve for the current account imbalances in equilibrium. Suppose we are now in period t. Because Country 1 does not have a domestic financial sector, its young agents only borrow and lend in the international capital market, where the gross interest rate is $1+r_{t+1}$. Young agents in Country 2, however, can access both domestic and international financial markets. They therefore need to satisfy the no-arbitrage condition: $\partial W_{2t+1}/\partial K_{2t+1} = 1+r_{t+1}$. Agents in both countries also need to satisfy first order conditions for inter-temporal consumption smoothing, which we previously showed: $\beta(1+r_{t+1}) = [½W_{it+1}-B_{it}(1+r_{t+1})]/[½W_{it}+B_{it}-K_{it+1}]$, i = 1, 2. However, since both countries are in complete specializations, according to the solution to the static equilibrium, wage rates are: $W_{1s} = (1-\alpha)(A_{2s}^F K_{2s})^\alpha (A_{1s}^M)^{1-\alpha}$ and $W_{2s} = \alpha(A_{2s}^F K_{2s})^\alpha (A_{1s}^M)^{1-\alpha}$, where $s = t, t+1$.

Still, international borrowing and lending in these two countries always sum up to zero. That is, $B_{1t}+B_{2t} = 0$. By moving the denominators to the left and adding the two first order conditions up, we have $\beta(1+r_{t+1})(W_{1t}+W_{2t}) =$

$(W_{1t+1}+W_{2t+1})+2\beta(1+r_{t+1})K_{2t+1}$. Domestic savings in Country 2, K_{2t+1}, can be backed out from the no-arbitrage condition: $1+r_{t+1} = \alpha^2 A_{2t+1}{}^F(A_{2t+1}{}^F K_{2t+1}/A_{1t+1}{}^M)^{\alpha-1}$. Hence, the equilibrium interest rate is

$$1+r_{t+1}=\left[\frac{(1+2\beta)\alpha^{\frac{2\alpha}{1-\alpha}}A_{1t+1}^{M}\left(A_{2t+1}^{F}\right)^{\frac{\alpha}{1-\alpha}}}{\beta\left(A_{1t}^{M}\right)^{1-\alpha}\left(A_{2t}^{F}K_{2t}\right)^{\alpha}}\right]^{1-\alpha}.$$

Replacing K_{2t} with its expression derived from the no-arbitrage condition, we have the following iterative equation for the equilibrium interest rate: $1+r_{t+1} = (2+\beta^{-1})^{1-\alpha}(g_1{}^M)^{1-\alpha}(g_2{}^F)^{\alpha}(1+r_t)^{\alpha}$. Thus, in the steady state, the interest rate is constant and equals

$$1+r=\left(2+\beta^{-1}\right)g_1^M\left(g_2^F\right)^{\frac{\alpha}{1-\alpha}}.$$

Bringing the interest rate back to the first order conditions, we can solve for the equilibrium scale of international borrowing and lending

$$-B_{1t}=B_{2t}=\beta(1+\beta)^{-1}\left(2+\beta^{-1}\right)^{-\frac{1}{1-\alpha}}\alpha^{\frac{2\alpha}{1-\alpha}}(1-\alpha)\left(g_1^M\right)^{-\frac{\alpha}{1-\alpha}}\left(g_2^F\right)^{-\left(\frac{\alpha}{1-\alpha}\right)^2}A_{1t}^M\left(A_{2t}^F\right)^{\frac{\alpha}{1-\alpha}}.$$

Obviously, $-B_{1t} = B_{2t} > 0$, which means that the young agents of Country 1 are lenders and those of Country 2 are borrowers in the international capital market. Because $W_{1t}/W_{2t} = (1-\alpha)/\alpha$, the output shares of these two countries are always constant. Hence, there is no *output share effect*. However, because the young agents of Country 2 leave deposits in their domestic bank, which will become the working capital for manufacturing firms around the world in the next period, their instantaneous consumption falls and their marginal utility rises. This *marginal utility effect* means that they are borrowers. Symmetrically, their counterparts in Country 1 are lenders. Because of productivity growth, the scale of international borrowing and lending increases over time.

As before, the current account balance is determined by the net change in NFA positions. As for Country 1, the young generation increases the NFA position as they lend to abroad, while the old generation clears their previous positive NFA position as they liquidate their assets. Thus, the current account balance of Country 1, CA_{1t}, is $-B_{1t}+B_{1t-1}$. In contrast, as for Country 2, the young generation reduces the NFA position as they borrow from abroad, while the old generation clears their previous negative NFA position as they fulfill their liabilities. Thus, the current account balance of Country 2, CA_{2t}, is $B_{2t}-B_{2t-1}$. Specifically, we have

$$CA_{1t} = -CA_{2t} = \frac{\beta^{\frac{2-\alpha}{1-\alpha}}\alpha^{\frac{2\alpha}{1-\alpha}}(1-\alpha)}{(1+\beta)(1+2\beta)^{\frac{1}{1-\alpha}}} \frac{g_1^M (g_2^F)^{\frac{\alpha}{1-\alpha}} - 1}{(g_1^M)^{\frac{1}{1-\alpha}} (g_2^F)^{\frac{\alpha}{(1-\alpha)^2}}} A_{1t}^F A_{2t}^M (A_{2t}^F)^{\frac{\alpha}{1-\alpha}-1} (\lambda_{1t} / \lambda_{2t}) .$$

This expression is composed of four parts. The first part is a set of parameters that are in utility and production functions. It is constant over time. The second part is determined by productivity growth rates. It is constant as well. It manifests that what we consider is a dynamic growth framework. Otherwise, if the economy features no growth, the change in the NFA position of the young generation will be totally offset by the change in the NFA position of the old generation in both countries, and the steady state will collapse and correspond exactly to the static case, where the instantaneous budget constraint holds and no international borrowing and lending occur on net. The third part includes absolute levels of productivities. It increases over time as productivities grow. The fourth part is the manufacturing-finance comparative advantage. Because productivity growth is comparative-advantage-enhancing, it increases as well.

The expression for current account balances bears two predictions. Firstly, $CA_{1t} = -CA_{2t} > 0$, so the country with the manufacturing comparative advantage, i.e. Country 1, runs a surplus, while the country with the financial comparative advantage, i.e. Country 2, runs a deficit. Intuitively, according to the manufacturing-finance comparative advantage, Country 1 completely gives up its financial sector. It means that agents of Country 1 have to rely on international financial services to complete inter-temporal consumption smoothing. Country 1 therefore is the net capital exporter. Secondly, the scale of global imbalances increases with the strength of the manufacturing-finance comparative advantage. Intuitively, when the comparative advantage gets stronger, benefits from trade will increase. As both economies become larger, there will be more international borrowing and lending as a result. The following proposition summarizes these results.

Proposition 4 *In the steady state of a dynamic growth framework where the manufacturing productivity grows faster in the country with a relatively strong manufacturing sector and the financial productivity grows faster in the country with a relatively strong financial sector, such that the manufacturing-finance comparative advantage enhances over time, the country with the manufacturing comparative advantage persistently runs a current account surplus, while the country with the financial comparative advantage persistently runs a deficit. The scale of current account imbalances increases as the comparative advantage gets stronger.*

Of course, in order to obtain an explicit solution, we only consider a simple case that features complete specialization in both countries in the steady state. In the real world, frictions to trade and capital flows may impede the international division. As a result, countries may partly keep the sector in which they do not have the comparative advantage. Although the manufacturing-finance comparative advantage still works, its effect on the scale of imbalances may be mitigated. In the extreme case where frictions are sufficiently high such that no trade or capital flows are allowed, all countries will go back to autarky and global imbalances will disappear. But to clearly consider the effect of frictions may scarify our explicit solution. To keep the result simple, our theoretical model will not deal with these frictions. Instead, we will leave them for the empirical part.

4 Empirical Analyses

4.1 The econometric model

The steady state of our dynamic growth model gives a structural equation that can be directly tested. First of all, we can rewrite the current account balances as shares of GDP for both countries: $CA_1/W_1 = \kappa[1-(g_1^M)^{-1}(g_2^F)^{-\alpha/(1-\alpha)}]$ and $CA_2/W_2 = -\kappa(1-\alpha)[1-(g_1^M)^{-1}(g_2^F)^{-\alpha/(1-\alpha)}]/\alpha$, where κ is a constant which equals $\beta^2/[(1+\beta)(1+2\beta)]$. The real world has more than two countries. But we can always reduce it to our two-country case if we take the rest of the world as whole. In particular, as for Country *i*, where Country *i* is any country in the world,

$$\frac{CA_i}{W_i} = \kappa\left[1-\left(g_i^M\right)^{-1}\left(g^F\right)^{-\frac{\alpha}{1-\alpha}}\right] \text{ if it runs a current account surplus,}$$

or

$$\frac{CA_i}{W_i} = -\frac{\kappa(1-\alpha)}{\alpha}\left[1-\left(g^M\right)^{-1}\left(g_i^F\right)^{-\frac{\alpha}{1-\alpha}}\right] \text{ if it runs a deficit.}$$

The productivity growth rates without the subscript *i* indicate the world average levels, which we assume orthogonal to the effect of a single country. Because for the world as a whole, sectoral productivities are relatively stable, we assume that g^M and g^F are unity for simplicity. Let $d_i^j = \ln g_i^j$ be the net productivity growth. Then the first-order Taylor expansion leads to $\frac{CA_i}{W_i} = \kappa d_i^M$ if the country runs a surplus, or $\frac{CA_i}{W_i} = -\kappa d_i^F$ if it runs a deficit.

Because the key idea of our story is that the difference of the manufacturing-finance relative productivity across countries generates global imbalances, we specifically focus on cross-country variations. For the sector in which a country has comparative advantage, the productivity growth is faster in that country than that in the rest of the world. In the steady state, that country will have a higher productivity in this sector relative to the world average level. On the contrary, for the sector in which a country does not have comparative advantage, its productivity growth is close to the world average level. In the steady state, that country will have a similar productivity in this sector to the rest of the world. Therefore, we can redefine $g_i^j = A_i^j/A^j$ as the relative productivity of Country *i* to the rest of the world. If sector *j* is the one in which Country *i* has comparative advantage, then $g_i^j > 1$. If instead, sector *j* is the one in which Country *i* does not have comparative advantage, then $g_i^j = 1$. Hence, we can rewrite $d_i^M = \ln(A_i^M/A^M) = \ln\lambda_i - \ln\lambda$ for surplus countries and $d_i^F = \ln(A_i^F/A^F) = \ln\lambda - \ln\lambda_i$ for deficit countries. This means that current account balances can be uniformly expressed by a simple equation as follows

$$\frac{CA_i}{W_i} = \kappa\left(\ln\lambda_i - \ln\lambda\right).$$

This expression bears the same implications as we summarized before in the two-country case. Particularly, for a country with the manufacturing comparative advantage, where $\lambda_i > \lambda$, it runs a current account surplus. For a country with the financial comparative advantage, where $\lambda_i < \lambda$, it runs a deficit. For countries whose comparative advantage is stronger, represented by greater $|\lambda_i - \lambda|$, their current account imbalances in GDP are also larger.

However, this expression still compares a country with the world average level, in the sense that it includes λ, the manufacturing-finance relative productivity of the rest of world. The world average relative productivity can hardly be measured, because it requires productivity information of every country. But we can circumvent this problem by taking a difference between any two countries so as to get rid of the world average level, and get

$$\frac{CA_i}{W_i} - \frac{CA_j}{W_j} = \kappa\left(\ln\lambda_i - \ln\lambda_j\right), \tag{1}$$

where i and j indicate any two countries in the world. This means, although the current account balance of a country is determined by its own manufacturing-finance relative productivity and those of all other countries in the world, its difference with the current account balance of another country, however, is solely determined by their own relative productivities. In other words, any third country does not affect the difference between current account balances in GDP of these two countries. Hence, our theoretical model produces a clear-cut structural equation, Equation (1), that can be empirically tested in a direct way.

Our empirical strategy takes three steps. We first show some preliminary results. According to Proposition 4, the country with the manufacturing comparative advantage tends to be the surplus country in a two-country model and the scale of imbalances increases with the strength of the comparative advantage. But in a multi-country framework, we cannot observe bilateral current account balances directly. Because the trade balance accounts for the bulk of the current account, we alternatively use the bilateral trade information and test with a linear probability model that for any two countries, whether the one with a stronger manufacturing sector tends to be the net bilateral exporter, while the one with a stronger financial sector tends to be the net bilateral importer. According to Equation (1), the comparative advantage between these two countries is measured by the difference of their logged relative productivities. Hence, the mathematical equation that we test first is

$$\Pr\left(EXP_{ij}=1\right)=\beta\left(\ln\lambda_i-\ln\lambda_j\right)+\gamma\left(X_i-X_j\right)+\varepsilon_{ij}, \tag{2}$$

where EXP_{ij} is a dummy variable which takes a value of 1 if Country i is the bilateral net exporter and takes a value of 0 if otherwise. X_i and X_j are an array of other nationwide characteristics that might affect current account balances. Measurements on frictions to international trade and capital flows are also included in them. We take a difference for each variable in order to compare countries in a bilateral sense, as we did for the logged relative productivity. ε_{ij} is random error term as usual. If $\beta > 0$, then we say for any two countries, the one with the manufacturing comparative advantage tends to run a surplus. We then use the bilateral trade balance, NX_{ij}, to approximate the scale of imbalances between these two countries, and test the following equation

$$NX_{ij}=\beta\left(\ln\lambda_i-\ln\lambda_j\right)+\gamma\left(X_i-X_j\right)+\varepsilon_{ij}, \tag{3}$$

Similarly, if $\beta > 0$, then we say for any two countries, when the comparative advantage between them is stronger, the scale of their imbalance is larger.

We then directly test our structural equation, Equation (1), and show our baseline results. According to Equation (1), for any two countries, the difference between their current account balances in GDP is determined by the difference of their logged relative productivities. Taking into account other determinants of current account balances, X_i and X_j, the equation we test becomes

$$\frac{CA_i}{W_i}-\frac{CA_j}{W_j}=\beta\left(\ln\lambda_i-\ln\lambda_j\right)+\gamma\left(X_i-X_j\right)+\varepsilon_{ij}. \tag{4}$$

To support out theoretical result, we also expect a $\beta > 0$.

We finally perform several robustness checks on our baseline results. In particular, we consider two problems. First, our theoretical model predicts that the difference of current account balances between two countries is orthogonal to the effect of any third country. We then check if our result still holds if multilateral resistance effects are taken into account. Second, the relative productivity may potentially be affected by the current account balance, meaning that Equation (4) faces a problem of endogeneity. We then use instrument variables to check if that problem biases our result.

4.2 Data and variables

We have panel data for 24 OECD countries from 1989 to 2008.[3] Unfortunately, because the data of sectoral productivities only cover a small number of countries, both China and the United States, as two major contributors to the current global imbalances, are not included in our sample. Without specifically mentioned, data are collected from the OECD database. Two exceptions are our dependent variables: bilateral trade data come from the United Nations Commodity Trade Statistics Database (UN Comtrade), and the share of current account balance in GDP is collected from the WDI database of the World Bank.

Our main independent variable is the manufacturing-finance comparative advantage, which, according to Equation (1), is represented by the difference in logged relative productivities of manufacturing to finance for each country pair. Relative productivities are measured by the ratio of value-added per labor hour of manufacturing to that of finance, which are provided by the OECD database. It's worth noting that the OECD database only reports the value-added of financial and business services together. That is, it includes not only financial activities themselves, but also business services such as real estate activities, renting of machineries and other back-office supports, like technology maintenance and legal consultancy. So the labor productivity we use for finance is actually the average of financial and business services. But this is the best data we can get.

We also control other potential determinants of current accounts, especially measurements of frictions to international trade and capital flows, which our theoretical model could not completely take care of. They are mostly selected with reference to Chinn and Prasad (2003) and are often used in the literature. These

[3] These 24 countries are: Australia, Austria, Bulgaria, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Republic of Korea, Lithuania, Mexico, Netherlands, Norway, Poland, Slovak Republic, Spain, and Sweden.

factors include:

(1) Fiscal balances. Fiscal balances are represented by the net fiscal surplus of the general government. According to Chinn and Prasad (2003), more government savings will raise the national saving rate if they are not completely offset by the decline in private savings. Hence, current account balances tend to rise with fiscal balances.

(2) Initial NFA stock. The initial NFA stock is measured by the stock of net foreign assets in GDP at the beginning of our observation period. We obtain the it from the updated and extended version of the External Wealth of Nations Mark II database developed by Lane and Milesi-Ferretti (2007).[4] Chinn and Prasad (2003) found that the initial NFA to GDP ratio is positively correlated with current account balances. This is because countries with a large NFA stock to begin with tend to receive more interest payments and run surpluses.

(3) The stage of economic development. When an economy starts to take off, it may borrow capital from abroad and thus run a current account deficit. Only when it reaches an advanced stage will it begin to pay off foreign liabilities by running a current account surplus. Hence, Chinn and Prasad (2003) postulated that the current account exhibits a U-shaped relationship with regard to per capita GDP. We deal with this relationship by controlling per capita GDP and its squared term.

(4) Dependency ratios. Coale and Hoover (1958), Leff (1969), Higgins and Willamson (1997), and Brooks (2003) all find consistent evidence that a higher ratio of the dependent population implies fewer savings and smaller current account balances. We break the ratio of dependent population into the youth dependency ratio and the elderly dependency ratio. The former is measured by the ratio of young people who age 0-14 over the people between 15 and 64. The latter is measured by the ratio of old people who age above 65 over the people between 15 and 64.

(5) Financial depth. In Caballero et al. (2008), Mendoza et al. (2009) and Ju and Wei (2010), the absolute disparity in financial development serves as the key driver to global imbalances, where more financially developed countries tend to run current

[4] Retrieved on September 8, 2012 from http://www.philiplane.org/EWN.html.

account deficits. With reference to Chinn and Prasad (2003), we use financial depth to measure financial development. Financial depth is defined as liquid liabilities, represented by M3, as a ratio to GDP. We obtain it from the Beck-Demirguc-Kunt Financial Structure Database.[5] A deeper financial sector relaxes credit constraints so consumption and investment can both increase. The country thus is more likely to run current account deficits.

(6) Growth rate of real incomes. Income growth is measured by the growth rate of real GDP per capita. With a persistent high income growth, people expect more cash flows in the future and increase consumption by borrowing more. The country thus tends to run a current account deficit. With a transitory high income growth, people smooth consumption over their whole life by saving more. The country thus tends to run a surplus (Romer, 2001, pp. 330-362). Chinn and Prasad (2003) found little relationship between the GDP growth rate and current account balances.

(7) Trade openness and capital controls. Trade openness is measured as the sum of exports and imports to GDP. And capital controls are measured by the Chinn-Ito Financial Openness Index.[6] They capture frictions to international trade and capital flows. When a country encourages trade, its export sector tends to grow, so it is more likely to run a surplus. When a country controls its capital account, foreign capital cannot fly out, so it is more likely to run deficit. Hence, the effect of trade openness tends to be positive and that of capital controls tends to be negative. However, things are reversed if countries encourage imports when they open up trade or restrict capital inflows when they control capital accounts. Chinn and Prasad (2003) found that neither variable significantly explained current account balances.

(8) Currency undervaluation. We estimate the percentage of undervaluation with the method of Rodrik (2008) using data from the OECD database. We first calculate the real exchange rate from the nominal exchange rate and the relative price level. We then regress it on per capita GDP to eliminate the Balassa-Samuelson effect. The residual between the real exchange rate and its esimated value that cannot be

[5] Retrieved on March 9, 2011 from http://siteresources.worldbank.org/INTRES/Resources/469232-110744951276 6/FinStructure_2009.xls.
[6] Retrieved on December 10, 2011from http://www.ssc.wisc.edu/ mchinn/research.html.

explained by income differentials is currency undervaluation that Rodrik (2008) defined. A positive residual indicates currency undervaluation, whereas a negative residual indicates overvaluation. An undervalued currency may potentially cause current account surpluses.

(9) Total population. The traditional gravity model shows that trade flows increase with the economic scale. So aside from the per capita income level, we also additional control the total population in our preliminary regressions on bilateral trade. We include population in following regressions on current account balances to GDP as well for a robustness concern, because more labor abundant countries may have an advantage in the labor-intensive manufacturing sector and thus become a surplus country.

Table 1 below presents a descriptive summary for these variables. Note that bilateral trade is defined for country-pairs. And other variables are for countries.

Table 1. Descriptive statistics

Variable	Obs.	Mean	Std.	Min.	Med.	Max.
Bilateral trade (billion dollars)	4971	-0.12	2.09	-27.76	-0.01	28.59
Current account (% of GDP)	387	-0.99	5.18	-18.52	-0.90	17.30
Manufacturing productivity (1,000 dollars)	348	23.80	12.50	3.32	24.36	64.47
Financial productivity (1,000 dollars)	348	31.58	13.74	6.86	34.03	60.04
Manufacturing-finance relative productivity	387	0.72	0.27	0.11	0.70	1.64
Fiscal balance (% of GDP)	364	-1.73	4.55	-12.80	-2.32	19.13
Initial NFA (% of GDP)	24	-24.70	38.58	-177.21	-16.93	16.95
GDP per capita (1,000 dollars)	422	21.61	12.37	1.37	22.70	74.66
Youth dependency ratio (%)	440	29.83	8.65	19.96	28.10	70.45

Elderly dependency ratio (%)	440	20.20	4.99	7.05	20.89	30.63
Financial depth (% of GDP)	407	53.73	20.78	19.00	49.24	140.96
Growth rate of GDP per capita (%)	416	4.66	10.45	-35.13	4.13	54.42
Openness (% of GDP)	362	81.32	38.60	31.36	69.72	184.42
Capital controls	467	1.41	1.37	-1.83	2.23	2.50
Undervaluation (%)	421	-0.74	10.34	-35.02	-0.94	61.95
Population (million people)	440	25.62	26.71	1.34	10.40	107.00

Notes: All dollar terms are measured by 2000 constant U.S. dollars. Variable definitions can be found in the text.

Because annual data are subject to significant measurement errors that can lead to biased estimates, we construct a panel data with non-overlapping five-year averages of the original data as Chinn and Prasad (2003). In other words, we split the 20-year sample into four period and in each five-year period calculate the average for each variable. These non-overlapping five-year averages constitute a new panel data that we use for all following regressions. Note that the bilateral net exporter dummy, EXP_{ij}, is defined for the five-year averaged bilateral trade flows. In particular, it takes a value of 1 if Country *i* exported more to Country *j* than what it imported from that country in a five-year period on average.

4.3 Preliminary results

Our theoretical model sits in a two-country framework. However, in the real world, bilateral current account balances can hardly be observed. We thus approximate them with bilateral trade and show some preliminary results here. Our first regression is based on Equation (2). Specifically, we test for any two countries, whether the one with a stronger manufacturing sector tends to be the bilateral net exporter. As in Chinn and Prasad (2003), we show three sets of estimations. In the first set of estimations, we run regressions on the linear probability model with the

OLS method, with and without controlling other explanatory variables aside from the comparative advantage. That is, we use the cross-sectional data of means in each country-pair group over these entire 20 years. As a result, we can get rid of the time dimension and focus on how cross-country variations in the manufacturing-comparative advantage generates imbalances. We then add period dummies and use our non-overlapping five-year averaged panel data to perform the "panel OLS regression" in Chinn and Prasad (2003). This allows us to take care of period-specific effects, especially possible trends in current account balances. Finally, we also include country-pair dummies and perform the two-way fixed-effects regression for a robustness check. Our results are shown in the following table.

Table 2. Preliminary results on the probability to be the bilateral net exporter

Dependent variable:	Cross-sectional		Panel OLS	Fixed-effects
Pr(EXP_{ij} = 1)	Reg. (1)	Reg. (2)	Reg. (3)	Reg. (4)
Δ Logged relative productivity	0.203***	0.368**	0.319***	0.210*
	(0.044)	(0.149)	(0.074)	(0.120)
Δ Fiscal balances		0.002	0.002	-0.027***
		(0.011)	(0.005)	(0.008)
Δ Initial NFA stocks		-0.000	-0.001	
		(0.001)	(0.001)	
Δ GDP per capita		0.010*	0.011***	-0.007
		(0.006)	(0.003)	(0.006)
Δ GDP per capita squared		0.000*	0.000*	-0.000
		(0.000)	(0.000)	(0.000)
Δ Youth dependency ratio		-0.021**	-0.017***	-0.010
		(0.008)	(0.004)	(0.010)

Δ Elderly dependency ratio		0.002	0.004	-0.029**
		(0.016)	(0.007)	(0.013)
Δ Financial depth		-0.007***	-0.005***	0.003*
		(0.002)	(0.001)	(0.002)
Δ Real income growth		-0.023	0.003	0.006
		(0.015)	(0.005)	(0.004)
Δ Trade openness		0.006***	0.005***	0.003*
		(0.001)	(0.001)	(0.002)
Δ Capital controls		-0.110**	-0.081***	0.035
		(0.045)	(0.022)	(0.029)
Δ Undervaluation		0.009*	0.007***	0.006***
		(0.005)	(0.002)	(0.001)
Δ Population		0.003***	0.004***	0.000
		(0.001)	(0.001)	(0.017)
Constant	0.439***	0.449***	0.430***	0.503***
	(0.025)	(0.036)	(0.038)	(0.105)
Period dummies	No	No	Yes	Yes
Country-pair dummies	No	No	No	Yes
Observations	276	210	589	589
Adjusted R-squared	0.068	0.350	0.258	0.213

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

In Table 2, Reg. (1) and (2) are for cross-sectional regressions on country-pair group means over the 20-year period, where Reg. (1) excludes explanatory variables except the difference of logged relative productivities, which represents the manufacturing-finance comparative advantage, while Reg. (2) controls these additional variables. Because we focus on cross-country variations, Reg. (2) gives our benchmark result. Reg. (3) and (4) use the non-overlapping five-year averaged data instead, where Reg. (3) only adds period dummies while Reg. (4) additional includes country-pair dummies. Note that in the two-way fixed effects model, the difference in initial NFA stocks is dropped, because it does not vary over time. Table 2 shows that in various specifications, the coefficient before the difference of logged manufacturing-finance relative productivities is always positive and significant. This means, for any two countries, the one with a stronger manufacturing sector has a higher probability to be the net bilateral exporter. To put the result in a more transparent perspective, we still take Germany and Italy for example. In the period from 1992 to 2008 where both Figure 1 and 2 cover, the average ratio of manufacturing productivity over that of finance is 0.825 in Germany and 0.683 in Italy. So the difference of their logged relative productivities is $\ln(0.825)-\ln(0.683) = 0.189$. The coefficient for the difference of logged relative productivities is 0.368 in our benchmark result. It implies that the probability for Germany to be a net exporter to Italy is seven percentage points higher due to its manufacturing comparative advantage. In other words, if these two countries are equal in other aspects, then in a ten-year period, Germany will run a surplus to Italy in 5.35 years, while Italy will run a surplus in 4.65 years statistically.

Reg. (2) and Reg. (3) further shows similar results for other control variables. The difference in per capita GDP and its squared term both have positive and significant coefficients, consistent with the development-stage argument that the relationship between running a surplus and the stage of development is U-shaped. Countries with a higher youth dependency ratio tend to have a lower probability to the bilateral net exporter. But the effect of elderly dependency ratio is insignificant. Countries with a more developed financial sector measured by their financial depth tend to run deficits. More open countries tend to export, while those highly control capital accounts tend to run deficits. Intuitively, countries that undervalue their currencies are more likely to run surpluses. And finally, more populous countries are likely to run surpluses as well. When the fixed-effects are added into Reg. (4), some coefficients changed signs. However, the result for the comparative advantage is still robust.

We then turn to Equation (3) and use trade volumes to approximate the scale of bilateral imbalances. We also perform four regression specifications as before. These results are shown in the flowing table.

Table 3. Preliminary results on bilateral trade volumes

Dependent variable:	Cross-sectional		Panel OLS	Fixed-effects
NX_{ij}	Reg. (5)	Reg. (6)	Reg. (7)	Reg. (8)
Δ Logged relative productivity	0.963***	1.226	1.680***	1.011*
	(0.206)	(0.906)	(0.433)	(0.552)
Δ Fiscal balances		0.030	0.055*	-0.042
		(0.066)	(0.031)	(0.037)
Δ Initial NFA stocks		0.003	0.000	
		(0.007)	(0.005)	
Δ GDP per capita		0.049	0.030**	-0.010
		(0.034)	(0.015)	(0.028)
Δ GDP per capita squared		0.000	0.000	-0.001
		(0.000)	(0.000)	(0.001)
Δ Youth dependency ratio		-0.036	-0.002	-0.051
		(0.051)	(0.024)	(0.044)
Δ Elderly dependency ratio		-0.011	-0.084**	-0.139**
		(0.096)	(0.038)	(0.061)
Δ Financial depth		-0.006	0.001	0.023***
		(0.012)	(0.005)	(0.008)
Δ Real income growth		0.006	-0.015	-0.030
		(0.094)	(0.030)	(0.020)
Δ Trade openness		0.020***	0.025***	0.025***
		(0.007)	(0.004)	(0.009)

Δ Capital controls		-0.296	-0.423***	-0.392***
		(0.275)	(0.127)	(0.135)
Δ Undervaluation		0.011	0.015	0.013**
		(0.029)	(0.010)	(0.006)
Δ Population		0.021***	0.025***	-0.312***
		(0.008)	(0.005)	(0.078)
Constant	-0.063	-0.067	-0.042	-1.674***
	(0.117)	(0.218)	(0.220)	(0.482)
Period dummies	No	No	Yes	Yes
Country-pair dummies	No	No	No	Yes
Observations	276	210	589	589
Adjusted R-squared	0.070	0.170	0.169	0.196

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

In Table 3, Reg. (5) and (6) use group means, whereas Reg. (7) and (8) use non-overlapping five-year averaged data. In various specifications, the coefficient before the difference of logged relative productivities is always positive. It is also significant except in Reg. (6). We hence take Reg. (7) where period-fixed-effects are controlled as our benchmark result. It implies that the manufacturing comparative advantage of Germany gave it a $1.680 \times [\ln(0.825) - \ln(0.683)] = 0.317$ billion constant 2000 US dollars surplus to Italy per year on average from 1992 to 2008. The real net trade volumes from Germany to Italy in that period averaged to 7.388 billion. So the effect of the manufacturing-finance comparative advantage accounted for 4.29% in the real data.

4.4 Baseline results

Bilateral trade flows are only a coarse characterization of current account imbalances. On the one hand, the UN Comtrade data rely on self-reports by individual countries and only cover the trade in major goods. On the other hand, trade balances differ from current account balances in that international payments are excluded. A more precise study shall be based on the current account information directly. Thanks to our theoretical model, we are able to do this with the structural model specified in Equation (4). Estimation results are shown in the following table.

Table 4. Baseline results

Dependent variable:	Cross-sectional		Panel OLS	Fixed-effects	Subsamples	
Δ Current account in GDP	Reg. (9)	Reg. (10)	Reg. (11)	Reg. (12)	Reg. (13)	Reg. (14)
Δ Logged relative productivity	7.567***	11.865***	8.590***	0.729	4.592***	10.951***
	(0.619)	(0.884)	(0.677)	(1.242)	(1.158)	(0.855)
Δ Fiscal balances		0.508***	0.395***	0.264***	0.219***	0.613***
		(0.063)	(0.049)	(0.081)	(0.062)	(0.066)
Δ Initial NFA stocks		0.025***	0.020***		0.009	0.014
		(0.007)	(0.007)		(0.010)	(0.009)
Δ GDP per capita		0.009	0.176***	-0.200***	0.033	0.094***
		(0.034)	(0.023)	(0.061)	(0.044)	(0.032)
Δ GDP per capita squared		-0.000	-0.001	-0.003*	0.001	-0.001*
		(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Youth dependency ratio		-0.292***	-0.205***	-0.064	0.174***	-0.419***
		(0.051)	(0.039)	(0.098)	(0.059)	(0.068)
Δ Elderly dependency ratio		-0.597***	-0.392***	0.318**	-0.042	-0.726***
		(0.095)	(0.058)	(0.131)	(0.073)	(0.102)
Δ Financial depth		-0.105*	-0.049*	-0.013	-0.103*	-0.042*

		**	**		**	**
		(0.012)	(0.009)	(0.017)	(0.029)	(0.011)
Δ Real income growth		-1.080***	-0.134***	0.072	0.170***	-0.279***
		(0.094)	(0.046)	(0.044)	(0.056)	(0.061)
Δ Trade openness		0.053***	0.024***	0.049**	0.032***	0.040***
		(0.007)	(0.006)	(0.020)	(0.008)	(0.007)
Δ Capital controls		-2.091***	-1.508***	-1.355***	0.565*	-2.152***
		(0.270)	(0.195)	(0.305)	(0.297)	(0.280)
Δ Undervaluation		0.041*	-0.019	0.106***	0.089***	0.038
		(0.021)	(0.020)	(0.037)	(0.021)	(0.029)
Δ Population		0.013*	0.036***	-0.526***	0.015*	0.037***
		(0.008)	(0.007)	(0.168)	(0.009)	(0.009)
Constant	-0.653*	-0.531***	-0.229	-1.258	-0.863***	-0.017
	(0.346)	(0.215)	(0.344)	(1.044)	(0.304)	(0.348)
Period dummies	No	No	Yes	Yes	Yes	Yes
Country-pair dummies	No	No	No	Yes	No	No
Observations	276	210	589	589	189	400
Adjusted R-squared	0.351	0.912	0.687	0.269	0.711	0.772

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 4, Reg. (9) and (10) are still cross-sectional regressions on group means, and starting from Reg. (11), the non-overlapping five-year averaged data are used. In order to check if our conclusions change over time, we also split the data into two subsamples. The first subsample covers the period from 1989 to 1998, and the second covers 1999 to 2008. Because each subsample only contains two periods, there might not be enough within-group variations to perform a two-way fixed-effects model. In particular, the first subsample has 189 observations. But 153 country-pairs are observed only once. Hence, we do not include country-pair dummies. Reg. (13) and (14) are results for the first and second subsamples respectively.

In various specifications, the coefficient for the difference of logged relative productivities is always positive. It is also highly significant except for the two-way fixed-effect model. We take Reg. (10) as our benchmark result. Because the logged relative productivity is higher in Germany by 0.189, it implies that its current account in GDP is 2.242 percentage points higher than that in Italy. In the real data, the difference in their current account ratios averaged to 2.567 during the same period, and it increased to 6.301 since 2001. Hence, the manufacturing-finance comparative advantage explains a significant part of the German-Italian imbalances as shown in Figure 2.

As for other control variables, the signs before their coefficients are also in line with our expectation. Firstly, same as Chinn and Prasad (2003), the effect of fiscal balances on current account balances is consistently positive. In the benchmark result, a one percentage point rise in fiscal balances tends to increase the current account in GDP by a half point. It suggests that a frugal government is essential for running a surplus. Also in line with Chinn and Prasad (2003), countries tend to enjoy benefits in their current accounts if they hold a large stock of NFA in the beginning. Secondly, there seems to be a correlation that richer countries tend to run surpluses. But it is not always robust. Like Chinn and Prasad (2003), the development-stage hypothesis does not hold or even gets reversed in our findings. Thirdly, consistent with previous conclusions in Coale and Hoover (1958), Leff (1969), Higgins and Willamson (1997), and Brooks (2003), we find that effects of both dependency ratios are generally negative, aside from two exceptions. This means that countries with higher dependency ratios tend to have smaller (larger) current account surpluses (deficits) in large. Fourthly, as Caballero et al. (2008), Mendoza et al. (2009), and Ju and Wei (2010) theoretically predicted and Chinn and Prasad (2003) empirically tested for industrial economies, countries with a more developed financial sector as measured by higher liquidity liabilities to GDP ratios tend to have smaller (larger) current account surpluses (deficits). Contrary to the scale of the financial sector, those populous countries however tend to have larger (smaller) current account surpluses (deficits). Next, countries that grow faster generally tend to borrow, except for the period from 1989 to 1998, in line with the inter-temporal consumption smoothing theory summarized in Romer (2001). And intuitively, countries that undervalue currencies tend to have larger (smaller) current account surpluses (deficits). Finally, trade openness and capital controls respectively have positive and negative effects on current account balances. The possible explanation is that when a country encourages trade, it tends to promote the export sector. And if a country controls the capital account by restricting capital flights, it tends to keep running deficits.

4.5 Robustness checks

Our structural model specified in Equation (4) shows that the difference of current account ratios to GDP for any two countries is orthogonal to a third country. That is, our theoretical results are proof against the multilateral resistance proposed by Anderson and Van Wincoop (2003). To see if empirical outcomes are affected when it does not hold, we repeat all the previous regressions in Table 4 with controls for multilateral resistance fixed effects as Baldwin and Taglioni (2006).[7] Specifically, we introduce N country dummies into all cross-sectional and panel OLS regressions. Thus, for the pair of Country i and j, there are two country dummies take a value of 1, while others are all zero. For the fixed-effects model, due to time variations, country dummies are interacted with period. Because we divide the sample into four periods, there are $4N$ interaction terms. Thus, for Country i and j in period t, interacted dummies for other periods are all zero. As for the N dummies of period t, only two of

[7] Baldwin and Taglioni (2006) doubled the number of dummies compared with us, because they imposed different multilateral resistance for importers and exporters.

them take a value of 1, while others are zero too. Our empirical results that take multilateral resistance into account are shown in the following table.

Table 5. Robustness checks on multilateral resistance

Dependent variable:	Cross-sectional		Panel OLS	Fixed-effects	Subsamples	
Δ Current account in GDP	Reg. (15)	Reg. (16)	Reg. (17)	Reg. (18)	Reg. (19)	Reg. (20)
Δ Logged relative productivity	10.097***	10.478***	8.018***	0.116	5.994***	9.574***
	(0.638)	(1.138)	(0.677)	(1.304)	(1.647)	(0.832)
Δ Fiscal balances		0.424***	0.431***	0.336***	0.219***	0.561***
		(0.065)	(0.048)	(0.088)	(0.067)	(0.063)
Δ Initial NFA stocks		0.023***	0.008	-0.173***	-0.002	0.011
		(0.007)	(0.008)	(0.064)	(0.011)	(0.009)
Δ GDP per capita		0.113***	0.180***	0.001	0.022	0.141***
		(0.039)	(0.024)	(0.002)	(0.049)	(0.029)
Δ GDP per capita squared		-0.000	-0.001*	-0.117	-0.000	-0.000
		(0.000)	(0.001)	(0.106)	(0.001)	(0.001)
Δ Youth dependency ratio		-0.236***	-0.161***	0.111	0.136*	-0.381***
		(0.050)	(0.038)	(0.146)	(0.075)	(0.062)
Δ Elderly dependency ratio		-0.416***	-0.269***	-0.019	-0.034	-0.595***
		(0.102)	(0.056)	(0.017)	(0.086)	(0.089)
Δ Financial depth		-0.097*	-0.043*	0.122***	-0.110*	-0.043*

		**	**		**	**
		(0.012)	(0.009)	(0.045)	(0.041)	(0.011)
Δ Real income growth		-0.673***	0.004	0.067***	0.251***	-0.080
		(0.096)	(0.043)	(0.020)	(0.056)	(0.055)
Δ Trade openness		0.026***	0.004	-1.157***	0.018*	0.018***
		(0.008)	(0.006)	(0.314)	(0.009)	(0.007)
Δ Capital controls		-1.933***	-1.329***	0.137***	0.282	-2.030***
		(0.280)	(0.201)	(0.038)	(0.342)	(0.266)
Δ Undervaluation		0.074***	0.042*	-0.186	-0.067**	0.112***
		(0.026)	(0.023)	(0.186)	(0.030)	(0.033)
Δ Population		0.020***	0.042***	-0.116	0.020*	0.047***
		(0.008)	(0.007)	(1.304)	(0.011)	(0.008)
Constant	-3.772**	-5.668***	-9.729***	-1.858	-6.325***	-2.094
	(1.894)	(1.222)	(1.379)	(1.451)	(1.847)	(1.793)
Period dummies	No	No	Yes	Yes	Yes	Yes
Country-pair dummies	No	No	No	Yes	No	No
Multilateral resistance terms	Yes	Yes	Yes	Yes	Yes	Yes
Observations	276	210	589	589	189	400
Adjusted R-squared	0.628	0.941	0.761	0.563	0.765	0.846

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

When multilateral resistance terms are added, our findings in Table 5 are very close to those of baseline regressions in Table 4. The coefficient before the difference of logged relative productivities is still positive in various specifications. Except for the two-way fixed-effects model, it is highly significant as well. This means, our empirical support for the manufacturing-finance comparative advantage is robust to the multilateral resistance. Coefficients before other control variables are also similar to baseline cases.

It is possible that our definition of the manufacturing-finance comparative advantage faces an endogeneity problem. Although we have controlled financial development, our regressions may still suffer from missing variables. For example, we may not have a full control of the relative strength of a country's financial sector relative to those of other countries. Some countries have financial centers, and most countries do not. The controls we have may not be able to account for this diversity. In addition, current account balances may influence a country's future financial and manufacturing development. To deal with the endogeneity stemming from the above two problems, we instrument the difference in relative productivities of manufacturing to finance in each country pair by their respective legal origins which are categorized by La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1998), since legal origins are often used to instrument financial development (Levine, Loayoza and Beck , 2000; Liberti and Mian, 2010). Our approach follows this line of literature to use La Porta et al. (1998)'s original categorization of legal origins: English, French, German and Scandinavian. We leave countries in our sample whose legal origins are not specified by La Porta et al. in a separate group. For the fixed-effects model, legal origins are interacted with period dummies to generate time variations. We then repeat all baseline regressions in Table 4. Because Country *i* and *j* are respectively in one of the five legal origins, there are multiple instrumental variables.[8] Efficient estimates are thus derived from GMM regressions. Table 6 presents the first stage results.

Table 6. Robustness checks on endogeneity: first stage

[8] There are eight instrumental variables in cross-sectional and panel OLS regressions, and 22 in the fixed-effects model (other interacted dummies are dropped for collinearity).

Dependent variable: Δ Logged relative productivity	Cross-sectional		Panel OLS	Fixed-effects	Subsamples	
	Reg. (21)	Reg. (22)	Reg. (23)	Reg. (24)	Reg. (25)	Reg. (26)
English origin for *i*	0.596***	-0.113	0.414***		0.410***	0.315***
	(0.077)	(0.077)	(0.071)		(0.050)	(0.070)
English origin for *j*	-0.710***	0.024	-0.398***		-0.562***	-0.243***
	(0.118)	(0.082)	(0.073)		(0.052)	(0.078)
French origin for *i*	-0.063	0.096	0.351***		0.013	0.391***
	(0.072)	(0.062)	(0.054)		(0.047)	(0.054)
French origin for *j*	-0.283***	0.001	-0.211***		-0.076	-0.252***
	(0.065)	(0.064)	(0.051)		(0.047)	(0.054)
German origin for *i*	0.564***	-0.055	0.245***		-0.216***	0.280***
	(0.083)	(0.066)	(0.058)		(0.053)	(0.057)
German origin for *j*	-0.458***	0.153**	-0.088		0.161***	-0.162***
	(0.097)	(0.068)	(0.056)		(0.056)	(0.057)
Scandinavian origin for *i*	0.587***	0.293***	0.607***		0.166**	0.669***
	(0.087)	(0.080)	(0.071)		(0.064)	(0.080)
Scandinavian origin for *j*	-0.296***	-0.212**	-0.439***		-0.240***	-0.518***
	(0.074)	(0.082)	(0.069)		(0.055)	(0.081)
English origin for *i*, period 1				0.573***		
				(0.078)		
English origin for *j*, period 1				-0.669***		
				(0.109)		
French origin for *i*,				0.491***		

period 1	
	(0.083)
French origin for *j*,	
period 1	-0.627***
	(0.073)
German origin for *i*,	
period 1	0.299***
	(0.068)
German origin for *j*,	
period 1	-0.253**
	(0.107)
English origin for *i*,	
period 2	-0.052
	(0.059)
English origin for *j*,	
period 2	-0.101
	(0.073)
French origin for *i*,	
period 2	-0.304***
	(0.055)
French origin for *j*,	
period 2	0.068
	(0.057)
German origin for *i*,	
period 2	-0.357***
	(0.056)
German origin for *j*,	
period 2	0.364***
	(0.063)

Scandinavian origin for *i*, period 2	-0.626*** (0.061)
Scandinavian origin for *j*, period 2	0.439*** (0.057)
English origin for *i*, period 3	0.085** (0.037)
English origin for *j*, period 3	-0.053 (0.054)
French origin for *i*, period 3	-0.060* (0.035)
French origin for *j*, period 3	-0.074** (0.035)
German origin for *i*, period 3	-0.002 (0.037)
German origin for *j*, period 3	-0.047 (0.046)
Scandinavian origin for *i*, period 3	-0.297*** (0.039)
Scandinavian origin for *j*,	0.190***

period 3				(0.037)		
Δ Fiscal balances		-0.003	0.002	-0.006	0.018***	-0.010**
		(0.005)	(0.004)	(0.004)	(0.003)	(0.005)
Δ Initial NFA stocks		0.001	0.003***		0.005 ***	0.002***
		(0.001)	(0.001)		(0.001)	(0.001)
Δ GDP per capita		0.018***	0.004*	0.000	0.005**	0.010***
		(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Δ GDP per capita squared		0.000	0.000	0.000***	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Δ Youth dependency ratio		0.030***	0.032***	0.049 ***	0.038***	0.048***
		(0.003)	(0.002)	(0.004)	(0.003)	(0.003)
Δ Elderly dependency ratio		0.060***	0.045***	-0.025***	0.032***	0.066***
		(0.006)	(0.004)	(0.006)	(0.003)	(0.005)
Δ Financial depth		0.009***	0.004***	-0.006***	0.017***	0.002***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Real income growth		0.011	0.000	-0.001	0.007***	-0.001
		(0.008)	(0.003)	(0.002)	(0.002)	(0.004)
Δ Trade openness		-0.001	0.001	0.004***	-0.001**	0.000
		(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
Δ Capital controls		0.050**	0.073***	0.053***	0.050***	0.066***
		(0.023)	(0.013)	(0.012)	(0.011)	(0.015)
Δ Undervaluation		-0.007**	-0.003***	0.003***	0.009***	0.000
		(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Population		0.002***	0.001***	0.028***	0.000	0.002***
		(0.001)	(0.000)	(0.009)	(0.000)	(0.000)
Constant	-0.067	-0.020	-0.097**	0.058**	0.085***	-0.090**

	(0.064)	(0.035)	(0.044)	(0.036)	(0.029)	(0.041)
Period dummies	No	No	Yes	Yes	Yes	Yes
Country-pair dummies	No	No	No	Yes	No	No
Observations	276	210	589	586	189	400
Adjusted R-squared	0.421	0.913	0.735	0.566	0.956	0.791
F-statistics	24.25	99.45	83.27	33.16	323.65	86.44

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6 shows that the F-statistics are large in various specifications. So our instruments are not weak. We then show our second stage results in the following table.

Table 7. Robustness checks on endogeneity: second stage

Dependent variable: Δ Current account in GDP	Cross-sectional		Panel OLS	Fixed-effects	Subsamples	
	Reg. (27)	Reg. (28)	Reg. (29)	Reg. (30)	Reg. (31)	Reg. (32)
Δ Logged relative productivity	10.884***	14.488***	12.111***	5.875***	5.870***	12.788***
	(1.002)	(1.480)	(1.652)	(1.356)	(1.284)	(1.443)
Δ Fiscal balances		0.535***	0.352***	0.268***	0.183***	0.676***
		(0.067)	(0.055)	(0.074)	(0.065)	(0.072)
Δ Initial NFA stocks		0.022***	0.018***		0.017*	0.020**
		(0.007)	(0.007)		(0.010)	(0.009)
Δ GDP per capita		-0.045	0.148***	-0.207***	0.018	0.042
		(0.042)	(0.032)	(0.055)	(0.054)	(0.040)
Δ GDP per capita squared		-0.000	-0.001	-0.003**	0.000	-0.002**
		(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Youth dependency ratio		-0.354***	-0.271***	-0.096	0.136***	-0.462***

		(0.061)	(0.050)	(0.100)	(0.051)	(0.072)
Δ Elderly dependency ratio		-0.735***	-0.505***	0.456***	-0.090	-0.806***
		(0.117)	(0.090)	(0.128)	(0.074)	(0.120)
Δ Financial depth		-0.111***	-0.069***	0.010	-0.133***	-0.036***
		(0.013)	(0.011)	(0.015)	(0.034)	(0.010)
Δ Real income growth		-1.070***	-0.123**	0.056	0.126	-0.372***
		(0.095)	(0.055)	(0.041)	(0.079)	(0.072)
Δ Trade openness		0.058***	0.026***	0.013	0.037***	0.049***
		(0.007)	(0.006)	(0.019)	(0.007)	(0.007)
Δ Capital controls		-2.280***	-1.814***	-1.645***	0.501*	-2.461***
		(0.288)	(0.238)	(0.248)	(0.281)	(0.290)
Δ Undervaluation		-0.043	0.018	0.005	0.089***	0.010
		(0.030)	(0.015)	(0.013)	(0.015)	(0.015)
Δ Population		0.014*	0.036***	-0.404**	0.021**	0.030***
		(0.008)	(0.007)	(0.172)	(0.010)	(0.008)
Constant	-0.509	-0.473**	-0.186	-0.216	-0.749***	0.485
	(0.366)	(0.220)	(0.435)	(1.132)	(0.290)	(0.432)
Period dummies	No	No	Yes	Yes	Yes	Yes
Country-pair dummies	No	No	No	Yes	No	No
Observations	276	210	589	586	189	400
Adjusted R-squared	0.285	0.914	0.678	0.223	0.724	0.771
Hansen statistics	128.204	34.119	92.086	109.429	63.340	80.718

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In Table 7, the coefficient before the difference of logged relative productivities is positive and highly significant in all specifications, including the two-way fixed-effects model. But the magnitude is substantially larger than those found in the baseline regressions, like many other similar studies have found out. The robust results of other control variables found in the baseline regressions are all preserved.

5 Conclusions

This paper sheds new lights on the understanding of global imbalances. Global imbalances are concerned mostly because of the unsustainability on the side of deficit countries and fiscal burdens on the side of surplus countries. This paper shows, both theoretically and empirically, that global imbalances are a by-product of the international division of labor based on the differential comparative advantages in manufacturing and finance across countries. Our theoretical model treats finance as a tradable service providing capital and risk screening for manufacturing firms. The manufacturing-finance comparative advantage is defined by the relative labor productivity between the manufacturing and financial sectors. Then in a dynamic growth framework where the Ricardian model is embedded, we show that a country with the manufacturing comparative advantage tends to specialize in producing the final product and run a current account surplus, and a country with the financial comparative advantage tends to specialize in providing financial services and run a current account deficit. The scale of imbalances increases with the strength of the manufacturing-finance comparative advantage. The advantage of our model is that it provides a structural equation that can be empirically tested immediately. Our empirical analyses of the OECD countries from 1989 to 2008 support our theoretical claims with various specifications and robustness checks.

It is worth emphasizing that although we show that global imbalances are a by-product of international division of labor between manufacturing and finance, our results do not imply that we should brush off the issue of their sustainability. However, our results do imply that a pure pursuit of eliminating global imbalances without addressing the relevant structural disparities among countries will eventually impair the welfare of individual countries and the world as a whole.

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